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OPTIMIZATION OF THE DISTRIBUTION OF FISH USING THE METHOD OF THE CHEAPEST INSERTION HEURISTIC AT THE PLACE OF FISH AUCTION IN PANTAI LABU

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ABSTRACT

Every day the distribution of fish should be done given the high demand distribution. Order optimal travel route to the area of the destination to be estimated by courier in a one-time distribution. Estimated travel route that randomly causes less maximum time of travel and the high cost of so needed a solution where the route of the trip can be optimized to be more cost-saving and meminimalir long time travel at the time of the distribution. This research create a system to optimize the route of travel distribution. The method used in this research is using the method of the Cheapest Insertion Heuristic (CIH), which is a method for finding the distance smallest insertion of a new value by looping to form the optimal travel route. The system displays the results of the travel route distribution using a graph model. The results of the testing carried out from testing of the process of determining the route distribution in a Fish Auction Place (TPI) is a system of distribution of fish using the Method of the Cheapest Insertion Heuristic that generates a travel route that is optimal in terms of travel time and total distance distribution.

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1. INTRODUCTION

The distribution system is a very important role in the activities of the distribution of goods and services. A common problem associated with the distribution is about the travel route and mileage and travel expenses, the number of vehicles operated, travel time and other resources available. Distribution system determine where the results of the production is marketed to consumers. The lack of management to distribution of the product may result in losses for a company. Need to be applied a model policy on the distribution process in order to optimize the routes and minimize the cost of distribution, i.e. with route optimization distribution of goods. In addition to the company, the distribution system is also applied to the distribution of the results of the sea in the Fish Auction. In this case, the Government plays an important role in developing the fisheries sector. The Fish Auction is a place of occurrence of the process of the transaction sale of fish or seafood either by auction or not, which is usually located in the fish landing base. The government provides supporting facilities that can provide ease in doing business fisheries sector. The means that can be used to support business activities in the fisheries sector is the availability of the facilities where the Fish Auction.

In North Sumatra, there are several Auctions Fish can be found, one of which is the Fish Auction, which is located in the village of Paluh Sibaji at Pantai labu city Deli Serdang district.The Fish Auction is a means of decline in fish with different kinds of seafood that one of its aims is to improve the economy of the society of the local. Fish Auction place Pantai Labu is one of the facilities provided by the government, which is still growing and be a place of interaction of buyers and sellers of fish both the local community and beyond. Fish Auction place Pantai Labu also seek to optimize the quality of the results of the sea into food products, which can meet the needs of consumers. Thus, the Fish Auction Place not only striving for quality results of the sea are better, but can also increase the economic income of the local community by utilizing the facilities and resources. As the Place where the Fish Auction that is responsible for the distribution of its results, the Dealer (the Owner of the Fish) in Place of the Fish Auction is required to distribute optimally to some destination location. In the fulfillment of these goals appear some of the constraints faced by an agent that is not optimal routing on the distribution of marine products such as fish, shrimp and other seafood.

To overcome this, it is necessary to do the calculation of the allocation the shortest route to the destination location. The analysis is expected to be the input for the fish market District Pantai Labu in distributing the results of the sea becomes more optimal. To achieve such optimization, the appropriate methods to overcome the problem above. The methods used to solve problems that have been previously described method is to use the *Cheapest Insertion Heuristic* (CIH) is a mathematical technique designed to resolve or explain the problems of the distance of travel or the allocation of limited resources in the best way possible.

2. RESEARCH METHODE

2.1 Theoretical Basis

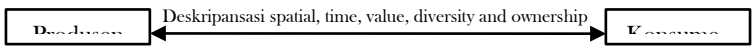
2.1.1 Optimization

In general, optimization is the search for the best value. Optimization is the process of search the completion of which is associated with the values of one or more of the objective function on a problem that the obtained optimal results. In addition, the optimization can also be interpreted as an attempt to improve the performance so as to give quality and good work. In a systematic, optimization is one of the disciplines in mathematics whose role is to get the value of the minimum or maximum of an opportunity, functions and search the value of the other in various problems. In this optimization can be used in a variety of fields in order to achieve the effectiveness and efficiency of the desired target. It can be concluded that optimization is an achievement of the state or action the best that can be achieved from a decision problem with a wide range of resources that limit. This technique is expected to provide the best solution to the results of the decisions that have been taken of the problems faced.

2.1.2 Distribution

Distribution is a series of marketing or distribution of goods and services from producers to consumers. The distribution of the most effective and efficient will facilitate the access of goods to the consumer so that it can be obtained easily and in accordance with what is required. Producers and consumers have differences of views on the gaps, such as time, value, keragamaan and ownership of the products. With a wide distribution is expected to overcome the gap between producers and consumers that can be seen in figure below:

FIGURE 2.1.2 The gap Between Producers and Consumers



The distribution here is often associated with the transportation problem. This is because in the process of distribution should consider how to get the most minimal cost, the products get to their destination in good condition (no defects) to estimate travel time and route the nearest at the time of the distribution process. Therefore, the manufacturer should be able to determine the path of the distribution of the best in order to meet consumer demand. The following distribution channels that can be used producer to reach the target market as follows:

1. Distribution through Agents (Sales Agent), where through the sales agent (sales agent) to distribute the product from the manufacturer to be distributed to wholesalers, retailers or both.
2. Distribution through wholesale, which a manufacturer distributes its products through wholesale channels, which then onwards distributed to retailers before reaching the consumer.
3. Distribution through a Retailer, where the manufacturer distributes its products through retailers to get to the consumer.

According to (Sari, Bu'ulolo and Ariswoyo, 2013), the Characteristics of the special issue of transportation include:

1. Have a variety of sources and a number of specific objectives.

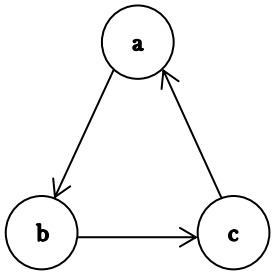
2. The amount of the commodity that is marketed (distributed) the magnitude of the specific.
3. The amount of goods shipped in accordance with the capacity of the source.
4. The cost of transporting the magnitude of the specific.

2.1.3 Cheapest Insertion Heuristic

Algorithm Cheapest Insertion Heuristic (CIH) is the Algorithm of Insertion where at each addition of a new city that will be inserted into the subtour have weights insertion least (at least). In general, the algorithm Cheapest Insertion Heuristic is a simple algorithm used in calculating the mileage and the insertion to the place that will be visited. This algorithm provides a route that is different depending from the order of insertion of the cities in the subtour concerned. Here are the steps in the execution of the algorithm Cheapest Insertion Heuristic (CIH), namely:

1. The problem can be represented into a complete chart.
2. Trip (tour) starting from the first cities towards the last city.
3. Connect the 2 cities with a subtour which is the journey of the first city and ends in the city first so as to form a sikel, for example (a,b) → (b,c) → (c,d) like the picture below:

FIGURE 2.1.3 Example of subtour



4. The substitution of one direction of the relationship (arc) of the two cities with a combination of two arc, that arc(i,j) with arc(i,k) and the arc(k,j), with k is the city of inserts with additional minimum distance, which is obtained from:

$$Cjk = Cik + Ckj - Cij$$

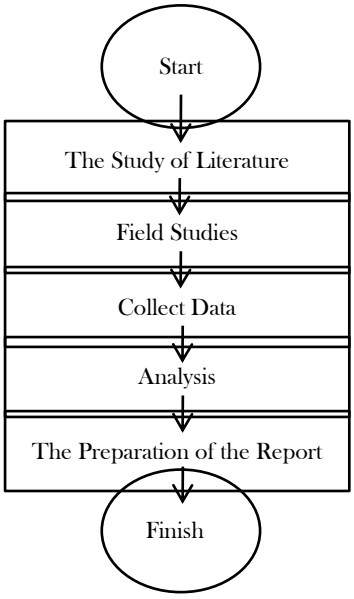
Description:

- Cik is the distance of the city from i to the city of k.
- Ckj is the distance of the city from k to the city of j.
- Cij is the distance of the city from i to the city of j.

2.2 Stages of Research

Data collection phase, the design phase of the data and the stage of preparation of the report are the stages used in this study. An overview of the stages of this research can be seen in the diagram the figure below:

FIGURE 2.2 Stages of Research



The initial step in this research is the stages of data collection. Making the data is adjusted based on informal interviews on one of the agendi to the Fish market with knowledge of the matter distribution in the neighborhood where the Sale of Fish. The problems that were identified namely the distributor, the courier having difficulty in determining the route of the shortest at the time of the distribution due to the location of the distribution or the place of destination which is quite a lot. The Data collected on the stages of a field study data sequence of the travel route and location data of the distribution. For the stages of the study of literature was conducted in order to find the method that will be used in determining the optimal route is the Method of Cheapest Insertion Heuristic (CIH). Then do an analysis of the distribution data obtained with the calculation Method of the Cheapest Insertion Heuristic (CIH). To produce the optimal travel route, made the design of the system which is designed according to the wishes. The stages of the design made after knowing that the methods of the Cheapest Insertion Heuristic (CIH) generate the optimal route compared with the data of travel routes obtained at the stage of data collection. The last stage is the stage of preparation of the report where this stage is done after all the stages successfully carried out.

3. RESULT AND ANALYSIS

Results and discussion in this case discusses the stages of the process of distribution of fish to the location of the distribution or the place of destination. As a first step, the used Method of the Cheapest Insertion Heuristic (CIH) to compute the travel mileage to the destination location. So that later will be known route of the shortest sequence.

3.1 Research Data

TABLE 3.1 Mileage the purpose of the distribution of fish

	Mileage Goals						
	1	2	3	4	5	6	7
1	0	34000	22000	16000	1900	32000	10000
2	34000	0	18000	15000	35000	30000	21000
3	22000	18000	0	12000	20000	28000	11000
4	16000	15000	12000	0	19000	17000	5000
5	1900	35000	20000	19000	0	33000	14000
6	32000	30000	28000	17000	33000	0	18000
7	10000	21000	11000	5000	14000	18000	0

Description:

1. Place fish auction of Paluh Sibaji
2. Market of Tanjung Morawa
3. Market of Batang Kuis
4. Market of Lubuk Pakam
5. Market of Pantai Labu
6. Market of Galang
7. Market of Beringin

Mileage in Table 3.1. obtained via Google Maps is then calculated from the units of Kilometers (Km) into units of Meters (m). In determining the subtour, the technique of calculation used is the calculation by the Method of the Cheapest Insertion Heuristic (CIH) with the following formula:

$$C_{jk} = C_{ik} + C_{kj} - C_{ij}$$

with, C_{ik} = the Distance between the Origin (i) and Insert (k)

C_{kj} = the distance between the Insert (k) and Destination (j)

C_{ij} = the distance between the Origin (i) and Destination (j)

3.2 Application Of The Method Of The Cheapest Insertion Heuristic

In determining the shortest route can be solved with some of the following stages:

1. Taken the route of travel 2 to 7
2. Make subtour $\longrightarrow (2,7) \longrightarrow (7,2)$
3. Create a table with the point are inserted in the subtour by adding a point that has not way out.

TABLE 3.2.1 Insert the First

Bow	Bow in the *subtour*	Inserts $C_{jk} = C_{ik} + C_{kj} - C_{ij}$
(2,7)	(2.1)+(1.7)	$C_{2.1} + C_{1.7} - C_{2,7} = 23000$
(2,7)	(2.3)+(3.7)	$C_{2.3} + C_{3.7} - C_{2,7} = 8000$
(2,7)	**(2.4)+(4.7)**	$\boldsymbol{C_{2.4} + C_{4.7} - C_{2,7} = -1000}$
(2,7)	(2.5)+(5.7)	$C_{2.5} + C_{5.7} - C_{2,7} = 28000$
(2,7)	(2.6)+(6.7)	$C_{2.6} + C_{6.7} - C_{2,7} = 27000$
(7,2)	(7.1)+(1.2)	$C_{7.1} + C_{1.2} - C_{7,2} = 23000$
(7,2)	(7.3)+(3.2)	$C_{7.3} + C_{3.2} - C_{7,2} = 8000$
(7,2)	**(7.4)+(4.2)**	$\boldsymbol{C_{7.4} + C_{4.2} - C_{7,2} = -1000}$
(7,2)	(7.5)+(5.2)	$C_{7.5} + C_{5.2} - C_{7,2} = 28000$
(7,2)	(7.6)+(6.2)	$C_{7.6} + C_{6.2} - C_{7,2} = 27000$

The Total distance of the shortest of the subtour taken from the smallest value which can then be subtour new for the next calculation. So on the Table. 2 values obtained inserts the smallest is -1000 meters. If the bow in (2.7) is replaced by the arc (2,4) and bow (4,7) or bow (7,2) be replaced with a bow (7,4) and bow (4,2). Because there are 2 routes which the total distance is the same, then the smallest distance that is replaced is the smallest distance that the second is:

$$(7,4) \longrightarrow (4,2) \longrightarrow (2,7)$$

4. Calculate the insertion point which has not bypassed as shown in the Table below:

TABLE 3.2.2 Insert the Second

Bow	Bow in the *subtour*	Inserts $C_{jk} = C_{ik} + C_{kj} - C_{ij}$
(7,4)	(7.1) + (1.4)	$C_{7.1} + C_{1.4} - C_{7,4} = 21000$
(7,4)	(7.3) + (3.4)	$C_{7.3} + C_{3.4} - C_{7,4} = 18000$
(7,4)	(7.5) + (5.4)	$C_{7.5} + C_{5.4} - C_{7,4} = 28000$
(7,4)	(7.6) + (6.4)	$C_{7.6} + C_{6.4} - C_{7,4} = 30000$
(4,2)	(4.1) + (1.2)	$C_{4.1} + C_{1.2} - C_{4,2} = 35000$
(4,2)	(4.3) + (3.2)	$C_{4.3} + C_{3.2} - C_{4,2} = 15000$
(4,2)	(4.5) + (5.2)	$C_{4.5} + C_{5.2} - C_{4,2} = 39000$
(4,2)	(4.6) + (6.2)	$C_{4.6} + C_{6.2} - C_{4,2} = 32000$
(2,7)	(2.1) + (1.7)	$C_{2.1} + C_{1.7} - C_{2,7} = 23000$
(2, 7)	**(2. 3) + (3. 7)**	$\boldsymbol{C_{2.3} + C_{3.7} - C_{2,7} = 8000}$
(2,7)	(2.5) + (5.7)	$C_{2.5} + C_{5.7} - C_{2,7} = 28000$
(2,7)	(2.6) + (6.7)	$C_{2.6} + C_{6.7} - C_{2,7} = 27000$

Value inserts the smallest in Table 3.2.2 is 4000 meters (m). Then the route the smallest (temporarily) replaced by a new arc in (2,7) with a bow (2,3) and the bow (3,7 in). So that the resulting subtour new:

$$(2,3) \longrightarrow (3,7) \longrightarrow (7,4) \longrightarrow (4,2)$$

Because there is still the route points that have not been entered into the subtour, then made the table insertion to save the results of the insertion in the subtour and the distance that can be seen in Table 3.2.3.

TABLE 3.2.3 Insert the Third

Bow	Bow in the *subtour*	Inserts $C_{jk} = C_{ik} + C_{kj} - C_{ij}$
(2,3)	(2.1) + (1.3)	$C_{2.1} + C_{1.3} - C_{2,3} = 38000$
(2,3)	(2.5) + (5.3)	$C_{2.5} + C_{5.3} - C_{2,3} = 37000$
(2,3)	(2.6) + (6.3)	$C_{2.6} + C_{6.3} - C_{2,3} = 40000$
(3, 7)	**(3. 1) + (1. 7)**	$\boldsymbol{C_{3.1} + C_{1.7} - C_{3,7} = 21000}$
(3,7)	(3.5) + (5.7)	$C_{3.5} + C_{5.7} - C_{3,7} = 23000$
(3,7)	(3.6) + (6.7)	$C_{3.6} + C_{6.7} - C_{3,7} = 35000$
(7, 4)	**(7. 1) + (1. 4)**	$\boldsymbol{C_{7.1} + C_{1.4} - C_{7,4} = 21000}$
(7,4)	(7.5) + (5.4)	$C_{7.5} + C_{5.4} - C_{7,4} = 28000$
(7,4)	(7.6) + (6.4)	$C_{7.6} + C_{6.44} - C_{7,4} = 30000$
(4,2)	(4.1) + (1.2)	$C_{4.1} + C_{1.2} - C_{4,2} = 35000$
(4,2)	(4.5) + (5.2)	$C_{4.5} + C_{5.2} - C_{4,2} = 39000$
(4,2)	(4.6) + (6.2)	$C_{4.6} + C_{6.2} - C_{4,2} = 32000$

In Table 3.2.3 values obtained inserts the smallest is 21000 meters (m) with 2 route total distance is the same, then replaced the distance smallest being the distance of the second smallest. Starting from the bow (3,7) be replaced with a bow (3,1) and bow (1,7) or bow (7,4) is replaced by the arc (7,1) and bow (1,4), then the smallest distance is taken (7,1) (1,4) (3,7).So subtour new ie:

$$(7,1) \longrightarrow (1,4) \longrightarrow (4,2) \longrightarrow (2,3) \longrightarrow (3,7)$$

TABLE 3.2.4 Insert the Fourth

Bow	Bow in the *subtour*	Inserts $C_{jk} = C_{ik} + C_{kj} - C_{ij}$
(7,1)	(7.5) + (5.1)	$C_{7.5} + C_{5.1} - C_{7,1} = 5900$
(7,1)	(7.6) + (6.1)	$C_{7.6} + C_{6.1} - C_{7,1} = 40000$
(1, 4)	**(1. 5) + (5. 4)**	$\boldsymbol{C_{1.5} + C_{5.4} - C_{1,4} = 4900}$
(1,4)	(1.6) + (6.4)	$C_{1.6} + C_{6.4} - C_{1,4} = 33000$
(4,2)	(4.5) + (5.2)	$C_{4.5} + C_{5.2} - C_{4,2} = 39000$
(4,2)	(4.6) + (6.2)	$C_{4.6} + C_{6.2} - C_{4,2} = 32000$
(2,3)	(2.5) + (5.3)	$C_{2.5} + C_{5.3} - C_{2,3} = 37000$
(2,3)	(2.6) + (6.3)	$C_{2.6} + C_{6.3} - C_{2,3} = 40000$
(3,7)	(3.5) + (5.7)	$C_{3.5} + C_{5.7} - C_{3,7} = 23000$
(3,7)	(3.6) + (6.7)	$C_{3.6} + C_{6.7} - C_{3,7} = 35000$

In Table 3.2.4 obtained value inserts the smallest is 4900 square by replacing the arc (1,4) with a bow (1,5) and bow (5,4). So that the resulting subtour new:

$$(1,5) \rightarrow (5,4) \rightarrow (4,2) \rightarrow (2,3) \rightarrow (3,7) \rightarrow (7,1)$$

TABLE 3.2.5 Insert the Fifth

Bow	Bow in the *subtour*	Inserts $C_{jk} = C_{ik} + C_{kj} - C_{ij}$
(1,5)	(1.6) + (6.5)	$C_{1.6} + C_{6.5} - C_{1,5} = 63100$
(5, 4)	**(5. 6) + (6. 4)**	$\boldsymbol{C_{5.6} + C_{6.4} - C_{5,4} = 31000}$
(4,2)	(4.6) + (6.2)	$C_{4.6} + C_{6.2} - C_{4,2} = 32000$
(2,3)	(2.6) + (6.3)	$C_{2.6} + C_{6.3} - C_{2,3} = 40000$
(3,7)	(3.6) + (6.7)	$C_{3.6} + C_{6.7} - C_{3,7} = 35000$
(7,1)	(7.6) + (6.1)	$C_{7.6} + C_{6.1} - C_{7,1} = 40000$

From the Table 3.2.5 obtained value inserts the smallest is 31000 square by replacing the arc (5,4) with a bow (5,6) and bow (6,4). So obtained subtour new:

$$(5,6) \rightarrow (6,4) \rightarrow (4,2) \rightarrow (2,3) \rightarrow (3,7) \rightarrow (7,1) \rightarrow (1,5)$$

3.3 Graph Mode

From the steps of mileage calculation above, created a model of graf the shortest route. So, he found the minimum distance to distribute the fish from the Fish market desa Paluh Sibaji district Pantai Labu to several areas in the District of Deli Serdang. Graph Model shown in the figure below:

FIGURE 4.7 Graph Models of Inserts Fifth

From Figure 4. model graph above, it is obtained that the mileage of the location of the distribution as follows:

$$C_{1,5} + C_{5,6} + C_{6,4} + C_{4,2} + C_{2,3} + C_{3,7} + C_{7,1}$$

= (1900 m) + (33000 m) + (17000 m) + (15000 m) + (18000 m) + (11000 m) + (10000 m)

= 105,900 m atau 105.9 km.

4. CONCLUSIOON

The results of the calculation of the allocation of the path of the optimal distribution on the distribution of Fish from the Fish Auction Place desa Paluh Sibaji District Pantai Labu, Deli Serdang Regency to the goal area by using the Method of the *Cheapest Insertion Heuristic* (HIC), it can be concluded that the determination of the route allocation of distribution lines the shortest or the nearest begins from the Fish auction place of Paluh Sibaji then continue to the Market of Pantai Labu, then to the Market of Galang continues to Market of Lubuk Pakam, and then to the Market of Tanjung Morawa continues to market of Batang Kuis and continues to the last route into the Market of Beringin with a total mileage of 105.9 km or 105,900 m. Afterwards back to the location of the auction fish of Paluh Sibaji.

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