JCGIRM Journal of Corporate Governance, Insurance, and Risk Management (JCGIRM)
2014, Volume 1, Series 2

Pages 162-180

Distribution Route Optimization by Utilizing Saving Matrix: Case Study In. Limas Raga Inti Bandung

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ABSTRACT

Along with the government's policy to convert from kerosene to LPG gas, LPG consumer demand is increasing. It requires the LPG distributors to be able to meet the needs of its customers. PT. Limas Raga Inti is an authorized distributor company PT. Pertamina LPG product devoted to distribute 12 kg. The company's main commitment is to provide the best service to the consumer. One of the efforts to improve the quality of service is to provide optimization of the distribution process. Optimization can be done by determining the distribution of the matrix saving method to obtain the optimal route. The purpose of the optimization of route determination is to provide effectiveness and efficiency of the distribution process. Effectiveness and efficiency can be seen with the speed of delivery time and can overcome the problems that exist in the company. In the process of determining the route to saving matrix, is done in the consumer sorting method which has produced the nearest neighbor and nearest the insert. Then do the repair method using 2-opt and or-opt in order to provide the best route to the selected proposal. Furthermore, the delivery time will be calculated based on the productivity of the proposal and indicating the optimal route. The results of this study are are 4 routes proposed by sorting nearest neighbor method with a total delivery time of 10 hours 30 minutes for 100 customers spread in the distribution area D14. The resulting productivity by 85.11%.

ARTICLE INFO

Keywords:
Route Determination, Distribution, Saving Matrix, Location Analysis Algorithm, Optimization.

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Article Submitted 12-01-2014
Article Accepted 24-02-2014

**Article previously published in EJEM 2014, vol 1, No. 2

1. INTODUCTION

1.1 General

Government has annually alocated amount of budget around Rp 50 trillion for the fuel subsidy: kerosene, gasoline, and diesel fuel. From of which, kerosene is one of the largest subsidies given to the Indonesian (more than 50% budget of fuel subsidy is wholly exploited to subsidize the kerosene). This budget obtains its hike due to the trend of fuel prices around the world that has unpredictably tended to increase. Considering this fact, the government has set conversion policy from kerosene to Liquefid Petroleum Gas (LPG) since 2007. This policy is aimed to alleviate the dependency of fuel consumption particularly kerosene, diminish the fuel subsidy, minimize the misuse of the subsidized kerosene, and provide the practical, clean, and efficient fuel. State-owned oil and gas firm PT *Pertamina* has raised the price of LPG 12 kg by Rp. 1.000,00 or Rp. 91. 300,00 per cylinder in 2014. The hike has caused 5% consumers of 12-kg LPG canisters in Bandung move to 3-kg LPG canisters (Marboen, 2013). From 5%, it is

generallly used for the importance of household. The other consumers of 12-kg LPG canisters (such as company, cafe, mall, hospital, and restaurant) do not move to 3-kg LPG canisters because they do not speculate the price raise. One of the bread businessmen in Bandung argues that the hike has only small influence, but the distribution of 12-kg LPG canisters must not be stagnant. It means that some consumers highly need the well-managed distribution process to support their business.

Distribution is the process of moving a product from its manufacturing source to its customers. The distribution process is composed by several steps; one of which is functioning the distributor service. Distributor company takes main role to distribute the product from its manufacturing source to its customers. Besides, the distributor can make the significant influence for the sold and distributed products. As an instrument of strategy, the policy of distribution network can be used to strengthen the competition ability of company. Thus, it can be said that the higher distribution intensity is established, the stronger the power has, and also the larger the possibility of selling products is well delivered to the consumers (Ferdinand, 2000). As another effort to raise the significant influence on the product selling, it is necessary to establish a well managed system or route to help the easily spread distribution that can be well environmentally accepted by the consumers as expected. The consumer .. has various demand on the certain product, so it is a deman for the distributor to serve better service for the consumers. The transportation is also highly needed in the distribution process of good due to its influence on the consumer interest to buy the products. Unexpectedly, ytransportation aspect is inspearble form common problems such as traffic, flood, etc. The problems can also be caused by the lack of distribution process and implementation process.

The distribution problem of PT. LRI is the time of delivery of 12-LPG canister to the consumers. The ideal amount of delivery time is maximally predicted for 12 hours after order, but there are some fleets that spend 3-4 hours to deliver the LPG. The interviews with PT. LRI officer showed that the raising problems are due to the long duration of order delivery. This is caused by the company policy applying **the consignment telephone.** This policy exhibits that after the consumers order the LPG, the distribution operatot give an instruction to directly send the LPG to the consumers. If the driver is in free of route, so the order can be directly delivered. In fact, the driver will not directly deliver the LPG rather than going to 2-3 places when receiving the instruction in which the delay of delivery can not be avoided. The second problem is that consumers order 2-3 times in a day that can cause inefficiency on the distribution process. This leads to the uneffective route that makes other orders delayed.

2. REVIEW OF RELATED LITERATURE AND METHODOLOGY

2.1 Review of Related Literature

This research employed direct survey gathered from the object to collect the relevant data. Then, the data were analyzed to find out the distribution and the parameter of the data to obtain the optimal solution. This research functioned the saving matrix to analyze the data. The saving method, according to Pujawan (2005:180), is the method to minimalize the distance, time, or the expenditure by considering the appearing problems. The distance is used as the purpose function when found the direction coordinate of delivery, then the distance will be minimized by all transportation. Based on Wongso (2012), there are some relevant steps to do:

a). Identifying the Matrix Distance

This step is necessary to comprehend the distance between the company warehouse to each grocery store and teh distance among the store. By understanding the coordinate between the warehouse to each store, the standard distance can be patterned. For example it is found coordinates (x_1, y_1) and (x_2, y_2) of two locations:

$$j(1,2) = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2} \quad (1)$$

The pattern above portrays the distance from fleet of company to each grocery store, or from one store to another store. The result of counting will be functioned to determine saving matrix that will be done in the next step.

b). Identifying Saving Matrix

This step is firstly assumed that every store will be exclusively visited by one truck so that saving can be benefited due to the cluster from two routes or more than two routes to be one route. Saving matrix represents the saving that can be formed by joining two stores in one route.

If each of store 1 and store 2 is inseparably visited, the distance is the commuting distance of the company fleet to the store 1 and vice versa. This also includes the commuting distance of the company fleet to store 2 and vice versa. If the delivery of store 1 and store 2 is joined in one route, the visited distance is from the fleet company to the storee 1 and from store 2 to the company fleet. Picture 2.2 illustrates the change.

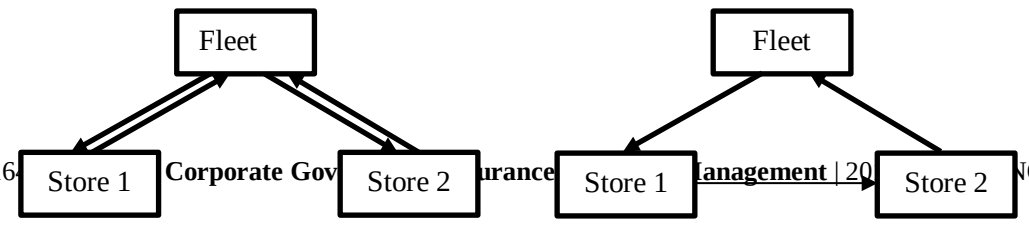

Figure 1: The Change of Consolidation between Store 1 and Store 2 into One Route

Figure 1 visualizes that the change of distance as one of saving ways is that the total of left distance is dikurangi right distance total:

$$2J(G,1) + 2J(G,2) - [J(G,1) + J(1,2) + J(2,G)]$$
$$= J(G,1) + J(G,2) - J(1,2) \quad (2)$$

This result is obtained by assumption that distance (x, y) is equal to distance(y, x). The result above can be generalized into this pattern:

$$S(x,y) = J(G,x) + J(G,y) - J(x,y) \quad (3)$$

$S\ (x, y)$ is the saving that is got by joining route x and y. By corellating the formula, the distance of saving matrix can be counted for all stores and the result can be used in one table of distance saving matrix.

c). Alocating The Consumers In One Route Of Transportation Vehicle

In this step, there will be divide of consumers in a transport route by considering the consumers and capacity of transportation vehicle. A route is categorized *feasible* when the number of all consumers do not exceede the minimal limit of transportation vehicle and the total of demand can be wholly coordinated by one transportation vehicle. The procedure to collect the consumers is based on the largest value of saving matrix. The first thing to do is ranking the the largest value of saving matrix into the transportation vehicle can carry all demands. If the capacity has been maximal, the procedure will be repeated till all consumers are alocated in a certain route.

d). Organizing The Direction Of Consumer (Store) In A Well Defined Route

This is the last step of *saving matrix* method. The purpose of this step is raaning the visit of transporttion vehicle to every consuemer that has been grouped in a route to obtain maximal distance. Several beneficial ways to organize the direction of consumer will be elaborated below:

a. Nearest Insert

This procedure is started by deciding the transportation vehicle roue that has nearest distance. This procedure, then, should be repeated until all of the consumers are included in the route.

b. Nearest Neighbour

This procedure starts its transportation vehicle route from the nearest distance with the restaurant. This route is additionally continued to the nearest consumer from the first consumer that has been early visited. This procedure has to be repeated until all of the consumers are included in the route.

e). The Improving Method to the Purposively Selected Route

After obtaining purposively selected route, the next step is giving the improving method in that selected route. It is functione to give more efficient route to the distance. This method improves visible solution by performing a series of side and knot exchange in one route or between the route of transportation vehicle with the direction to reduce the solution payment. The improvement method between route is used in the route improvement (Laporte & Semet 2002). According to Salaki (2010), there are some hints for conducting the improvement method:

a. Method *2-Opt*

This method moves two available strips and reconnects the strips with different match. The analyzis technique of method *2-opt* will be explained in the picture 2 below:

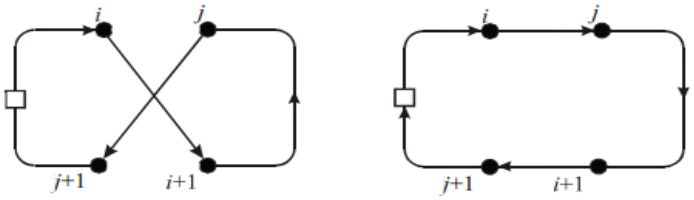

Figure 2: The Route Change by Method *2-Opt*

Based on the figure 2 above, the connecting line (i, i+1) and (j, j+1) is related to (i, j) and (i+1, j+1). from point j to point i + 1 turn counterclockwise to adjust the turn of the route. This method offers new alternative solution by its shorter distance than the sedond method. The steps to determine the well organized route by using the improvement method 2-opt is by exchanging position of two points based on the index.

b. Method Or-Opt

Method Or-Opt is identical with the method 2-Opt, but the number of routes that can be exchanged or added is more than two. The fundamental idea of this method is relocating close consumers. The analysis technique employs method Or-opt will be explored below:

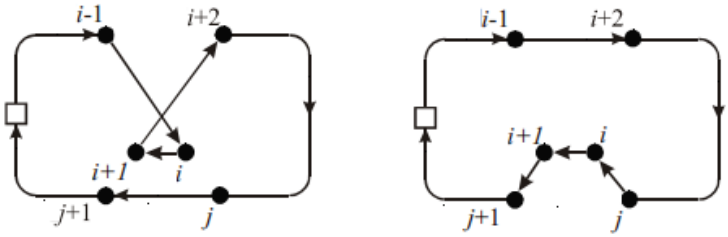

Figure 3: Route Change by Method Or-Opt

Source: Braysy & Gendreau (2005:12)

The analysis technique changes direction from G-(i-1)-(i)-(1+1)-(i+2)-(j)-(j+1)-G to (i-1)-(1+2)-(j)-(i)-(i+1)-(j+1)-G.The improvement analysis will be done by using *software VRP Solver 1.3* to obtain the accuracy of the counting result.

f). Adjoining the Delivery Time on the Alternative Route

The next step after the improvement is by giving delivery time to the alternative route. The analysis technique will be used as the point on the alternative creating. The pattern of delivery time calculation will be elaborated below:

$$T(1,2) = \frac{\mathrm{j}(1,2)}{\mathrm{AS}} x60 \qquad (4)$$

The calculation is done by dividing distance between consumer and the average speed of transportation vehicle. This research employed the average speed of the transportation vehicle Toyota Kijang 50 km/h.

g). Checking Productivity Optimization of The Proposed Route

According to Heizer and Render (2005) productivity is the ratio between the output (goods and services) divided by the input (resources, such as labor and capital). The definition of productivity is well expressed by showing the ratio of output to input. Inputs can include the cost of production and equipment. While the output may consist of sales, revenues, market share, and damage. Productivity is not equal to the production, but the production

is a component of business productivity. (Heizer & Render 2005). Measurement of productivity which only consider one of the resources as the input variables is known as single factor productivity (single-factor productivity). In contrast, productivity measurement that takes into account all input variables (labor, materials, energy, capital) is known as multifactor productivity (multyfactor productivity) or total factor productivity (Heizer and Render, 2005).

2.2 Review of Related Literature

2.2.1 Thesis

Some previous research will be explored below:

1. Taufiq (2013), conducted research entitled **Analisis Rute Distribusi Guna Penjadwalan Sistem Transportasi Produk X dengan Pendekatan metode *saving matrix*.** Transportation System Product X by saving matrix method. This study used a matrix with space variable as saving reference. The object of this research is demand for the product X at. BTR. This research concludes that the space savings were generated by 5022 miles. The difference between the previous research and current research is the product of data processing and analysis techniques.
2. Melati (2008), analyzed Determination of Route Product Distribution by Using Matrix Saving Method to minimize the cost of transportation. This study uses the technique of matrix analysis is the method of saving. The object under study is *Garudafood* products distributed by PT. Sinar Niaga Sejahtera Banjarmasin. The findings show that it was obtained savings of 11.1% in total distance, travel time by 9.04% and 22.75% of the cost per day. However, the difference of the research that is being done is the product of data processing and analysis techniques.
3. Wongso (2012), conducted research entitled Optimization on Route Determination by Forecasting Approach, the Saving Matrix Distribution method, and design of information distribution system of goods. The analysis technique used in this study is a method of saving matrix and forecasting and information system design. The difference between the previous research and the current research is on the method used and the products that were investigated.
4. Wulandari (2007), conducted research with the title of The Determination of the vehicle route in the process of distribution products by saving matrix method to minimize transportation costs. This research was conducted with a case study at PT Bambangan Foodpacker Indonesia. This study uses a technique saving matrix

analysis. The object of this research is canned marine fish sardines. The conclusion of this study is the savings of a total distance were obtained 39.85%, 37.62% for travel time, and 27.64% transportation cost of per month. The difference between the previous research and the current research is the product, and analysis techniques of data processing.

5. Kristiani (2006), conducting research entitled Determination of the route distribution of the cement gresik by using saving matrix method in PT. Varia Usaha Unit Malang. Technique of analysis in this research is the use of route determination of saving matrix. The object of this study is cement Gresik. The finding show that there is distance saving of 19.9 km. The difference between the previous research and the current research is the research object, and analysis techniques of data processing.
6. Salaki, Rindegan (2010), in a journal entitled Distribution Optimization on Route Item Using Heuristric System. The variables of the research were the vehicle routing problem with heuristic methods. This method was begun by constructing route by using nearest-to-depot and then proceed with the repair using the 2-opt, Or-opt, relocate, exchange and cross. The conclusion of this research journal is that the distribution of bakery products to the customers needs 3 vehicles with a total distance of 27.8516 km, 52.7287 and 55.8329 km. The first vehicle served 6 customers with a total of 84 cargo crate, the second vehicle served 9 customers with a total of 158 cargocrate, and the third vehicles served customers with a total of 9 139 cargo crate.

2.2.2 The National Journal

Some previous national journals will be elaborated as follow:

1. Natalia, Christine, Dick (2012), in a journal entitled Application Program Distribution System Design by Saving Method as the Basis Purchase Decision Matrix Fleet with A Case Study at PT. Kabelindo Murni Tbk. This journal uses variable of distribution system application design with a sample population of fleet purchasing decisions. This journal described how the processing of information system design process by using the method of saving matrix as the basis for data processing. The findings indicate that the current transportation system has a lower rental costs than the first alternative with a total cost of USD 196,200,000.00. The difference between the cost of the first

alternative to the second choice is Rp. 202,467,482.00. The chosen system was the second alternative, using a transportation service to deliver to the four distributors in Jakarta, Bekasi and Tangerang.

2. Yuniarti, Astuti (2013), in a journal entitled the Application of Saving Matrix in Scheduling and Determining the the premium route of distribution at the Gas Station Malang. The variables of this research are the scheduling and determining the distribution route of these premium products. The taken population samples are gas station in Malang. The data were analyzed by using saving matrix to determine the purposes and sort premium delivery to the gas stations throughout Malang. The conclusion of this research is the saving distance on the initial distance changed from 261 km to 259.6 km, and a tanker truck that was originally needed 11 pieces declining into 6 pieces.
3. Octora Rahman, Susanty (2013), in a journal entitled Establishment of Distribution Route by Using Clarke & Wright Savings and Algorithm Sequential Insertion. This article examined the formation of route distributions by using the VRP algorithm method Clarke and Wright Savings and Algorithm Sequential Insertion. Clarke and Wright Savings and Sequential Insertion Algorithm were used in this research to provide solutions to problems in PT Panca Lestari Primamulya. The constructed routes in this research indicate that the Sequential Insertion Algorithm is better than Clarke and Wright Savings.
4. Akbar Rahman, Tantrika (2013), in a journal entitled Optimization of Distribution and Material Allocation Flow with Linear Programming Method with Case Study: PT. PLN (Persero) APJ Distribution Malang. The method that is used for the optimization of distribution flow is one of the VRP methods, namely the method of linear programming. This study uses Linear Programming approach to solve the problem of optimizing the flow of materials to the distribution and allocation of the distribution. Linear Programming approach is formulated with an objective function for cost minimization and restricted distribution of some functions related constraints warehouse capacity, demand and capacity of transport modes rayon.

2.2.3 International Journal

Some previous research in the form of national journal will be discussed as follows:

1. Shamsuddin Ahmed (2009) writing *Supply Chain Planning for Water Distribution in Central Asia* functioned *Location Analysis Algoritm* by determining consumer position based on the coordinate and counting saving matrix based on the coordinate. The establishment on this case study was composed by identifying water limit DCs in the city. By well developing distribution and logistic managment, this research dealth with the economical operations, region distributions, and responsive SCM. Additionally, the solution of route determination planning is functioned to develop distribution of drinking water.
2. Chwen-Tzeng Su (2006), in a journal entitled *Dynamic vehicle control and scheduling of a multi-depot physical distribution system* portrayed that there are some necesssary factors to support the optimization of route determination such as the factors of location, quantity, and date of delivery. This research is aimed to provide controlling system on distribution and scheduling to the company which has many branches and distribution regions. The general information or knowledge in distribution, controlling and setting the rule of branches in each area, vehicle route, and consumer feedbacks as the components to maximize the distribution effectiveness should be taken a hint. This article also provides the simulation used to evaluate the available system and offer new acceptable system for all company branches as well as the distribution condition itself.
3. Yiyu Kuo, Hsing Kuo, Chi-Chang Wang (2011), in a journal *Optimizing the VRP by minimizing fuel consumption* argues that there is innovative method to save the trasportation distance by looking at the amount of fuel that is needed in the transportation process. Providing new optimal route can give positive effect on the driver to see the vehice speed, the patch, and the amount og emigation remove. Besides, it can influence the consu,ers on how to consume the fuel.
4. A.C. Caputo L., Fratocchi, P.M. Pelagagge (2006), in a journal entitled *A Genetic for Freight transportation planning* analyzed the transportation of goods by container. The researcher has a conclusion that route determination can be used in all transportation modes. The transportations that were used in this research wer the atutoruck. The hereustic method is considered the best method and the best solution to give distribution savings.

2.3 Methodology

This research employed descriptive research design. Sekaran (2011:158) argues that descriptive research is functined to find out the characteristics of variable that are analyzed in the certain situation.

This research is procedurally inseparable from data collection and data analysis that can be elaborated below:

a). Data Collection

a. Literature Study

Literature study is done by searching, reading, and collecting data relvant to the theoretical object under study. Sources used can be accessed through electronic media (website), and print media (journals, textbooks, articles) that are useful to convince the reader as well as support information and phenomena.

b. Field Survey

The field survey was conducted to see the problems that occur to make an assessment.

c. Interview

Research carried out by direct communication to the relevant parties in order to collect data that can be used as a reference in solving the problem.

b). Metode Analisis Data

a. The method of data analysis in this study is a method of determining the route saving matrix. Determining the location of consumers was conducted by the method of analysis alghoritm location.Ordering customer visits is determined by the consumer sorting method nearest neighbor and nearest the insert. Optimal route while visits were conducted by sequencing methods improved 2-opt and or-opt. Further analysis of the time and delivery schedules can be done by using the assumptions of existing companies. After that, productivity test was applied by dividing the output (after the repair) with the input (before the repair).

b. Data Analysis

The method to analyze data is the method to determine route of saving matrix. The consumer location is applied by location analysis algoritm method. The list of consumer visit is determined by method od consumer list nearest neighbor and nearest insert.

3. FINDINGS

PT. Limas Raga Inti is one of distributor companies of PT. Pertamina Persero. PT. Limas Raga Inti distributes products of PT. Pertamina, one of which is LPG 12 Kg. PT. Limas Raga Inti has many distribution areas in the Bandung city. However, the distribution area in this research is limited to the distribution area D14 that includes the Kembar, Mekar, dan Moh. Toha. The distribution is done by sending a 12 Kg LPG by using vehicles Toyota pick-up type. The vehicle is capable of carrying 50 LPG 12 Kg in one visit. PT. Limas Raga Inti provides 1 unit distribution to area D14.

a). Assumptions of this research includes:

a. All customer orders can be met by PT. Limas Sports Core Bandung
b. Consumer demand is fixed and known in advance
c. Vehicles used to have a capacity of 50 to 12 Kg LPG with an average speed of 50 km / h,
d. Each location is connected to each other and the distance between the symmetrical location, meaning that the distance between the consumer A to B is equal to the distance of consumer B to A.
e. The travel time between customer A and B are T (A, B). This time is already included in the service consumers A.

The results of data processing by applying the method of saving matrix on construction and repair methods are described in Table 1.

Table 1: The Construction and the Repair Result on the Route Determination by Saving Matrix

Route	The amount of charge	Composition of Consumer on Route	Distance Total	Total Delivery Time (in hour)
1	50	G-31-89-40-39-42-41-43-97-37-36-38-35-20-19-17-18-16-15-14-13-21-22-34-33-23-32-28-G	171,28	3,4256
2	47	G-45-44-87-88-1-2-3-4-46-47-98-48-49-54-53-79-67-66-65-69-100-99-68-52-51-50-G	132,53	2,6506

3	50	G-55-56-57-59-58-60-64-63-62-61-78-76-77-75-74-71-70-72-73-80-81-83-82-96-G	110,27	2,2054
4	50	G-5-90-7-6-94-93-92-91-8-9-95-12-11-10-24-25-26-27-29-30-86-84-85-G	109,60	2,1920
Total	197	100	523,69	10,4736

Four vehicles as presented in the table 4:25 above are necessary to meet consumer demand and reduce the existing problems. The first route with a total of 50 LPG 12 kg payload includes a warehouse, customer 31, customer 89, customer 40, customer 39, customer 42, customer 41, customer 43, customer 97, customer 37, customer 36, customer 38, customer 35, consumer 20, consumer 19, consumer 17, consumer 18, consumer 16, consumer 15, consumer 14, consumer 13, consumer 21, consumer 22, consumer 34, consumer 33, consumer 23, consumer 32, consumer 28, and warehouses with a total mileage of 171 , 28 and the delivery time for 3 hours 26 minutes. While the second route includes the warehouse, consumer 45, consumer 44, consumers 87, consumer 88, consumer 1, consumer 2, consumer 3, consumer 4, consumer 46, customer 47, customer 98, customer 48, customer 49, customer 54, consumer 53, customer 79, customer 67, customer 66, customer 65, customer 69, customer 100, customer 99, customer 68, customer 52, customer 51, customer 50, and warehouses with a total mileage of 132.53 and delivery time for 2 hours 39 minutes. While the third route includes the warehouse, customer 55, customer 56, customer 57, customer 59, customer 58, customer 60, customer 64, customer 63, customer 62, customer 61, customer 78, customer 76, customer 77, customer 75, consumer 74, customer 71, customer 70, customer 72, customer 73, customer 80, customer 81, customer 83, customers 82, customer 96, and warehouses with a total distance of 110.27 and delivery time for 2 hours 13 minutes. The last route includes the warehouse, consumer 5, consumer 90, consumer 7, 6 consumers, consumers 94, consumer 93, consumer 92, consumer 91, consumer 8, customer 9, customers 95, customers 12, customers 11, customers 10, consumer 24, consumer 25 consumer 26, consumer 27, consumer 29, consumer 30, consumer 86, consumer 84, consumer 85, and warehouses with a total distance of 109.60 as well as the delivery time for 2 hours 12 minutes. Figure 4. is the visualization of the resulting determination of the VRP Solver software version 1.3 based on Table 1.

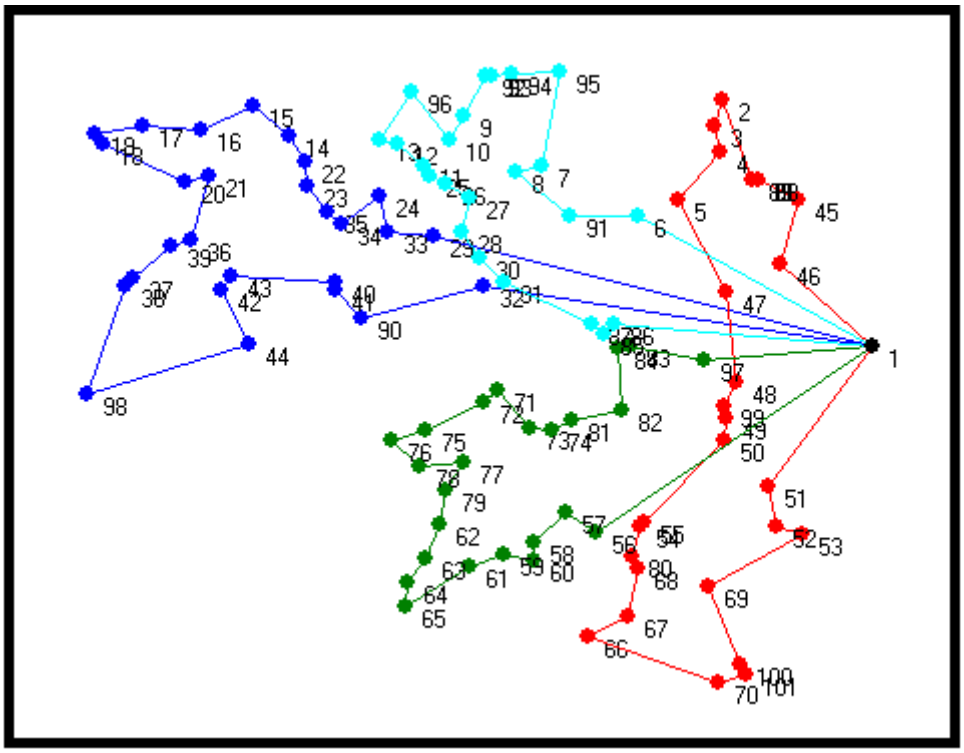

Figure 4: The Visualization Result of Route Determinantion VRP Solver Version 1.3

Figure 4 portrays the 1st route with the blue line, the 2nd route with the red lines, the 3rd route with the green line, the 4th route with the light blue lines. The portrayal is done in the opposite form of regulation due to software version 1.3 of the VRP Solver.

4. CONCLUSION AND SUGGESTION

4.1 Conslusion

Based on the data analysis and the findings previously, this research concludes that:

1) After doing some data processings, the routes that were produced by saving matrix consisted of 4 routes. Of the four routes, the most effective procedure is nearest neighbor procedure. Routes that have been purposively selected, then subsequently analyzed by the method of repair. After a process of analysis by the method of repair, the selected routes were analyzed by giving delivery time based on the mileage.

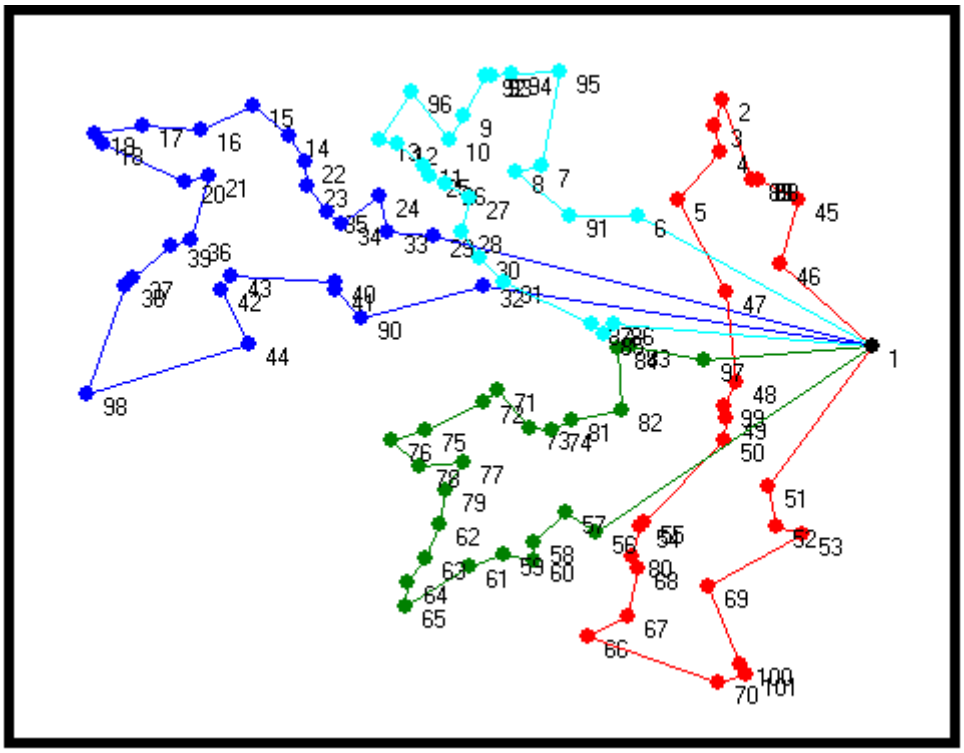

Figure 5: The Visualization Result of Route Determinantion VRP Solver Version 1.3

Figure 5 portrays the 1st route with the blue line, the 2nd route with the red lines, the 3rd route with the green line, the 4th route with the light blue lines. The portrayal is done in the opposite form of regulation due to software version 1.3 of the VRP Solver. By the total delivery time for 10 hours and 30 minutes, The total distance of the 4 routes is 523.69 km

2) Based on the result of the route determination and time of delivery, it can be deemed optimal if the distribution system is implemented on the PT. Limas Raga Inti because it can overcome the existing problems. The first problem solving is firstly centered on the delivery process spending more time than the specified time of the company, 2 hours. The second alternative solution is the consumer ordering more than one in one day. The newly found route can overcome the two problems above because the delivery schedule becomes more structured and utilizes the 1st assumption of customer first visit. Optimization of the route determination route can be categorized optimal because it has a productivity of 85.11%.

4.2 Suggestion

The suggestion for the company is explored as follows:

1) The company should determine delivery routes and schedules prior to delivering the consumer's orders to understand the most optimal direction so as to minimize shipping costs and save distance.

2) The company should implement an information system that can assist convenient ease in every activity of business process. It can be started from identifying consumers and their demand, determining route visits that will be visited, and setting the structured delivery schedule so as to reduce and overcome the existing problems of the company and provide convenience to everyone in the distribution system, such as the distribution operators and fleet drivers who delivered canister.

4.3 Suggestion for the Future Researchers

The suggestion for the next researchers is explored as follows:

1) Further research can be done by comparing several methods such as the method of determining the saving heuristic, Clarke and Wright saving method, large neighborhood, and many more.
2) Further research can also be done by the method of determining the location of the consumer using the rounded Euclidian distance or geodesic approximation.
3) Future studies can also add various repair methods in accordance with the method of route determination and the determination of the location of the consumer for instance the relocated method, exchange, swaps, and cross.
4) Future research can also add the process of forecasting consumer demand to provide a more accurate optimization.

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