PROPOSED IMPLEMENTATION OF ROUTE DETERMINATION AND SCHEDULING SYSTEM USING VBA EXCEL DASHBOARD WITH VRP SPREADSHEET SOLVER APPROACH ON GARBAGE PICKUP TO BANK SAMPAH INDUK CIMAHI CUSTOMER (SAMICI BANK)

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ABSTRACT

Bank Samici has received some complaints from its customers regarding the delays and postponement in picking up waste to customer units which, if presented, may reach 60% of the total customers weekly, or equal to 6-7 customers submitting their complaints per week. One of the delays and postponement in picking up garbage is caused by the waste pick-up scheduling factor that is carried out at the end of the month, the weather factor is also a supporting factor, the delay in picking up garbage caused by weather factors reaches 1 day and the minimum time to reschedule is 2 days, while the error factor of officers in planning may take 1-2 days and the minimum time to reschedule takes 2 days. This causes inconvenience and the waiting list, which is caused by scheduling, route choices, and selection of operational vehicles by Bank Samci which is still done manually and has not been equipped with a support system to make the arrangement automatically. The purpose of this research is to determine out what kind of route and scheduling is required on garbage pickup to Samici Bank customers and to know what kind of system can support optimization of route determination and scheduling on garbage pickup to Samici Bank customers. The method used in processing the data is Vehicle Routing Problem with Time Window (VRPTW) with Large Neighborhood algorithm. Based on the research there obtained the results of print out solutions and print out visualization routes. In the first week there are as many as 17 customers who are scheduled to have their garbage picked up. The total optimal distance traveled on the first week route is 48.99 km. The optimal time taken on the first week's route is 125 minutes. The second week as many as 15 customers, with the total optimal distance taken on the second week route of 40.30 km. The optimal time taken on the second week route is 90 minutes. In the third week as many as 12 customers, with the optimal distance taken on the third week route of 37.92 km. The optimal time taken on the third week route is 99 minutes. In the fourth week as many as 12 customers. With the optimal distance traveled on the fourth week route 33.24 km. The optimal time taken on the second week route is 91 minutes. All routes that are taken begin and end at the Cimahi Main Waste Bank. Optimal route determination and scheduling can be done by implementing a support system that is VBA Excel Dashboard with VRP Spreadsheet Solver Approach.

Keywords: VBA Excel Dashboard, VRP Spreadsheet Solver, Vehicle Routing Problem with Time Window (VRPTW), Large neighborhood Algorithm, Bank Samici.

1. INTRODUCTION

Bank Samici has received some complaints from its customers regarding the delays and postponement in picking up waste to customer units which, if presented, may reach 60% of the total customers weekly, or equal to 6-7 customers submitting their complaints per week. One of the delays and postponement in picking up garbage is caused by the waste pick-up scheduling factor that is carried out at the end of the month, the weather factor is also a supporting factor, the delay in picking up garbage caused by weather factors reaches 1 day and the minimum time to reschedule is 2 days, while the error factor of officers in planning may take 1-2 days and the minimum time to reschedule takes 2 days. This causes inconvenience and the waiting list, which is caused by scheduling, route choices, and selection of operational vehicles by Bank Samci which is still done manually and has not been equipped with a support system to make the arrangement automatically. Based on this, researchers are interested to know what kind of route and scheduling is required on garbage pickup to Samici Bank customers and to know what kind of system can support optimization of route determination and scheduling on garbage pickup to Samici Bank customers. Thus, this paper aims to know what kind of route and scheduling is required on garbage pickup to Samici Bank customers and to know what kind of system can support route determination optimization and scheduling on garbage pickup to Samici Bank customers.

2. LITERATURE REVIEW

Vehicle Routing Problem with Time Windows (VRPTW)

According to Pierre & Zakaria (2015), Vehicle Routing Problem with Time Window (VRPTW) is a combinatorial problem related to the limited time of service provision. According to Kallehague (2006) the mathematical model form of Vehicle Routing Problem with Time Window is generally defined as follows:

$$Zvrptw = minimum \sum_{i,j \in N} Cij + \sum_{i \in N} Pi$$

Description:

1. C_{ij} : Distance from the point I to point j
2. P_i : Penalty if the vehicle exceeds the capacity and time window
3. N : A collection of points consisting of customers

Algoritma *Large Neighbourhood Search* (LNS)

According to Pisinger and Ropke (2010) large neighborhood search algorithms, was first introduced in 1998 by Shaw. The three main stages for solving VRP problems using large neighborhood search algorithms, namely the formation of initial solutions, the formation of environmental solutions, and the calculation of the value of evaluation functions. Here is the flow chart of the Large Neighborhood Search algorithm used in the search for solutions on the program.

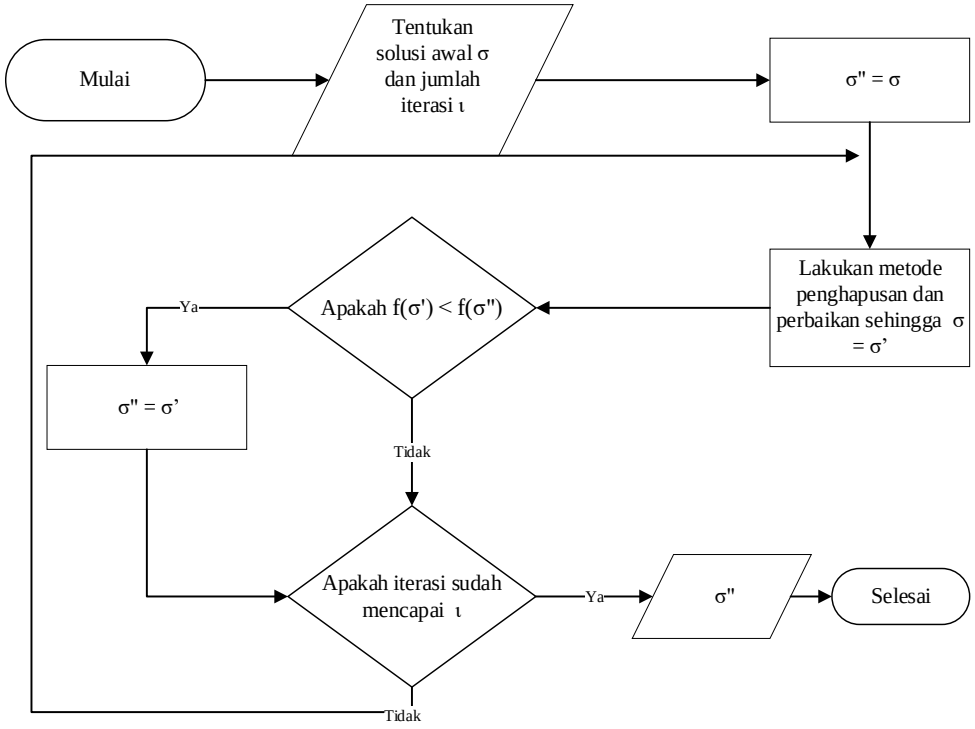


Figure 1. Large Neighborhood Search Algorithm Flow Chart

Description :

1. σ : Current solution
2. σ" : The best solution
3. σ' : Environmental Solutions
4. f(σ) : Value of objective function σ
5. ι : Many iterations

Optimation

According to Nyoman Gunantara (2018) optimization is a process of finding the best solution, or looking for the optimal value of an optimization problem.

3. RESEARCH METHODOLOGY

In this research methodology chapter will be discussed about the steps used in this study. Figure 2 shows a flow chart of the stages of data processing.

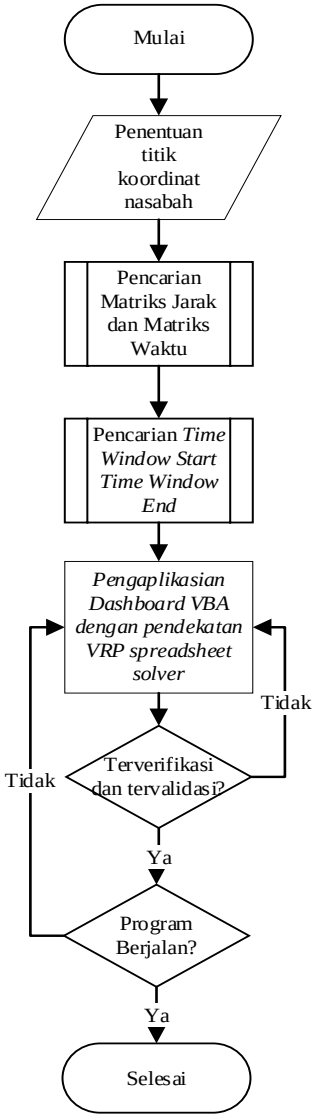


Figure 2. Data Processing Flowchart

Figure 3 illustrates the design of a system in the form of a flow of information between worksheets on an Excel VBA dashboard with a VRP approach to spreadsheet solvers.

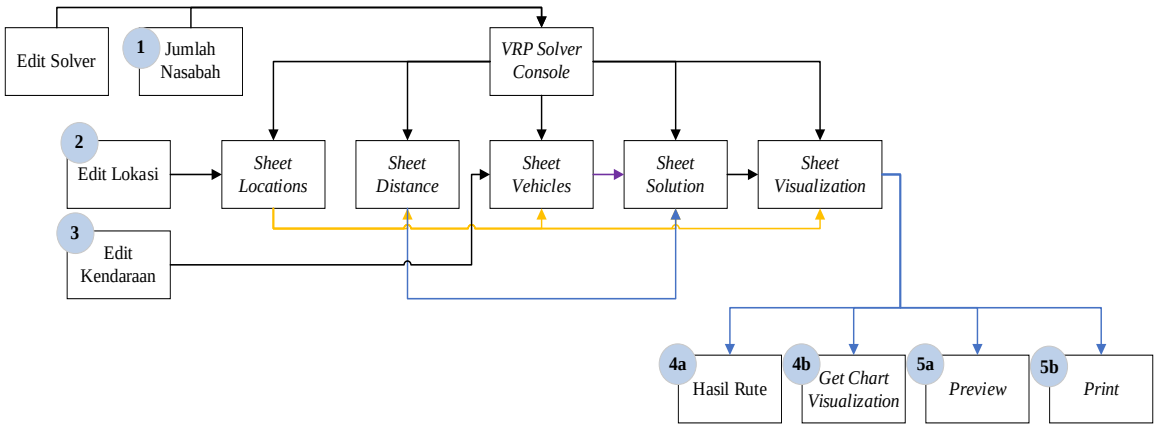


Figure 3. Excel VBA worksheet structure with VRP spreadsheet solver approach

4. DATA COLLECTION

Data collection is conducted by direct observation to Cimahi Main Waste Bank, data collected proactive terms and conditions (withdrawal to customer location), terms of garbage pickup service, and Samici Bank customer data scheduled at garbage pickup in December. In addition to direct observation, data collection is also conducted through interviews with Samici Bank Directors. Customer's data are grouped weekly so that they become 4 groups. Table 1 is the fourth group data, namely customer's data and its time window in the fourth week.

Table 1 Name and Time Window customer on week fourth

No	Customer Name	Customer Time Window	
		Time Window Start	Time Window End
0	Bank Samici	09.00.00	15.00.00
1	Ecovillage Rena Margamulya	09.00.00	12.00.00
2	Eropa Cipageran	08.00.00	12.30.00
3	Puspa Bukit Permata	08.00.00	14.00.00
4	Tabah RW 26 Melong	07.00.00	15.00.00
5	Mekar Harapan RW 09 Melong	08.00.00	12.30.00
6	Unit Mutty	10.00.00	12.00.00
7	Lembah Hanjuang	08.00.00	12.30.00
8	Unit Cetar	09.00.00	15.00.00
9	RW 31 Melong	08.00.00	15.00.00
10	Salfah Marwa Cigugur	09.00.00	15.00.00

No	Customer Name	Customer Time Window	
		Time Window Start	Time Window End
11	RW 17 Buciper	08.00.00	12.00.00
12	RW 16 Ciptamas	08.00.00	12.00.00

5. OUTPUT

The dashboard view of this study is shown in Figure 4 as follows.

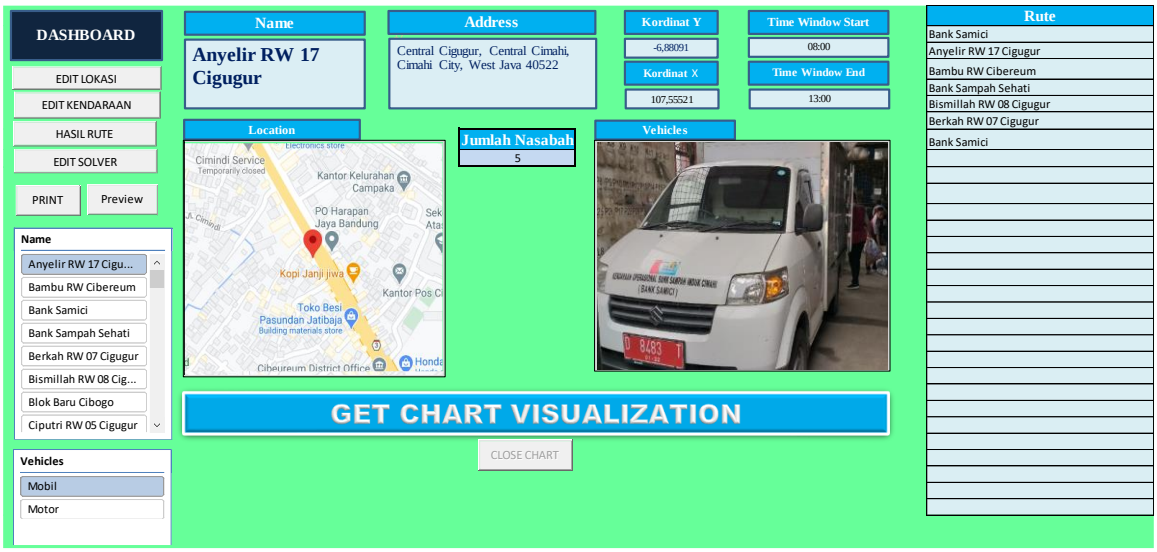


Figure 4 *Dashboard View*

Dashboard view description:

1. To enter the number of customers, the administration staff can fill in the number of customers to the number-of-customers column on the dashboard.
2. When the edit-location button is clicked it will be connected with a sheet to manage customers' data, then the administration staff can make changes to the data as needed.

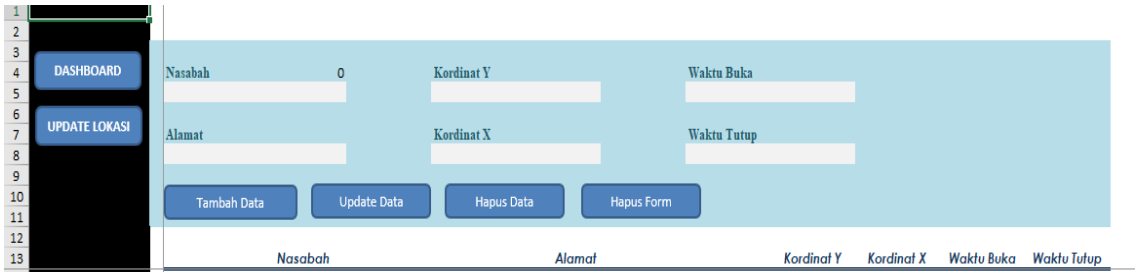


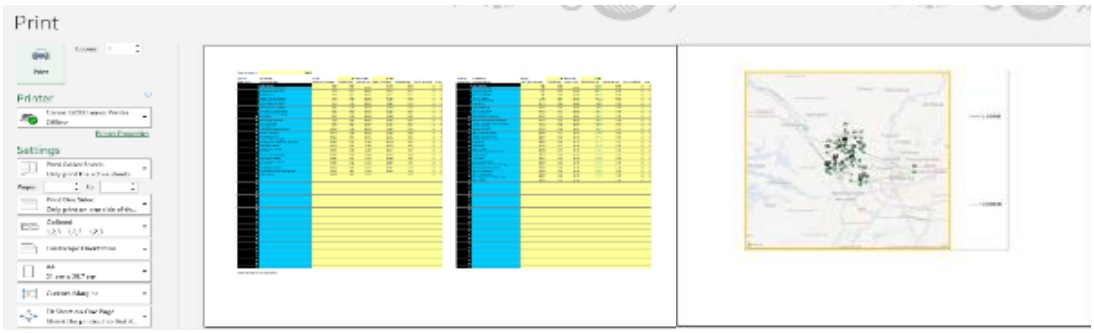
Figure 5. Customer Data Management

3. After finishing adding, deleting, or changing customers' data, click the update location button, then the data will be automatically copied into the location sheet.

4. When the vehicle-edit button is clicked, it will be connected with a sheet to manage vehicle data, then the administration staff can make changes to the data as needed.

Figure 6. Pengelolaan Data Kendaraan

5. After finishing the adding, deleting, or changing the vehicle data, click the vehicle update button, then the data will be automatically copied into the vehicle sheet.
6. a. When you click the route result button it will bring up the route you need to go through.
   b. The route visualization will be displayed in the dashboard when the chart visualization button is clicked, and to close it again, click the close chart button.
7. a. When clicking the preview button, it will bring up a preview of the output result to be printed. The solution algorithm implemented in this VRP Spreadsheet Solver is the Large Neighbourhood Search (LNS) algorithm.
   b. When clicking the print button, the output will be printed immediately.



Figurer 7. Excel VBA Dashboard Output with VRP Spreadsheet Solver Implementation

8. For the columns of name, address, x coordinate, y coordinate, start time window, time window end, and customer location point view, it will change according to the customer's name clicked on the name field located below the print and preview buttons.
9. In the vehicle's column on the dashboard, when clicking on the car, the visualization of the vehicle that will appear is the image of the car, while when clicking on the motor then the visualization of the vehicle that will appear is the image of the motor. The images of cars and motorcycles shown are the result of research documentation.

10. On the edit-solver button located on the dashboard, when clicked it will bring up the sheet vrp console solver, where on this sheet, it some settings can be made that can be done when going to make certain improvements to the program.

Based on data processing obtained the following results:

Table 2. Total Distance and Optimal Time

Group Of Weeks	Number of Customers	Total Distance (Km)	Total Optimal Time (Minutes)
1	17	48,99	125
2	15	40,30	90
3	12	37,92	99
4	12	33,24	91

The route visualization in the first to the fourth week is as follows:

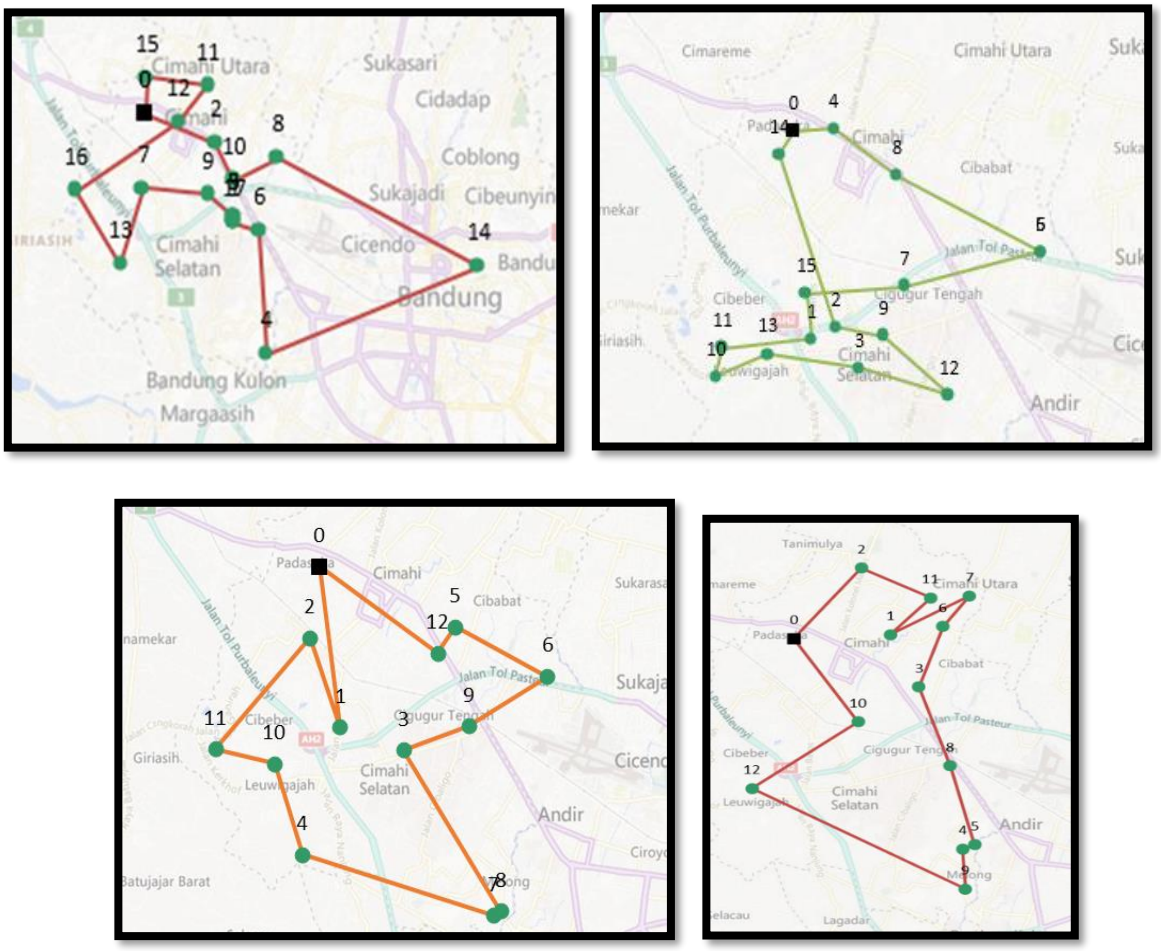


Figure 10. First Until Fourth Week Route Visualization

All routes are initiated and ended at Cimahi Main Waste Bank.

6. CONCLUSION

Conclusions that can be drawn from this study are:

1. In the first week there are as many as 17 customers scheduled for garbage pickup. The total optimal distance traveled on the first week route was 48.99 km. The optimal time taken on the first week route is 125 minutes. The second week was 15 customers, with the total optimal distance traveled on the second week route of 40.30 km. The optimal time taken on the second week route is 90 minutes. In the third week as many as 12 customers, with the optimal distance traveled on the third week route of 37.92 km. The optimal time taken on the third week route is 99 minutes. In the fourth week as many as 12 customers. The optimal distance traveled on the fourth week route is 33.24 km. The optimal time taken on the second week route is 91 minutes. All routes are initiated and ended at Cimahi Main Waste Bank.
2. Calculation of route determination, scheduling, and vehicle selection with the application of VBA Excel dashboard with VRP Spreadsheet Solver approach can support optimization of scheduling and route determination on garbage pickup to Samici Garbage Bank customers.

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