Integrated Location and Technician Routing Problem with Profits and Time Windows for Supporting Maintenance Activities of Technology Infrastructure

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Abstract

Information technology has been widely used in many industries in recent days, and many companies use outsourcing services through managed service schemes with revenue sharing patterns. To maintain the services, the managed service providers need to have a well-planned maintenance activities for both preventive and corrective purposes. Several operational parameters of maintenance are the number and location of the technician depot. These parameters must be determined optimally to meet the targeted service level. Meanwhile, there are some constraints that make the service providers require to design the optimum maintenance travel route for the maintenance technicians. This research use a case research of a service provider and adopts a vehicle routing problem (VRP) concept to develop an optimum route to support the maintenance activities for information technology infrastructure. To define the location of the depots and the maintenance routes, an algorithm of integrated location and technician routing problem with profits and time windows is developed. The numerical experiments show that the algorithm provides a better solution compared to the existing practice in the case research. This work provides not only a better solution and simple practice for the service provider companies but also enrich the literature in the development of VRP concept.

Keywords
Location Routing Problem, Managed Service Provider, Maintenance, Technician Route, Profit, Time Windows

1. Introduction
The development of internet of things (IoT) technology is primarily driven by the need for large enterprises to get a foresight based on the predictability provided by the ability to keep up with the flow of all objects (materials or services) flowing through the commodity chain or enterprise supply chain (Lianos, 2000). In an industrial environment, it is characterized by the use of interconnected computers, smart materials, smart machines and instruments that communicate with each other, interact with the environment, and ultimately make decisions with minimal human involvement (Gilchrist, 2016).

The trend of the use of information and digital technology in the industrial sector, as well as the need for fast and precise data and information and on a large scale, makes many companies that transform the use of information and

digital technology in the company's operational activities, including in the production process and supply chain. Utilization of information and digital technology or digitization in the company's supply chain allows the supply chain to access, store and process large amounts of data both internal and external data of the company (Sniederjans et.al. 2020). Digitalization furthermore allows information to be shared directly with company stake holders to obtain better operational performance and service levels. Stored and disseminated data can furthermore improve prediction accuracy and facilitate prescriptive solutions (Schniederjans et al, 2020)

According to Kumbakara (2015), the implementation of digital information technology or digitalization in corporate operations requires companies to provide a standard operating environment as well as manage a complex and diverse information technology (IT) infrastructure environment. Scalability and flexibility of IT systems is important to reduce time to market and to increase organizational agility. Given the complexity and challenges in providing digital information technology, more and more organizations are contracting managed service providers/MSPs to manage their complex and widely distributed IT infrastructure.

Managed IT Services is a series of Information Technology service activities carried out by providers for their clients. Managed Service Providers handle the client's IT needs, which can be done remotely, on the customer's premises or a combination of both. Managed Services can include a diverse set of activities ranging from network monitoring and maintenance, server administration, database support and applications including centralized management of it assets of a Company (Wattal, 2020). In carrying out its service operations, managed service providers provide technicians who routinely carry out priventive and corrective maintenance activities for geographically separated customers by using operational vehicles with typical routes shown in figure 1.
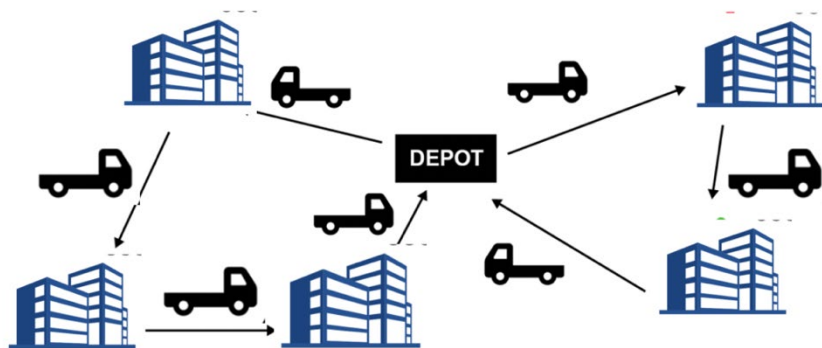

Figure 1. Typical vehicle route managed service provider maintenance technician

Given that the reliability of digital technology systems or IoT determines the smooth operation of the company, a Managed Service Provider must carry out the planning of maintenance operations both corrective and prefentive maintenance optimally to reduce existing operational costs. Operational planning includes the determination of technician depots that can meet repair response time standards in the event of damage disruption, as well as the route of technician vehicles in performing optimal preventive maintenance by paying attention to several factors according to the parameters of the specified service contract.

Some previous studies have discussed the problem of technician routes, such as the problem of technician routes using matheuristic and coloumn generation methods (Dupin et.al, 2021) as well as models for forklift maintenance technicians using Multiperiod Technician Routing and Scheduling Problem by Zamorano & Stollez (2016). In this research, before determined the route of the maintenance technician team, it will be determined in advance the location of the depot for the technician. For this reason, the model that will be developed is the Location and Routing Problem model according to Berger et.al (2007), which is a combination of the Location Problem model (Daskin 2015) and the Routing Team Orienteering Problem with Profit (Archetti et.al, 2015)) model. The location of the depot is determined in advance according to the requested response time limit, and determined by the customer

group according to the selected depot. Furthermore, the technician route is determined for each customer group taking into account the profit that is revenue sharing from each customer.

The model resulting from the research is expected to help manage digital IT service providers in planning optimal maintenance operating systems that minimize costs and maximize profits obtained. To test the model, numerical experiments will be conducted using real data on the ground and analyzed for several scenarios based on different parameter conditions.

1.2 Objective
The Obkjevtive of this research is to model the depot location and technician routes to provide managed service providers by considering revenue sharing to help providers in planning operations and service maintenance activities.

2. Literature Review
2.1 Facility Location
Facility location is the process of identifying the best geographic location of a production facility or service. Facility location is the process of choosing a geographical location for a company's operations. Facility location for operations research is completed by modeling, algorithm development, and complex theories (Daskin, 2008).

Location modeling can be applied to determine the location of emergency medical service (EMS), fire stations, schools, hospitals, airports, landfills, and technician warehouses or depots. Location modeling is furthermore used on route determination, and analysis of archaeological areas. One of the theories and modeling of location pioneered by Weber (1929) was to consider facility location with the aim of minimizing the amount of travel distance between the facility and the collection of consumers.

2.2 Set Covering Problem
The set covering model (Toregas et al., 1971) aims to minimize the number of location points of service facilities but can serve all points of demand. According to Daskin (2013), Set Covering Models aims to find a minimum cost of a limited number of facilities from among a limited set of candidate facilities so that each demand node is covered by at least one facility. This problem can be formulated mathematically using the following notation:
Input:

If
If $\quad a_{ij} = \begin{cases} 1 & \text{the candidate location } j \ J \in \text{can meet the demand at point } i \in \\ 0 & \text{not} \end{cases}$

$\qquad f_j$ = cost of placing facilities in location candidate $\quad j \in$ Variable

Decision:

$\qquad X_j = \begin{cases} 1 & \text{If placing facilities in candidate location } j \ J \in \\ 0 & \text{If not} \end{cases}$

With the above notation, the formulation *of the set covering problem* model is:

MINIMIZE: $\quad \sum_{j \in J} f_j X_j$

Limitation $\quad \sum a_{ij} X_j \geq 1 \quad \forall i \in I$
$\qquad\qquad X_j \in \{0,1\} \quad \forall j \in J$

2.3 VRP with Time Windows (VRPTW).
According to Toth &Vigo (2015), VRPTW is a service for every customer must be started in associated time intervals and called windows time. VRPTW has two categories:
- Soft time windows

Vehicle arrive after the latest time, any windows time can be violated by bearing penalty costs.

- Hard Time Wondows
  Window time (especially the final time jendeal) that cannot be broken. Therefore to avoid coming when the time window has closed, then the vehicle comes before the earliest time so as to produce *idle time* (waiting time).

VRPTW's objective is to minimize the overall number of vehicles used to serve customers and minimize the travel costs of all vehicles while meeting the limitations of:

- Each customer is only visited exactly once.
- Every vehicle with every route starts and ends at the depot.
- Demand from all customers on one route must not exceed the capacity of the vehicle.
- Windows time must be fulfilled

Objective function *Minimize* $\sum_{k \in K} \sum_{(i,j) \in N} c_{ij} \, x_{ijk}$

Decision Variables

$$x_{ijk} = \begin{cases} 1 & \text{If vehicle k visits directly from vertex i to vertex j} \\ 0 & \text{If notidak} \end{cases}$$

Limitation

$$\sum_{k \in N} \sum_{i \in N} x_{ijk} = 1 \qquad\qquad \forall \, i \in C$$
$$\sum_{j \in N} x_{ojk} = 1 \qquad\qquad \forall \, k \in K$$
$$\sum_{i \in N} x_{ihk} - \sum_{i \in N} x_{hjk} = 0 \, \forall \, k \in K, h \in C.$$
$$\sum_{i \in N} x_{i,n+1,k} = 1 \, \forall \, k \in K$$
$$x_{ijk}(w_{ik} + s_i + t_{ij} - w_{jk}) \leq 0 \, \forall \, k \in K, (i,j) \in N$$
$$\sum_{i \in C} d_i \sum_{j \in N} x_{ijk} \leq q \, \forall \, k \in K$$
$$a_i \leq w_{ik} \leq b_i \, \forall \, k \in K, i \in N$$
$$X_{ijk} \geq 0 \text{ and } x_{ijk} \in \{0,1\} \, \forall \, k \in K, (i,j) \in N$$

The objective function is to minimize the total cost. The Limiting function ensures that each customer is passed by exactly one route. The barrier ensures the vehicle of each vehicle k returns to the original depot as well as to ensure a schedule that matches the window of time and capacity of the vehicle. As a note to note, for each vehicle k, the value of Tik is meaningless if the customer i is not visited by vehicle k. Finally, variable arc flow is binary.

2.4 Team Orienteering Problem with Profit.
VRP variant where route length / travel time is limited and the goal is maximum profit is called Team Orienteering Problem (Archetti et.al, 2015). Examples of implementing team orienteering problems are the recruitment of athletes (Chao et.al, 1996), technisian routing (Tang & Hooks, 2005) and tourist travel plans (Vansteenwegen et.al, 2011). According to Archetti et.al (2015), TOPP can be mathematically modeled as follows:

Decision variables

- y_{ik} = binary variable, equal to 1 if *vertex i V* $\in$ is visited by route vehicle $k \in K$ and 0 if not
- x_{ijk} = binary variable, equal to 1 if arc $(i, j) \in A$ is traversed by vehicle $k \in K$ and 0 if not.

The mathematical programming formulations are:

Objective Function
(TOP1)Maximize $\sum_{i \in V} P_i \sum_{k \in K} y_{ik}$
Limitation
$$\sum_{j \in V} X_{ijk=} y_{ik} \qquad \forall \, i \in V, k \in K,$$
$$\sum_{j \in V} X_{jik=} y_{ik} \qquad\qquad \forall \, i \in V, k \in K,$$
$$\sum_{k \in K} y_{0k} \leq |K|,$$

$$\sum_{k \in K} y_{ik} \leq 1 \qquad i \in V \setminus \{0\}$$
$$\sum_{(i,j) \in A\delta+(s)} X_{ijk} \geq y_{bk} \qquad \forall S \subseteq V \setminus \{0\}, b \in S, k \in K,$$
$$\sum_{(i,j) \in A} t_{ijX_{ijk}} \leq T_{max} \qquad \forall k \in K,$$
$$y_{ik} \in \{0,1\} \qquad \forall i \in V, k \in K,$$
$$X_{ijk} \in \{0,1\} \qquad \forall (i,j) \in A, k \in K$$

The objective function of the above model is to maximize the profit obtained. The barrier limits the number of routes from the total K vehicle, and ensures that each customer is visited at least once. The barrier ensures that each route is connected and limits the maximum distance from each route.

2.5 Location Routing Problem
The problems that occur in this research can be expressed as a problem of routes - location as a series of problems in location theory. This theory was clarified by Balakrishnan et al. (1987) and Nagy & Salhi (2006) where the problem of location-route is essentially a strategic decision regarding the location of the facility. This definition comes from a hierarchical point of view, where the main goal is to solve the problem of facility location as a master problem. But to achieve this simultaneously need to be solved the problem of vehicle routes. In this case the vehicle route is as a subproblem. Therefore, it can be formulated that the purpose of solving this problem is to determine the optimal location of a facility, allocate customers to selected facilities, and determine the route of the vehicle to meet the objectives expected by the customer.

In this research the master problem was solved using a set covering model (Daskin, 2015) and vrp completion as a subproblem using the Team Orienteering Problem with Profit and Time Windows approach with heuristic methods and using the help of excel software.

3.Methods
The completion of location routing problems in this research is divided into 2 stages. Stage 1 is location model dan vehicle stage 2 is routing model. Stage 1 use set covering problem model to determine depot location and stage 2 use team orienteering problem with profits and time windows model for determine vehicle route. To solve the model we used exact methods for solve location problem and heuristic methods for vehicle routing problem. The research steps are field research, data collection, data processing, modeling, solving. analyzing and concluding.

4. Data Collection
4.1 Field Studies and data collection.
In this research conducted direct observation studies in the field, namely at the provider (6 site operations as depot location candidates) and in customers who became the object of research (15 sites) and the collection of secondary or primary data using google maps. The data needed in this research are:
- a. Customer sites location as are the object of research.
- b. Number and location of the site operation provider's office
- c. Operating hours and hours allowed for Customer maintenance.
- d. Travel time of technician vehicles from the site operation office to the customer using google maps.
- e. Time required for maintenance preparation and implementation activities.
- f. Other data as assumptions for this research

4.2 Data Processing and Modeling.
The problem-solving modeling in this research was carried out in two stages, namely:
a. Determine Facility Location
Distance matrix data converted into vehicle travel time is used to determine the number of depot facilities and depot location needs from 6 existing location candidates using the set covering problem model and solved using solvers in excel applications. The critical parameter of travel restrictions from the depot to the customer is a maximum travel time of 30 minutes (as a substitution of the maximum distance, according to the specified service level) when there is a service downtime report.
b. Determine vehicle route and travel order of service maintenance team.

In determining the route and order of nodes (15 nodes) for the routine maintenance of the technician team, the team orienteering problem with profit and time windows model is used, with the following node sequence determination algorithm :

1. The selection of the order of visits of the team of technicians based on the highest profit insertion algorithm is starting from the Customer with the largest revenue.
2. The arrival of the technician team must be within the time window allowed by the Customer to carry out maintenance (time windows).
3. Completion of maintenance activities must not exceed the end of maintenance time allowed by the customer.
4. The team of technicians must return to the depot before the operational work ends.
5. If the arrival before the beginning of the allowable time, then the team of technicians must wait so that there is *idle time*.
6. Calculations are done for :
   - Total maintenance activity time.
   - Total revenue from each route.
   - Total *idle time.*
   - Total cost of travel.

5. Results adn Discussion
5.1 Developed Models
Problem Location Routing
Parameter

$a_{ijk} = \{ \begin{matrix} 1 \\ 0 \end{matrix}$ If route k related to facility j visits customer i ,$\forall i \in I$, , $\forall j \in J \forall k \in Pj$
          If not

pi = profit related to each customer i, $i \in I$
c_{jk} = the cost of route k associated with facility j, ,,$\forall j \in J \forall k \in P_j$
f_j = fixed costs associated with the selection of facilities j, ,$\forall j \in J$

Decision Variables

$X_j = \{ \begin{matrix} 1 \\ 0 \end{matrix}$ If the j facility is selected, $\forall j \in J$
          If not

$Y_{jk} = \{ \begin{matrix} 1 \\ 0 \end{matrix}$ If route k relates to the selected j facility, , $\forall j \in J \forall k \in P_j$
          If not

Formulation

Objective Function : *Maximize* $\sum_{i \in V} P_i \sum_{k \in K} y_{ik} - \sum_{j \in J} f_j X_j - (\sum_{j \in J} \sum_{k \in P_j} C_{jk} Y_{jk}$ (5.1)

Limitation

$\sum_{j \in J} \sum_{k \in P_j} a_{ijk} Y_{jk} = 1$ $\forall i \in I$ (5.2)
$X_j - Y_{jk} \geq 0$ $\forall j \in J \forall k \in P_j$ (5.3)
$X_j \in \{0,1\}$ $\forall j \in J$ (5.4)
$Y_{jk} \in \{0,1\}$ $\forall j \in J, \forall k \in P_j.$ (5.5)

The objective function (5.1) is the maximum profit secured from the technician's visit according to the resulting route minus travel costs and facility costs.
The limiting function (5.2) ensures that each customer *is* served precisely by one selected route.
The limiting function (5.3) ensures that facility j is separated if route k is associated with the selected j facility.

The limiting function (5.4) and (5.5) are standard limiters of binary variables.

Subproblem 1. Facility Selection Model (*Set covering problem*).
Parameter

$$\alpha_{ij} = \begin{cases} 1 & \text{If the candidate location } j\ J \in \text{can meet the demand at the point } i\ \in I \\ 0 & \text{If not} \end{cases}$$
$$f_j = \text{cost of}$$

Decision Variables:

$$X_j = \begin{cases} 1 & \text{If placing a facility in the location } j\ J \in \\ 0 & \text{If not} \end{cases}$$

With the above notation, the formulation of the set covering problem model is:

Objective function : Minimize $\sum_{j \in J} f_j X_j$ (5.6)

Subject to

$$\sum_{j \in J} a_{ijX_j} \geq 1 \text{ (5.7)} \qquad \forall i \in I \qquad (5.7)$$
$$X_j \in \{0,1 \qquad \forall j \in J \qquad (5.8)$$

Objective function (5.6) is the minimize of the total cost of the selected facility. The barrier (5.7) stipulates that each point of demend i ∈ I must be met by at least one facility. The barrier (5.8) is the integrality barrier. Furthermore, the output of the location selection result of the sub problem will be the input of subproblem 2

Subproblem 2. Vehicle Routing Model (TOPPTW).
Decision variables
   2.4 yik = binary variable, equal to 1 if *vertex i V ∈* is visited by a vehicle on route $k \in K$ and 0 if not
   2.5 xijk = binary variable, equal to 1 if path/arc $(i, j) \in A$ is traversed by the vehicle on route $k \in K$ and 0 if not.

Objective Function : Maximize $\sum_{i \in V} P_i \sum_{k \in K} y_{ik}$ (5.9)

Limitation

$$\sum_{j \in V} X_{ijk=} y_{ik} \qquad \forall\ i \in V, k \in K, \qquad (5.10)$$
$$\sum_{j \in V} X_{jik=} y_{ik} \qquad \forall\ i \in V, k \in K, \qquad (5.11)$$
$$\sum_{k \in K} y_{0k} \leq |\ K\ |, \qquad (5.12)$$
$$\sum_{k \in K} y_{ik} \leq 1 \qquad i\ \in V \setminus \{0\} \qquad , \qquad (5.13)$$
$$\sum_{(i,j) \in A\delta+(s)} X_{ijk} \geq y_{bk} \qquad \forall\ S\ \subseteq V \setminus \{0\}, b\ \in S, k\ \in K, \qquad (5.14)$$
$$x_{ijk}(w_{ik} + s_i + t_{ij} - w_{jk}) \leq 0. \qquad \forall\ k \in K, (i,j) \in N \qquad (5.15)$$
$$a_i \leq w_{ik} \leq b_i \qquad \forall\ k \in K, i\ \in N \qquad (5.16)$$
$$\sum_{(i,j) \in A} t_{ijX_{ijk}} \leq T_{max} \qquad \forall\ k \in K, \qquad (5.17)$$
$$y_{ik}\ \in \{0,1\} \qquad \forall\ i \in V, k\ \in K, \qquad (5.18)$$
$$X_{ijk}\ \in \{0,1\} \qquad \forall\ (i,j) \in A, k\ \in K \qquad (5.19)$$

The objective function of the above model (5.9) is the maximize of profits earned. The barriers (5.10) and (5.11) ensure that vertex *i* is passed by route *k*. The limiter (5.12) limits the number of routes from a maximum of | *K*|, and limiter (5.13) ensure that each customer is visited a maximum of once. Barrier (5.14) ensures that each route is connected Limiters (5.15) and (5.16) ensure a schedule that fits the time window. The limiter (5.17) limits the maximum distance from each route. The limiters (5.18) and (5.19) are standard barriers for binary variables.

5.2. Numerical Experiments and Results
Numerical Data
Numerical experiments to complete the model are performed using exact and heuristic methods.
The following is the data from the provider and customer used in numerical experiments stated in table 1, while parameters and assumptions are stated in table 2.

Table 1. Customers and depots data

No	Name	Address	Maintenance Time Windows		Profits/
			Open (*ai*)	Closed (*bi*)	Revenue (Rp)
1	Customer 54601109	Raya Nginden	8	10	3,151,300
2	Customer 5460185	Pandugo	13	15	2,820,661
3	Customer 5460260	Medokan Ayu	9	11	2,812,325
4	Customer 5460264	Panjang Jiwo	11	13	2,893,677
5	Customer 54601100	Ngagel	10	12	3,478,661
6	Customer 5460106	Dharmahusada	8	10	3,772,303
7	Customer 5460180	A Yani	12	14	2,349,770
1	Customer 5460188	Sulawesi	8	10	3,454,988
2	Customer 5460190	Sumatra	10	12	3,250,070
3	Customer 5460167	Diponegoro	9	11	3,436,005
4	Customer 5460248	Jagir Wonokromo	11	13	2,362,927
5	Customer 53601125	Bubutan	13	15	2,112,394
6	Customer 5460259	Mayjend Sungkono	8	10	2,864,797
7	Customer 54601111	Margorejo Indah	9	11	2,621,871
8	Customer 5460213	Mayjend Sungkono	12.30	14.30	2,663,078
9	Depot 1	Ketintang	-	.	-
10	Depot 2	Manyar	-	-	-
11	Depot 3	Gubang	-	-	-
12	Depot 4	Raya Darmo	-	-	-
13	Depot 5	Gayungsari	-	-	-
14	Depot 6	Raya Rungkut	-	-	-

Table 2. Parameters and Asumptions

Parameters	Values	Units
Work hour start time	07.30	AM
Work hour finish time	04.30	PM
Preparation of maintenance team	15	Minutes
Maintenance at the customer	60	Minutes
Vehicle fuel consumption	10	km/litre
Fuel price	9,200	Rp/litre
Vehicle speed	25	km/hour
Waiting cost	50,000	Rp/ hour
Overtime cost	50,000	Rp/ hour

Numerical Results
Location Problem
Based on data processing obtained 2 locations of facilities selected as depots from 6 candidates in Provider. The location of the selected depot facilities is Depot 1, namely Provider Office and Depot 2, Namely Site Operation Gubeng. Grouping of Customer clusters served by each depot is seen in figure 2.
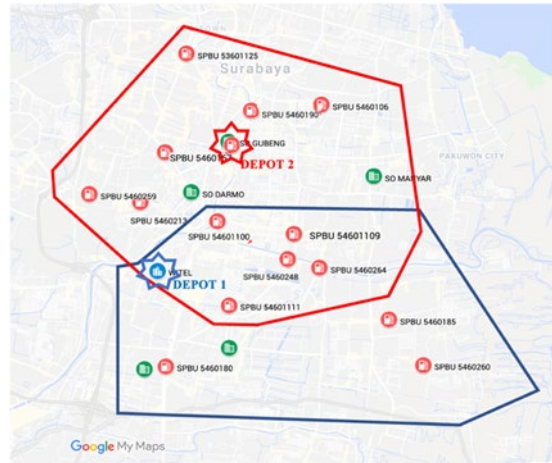
Figure 2. Graphic numerical experiments result for determine depot

There are 5 Customer locations that intersect between depot 1 and depot 2. Because of the consideration of work load balance, the determination of Customers covered by each depot according to table 3 and table 4 below.

Table 3. Customers served by depot 1

Customer Covered	Time Travel (minutes)
Customer 55601109	18
Customer 5560185	16
Customer 5560260	25
Customer 5560265	22
Customer 55601100	25
Customer 5560106	15
Customer 5560180	30
dij max	30

Maximum travel time from depot 1 to Customer (*dij max*) is 30 minutes

Table 4. Customers served by depot 2

Customer Covered	Time Trevel (minutes)
Customer 5560188	5
Customer 5560190	8
Customer 5560167	16
Customer 5560258	20
Customer 53601125	20
Customer 5560259	30
Customer 55 601111	25
Customer 5560213	25
dij max	30

The maximum travel time from depot 2 to the Customer (*dij* ma*x*) is 30 minutes.

Vehicle Routing Problem
From the results of data processing and completion using *heuristic* methods for The Team Orienteering Problem wih Profit and Time Windows model obtained 2 route groups in 1 day for depot 1 as shown in table 5.

Table 5. Order of node routes for depot 1

Route	Order of Node Routes
1	Depot
	Customer 5560106
	Customer 55601100
	Customer 5560265
	Customer 5560185
	Depot
2	Depot
	Customer 55601109
	Customer 5560260
	Customer 5560180
	Depot

As for total revenue, distance, idle time and cost can be seen in table 6.

Table 6. Total Revenue, distance, idle time and cost for depot 1

Route	Revenue (Rp)	Total Distance (km)	Idle Time (minutes)	Cost (Rp)
1	12,965,302	58,5	169	55,620
2	8,313,395	56	232	52,320
TOTAL	21,278,697	95,5	500	86,950

Travel routes from depot 2 can be seen in table 7,

Table 7. Order of node routes for depot 2

Route	Order of Node Routes
1	Depot
	Customer 5560188
	Customer 5560167
	Customer 5560190
	Customer 5560213
	Depot
2	Depot
	Customer 5560259
	Customer 55601111
	Customer 5560258
	Customer 53601125
	Depot

Total revenue, distance, idle time and cost can be seen in table 8

Table 8. Total Revenue, distance, idle time and cost for depot 2

Route	Revenue (Rp)	Total Distance (km)	Idle Time (minutes)	Cost (Rp)
1	12,518,868	56	187	52,013
2	9,961,989	52	138	57.380
TOTAL	22.380.857	97	326	89.393

6. Conclusion

From the results of data processing and analysis above, it can be concluded that for the research object of 15 Customer locations it takes 2 depots of operations technicians and maintenance, namely Depot 1 (Provider Office) which serves 7 Customers and Depot 2 (Site Operation Gubeng) to serve 8 Customers. While in determining the vehicle travel route of the maintenance technician team, it can be concluded that it must be done to break the route into 2 routes in order to meet the limit that the vehicle must return to the depot before business hours end, with the total cost for both depots is Rp. 176,333 per travel cycle. The existence of these 2 routes became the basis for Provider Management to determine the operational policy, whether the addition of the team and fleet of vehicles or maintenance scheduling the next day. The use Location and Routing Problem with set covering models and team orienteering problems with profits and time windows can solved by an exact and heuristic approach that meet the objective function and limitations, but need to be compared with other methods in anticipation for local optimum phenomena.

For the further research, this research can be extended by considering application of the model to a larger number of objects. Adding more restrictions in accordance with the actual conditions in different cases may also be required to enable the algorithm to implement.

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