SPARE PARTS DISTRIBUTION ROUTE PLANNING WITH SAVING MATRIX METHOD AT PT XYZ

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ABSTRACT

PT XYZ is a company engaged in the field of heavy equipment distributor, provider of spare parts, and service specifically for heavy equipment. Regional marketing PT XYZ has a fairly extensive market coverage throughout Indonesia. Thus, it needs an effective distribution to supply goods to the customer. One method used is the Saving Matrix.
In this study the distribution of items to be searched routes to minimize mileage. Before determining the route, the first step is to determine the capacity according to the demand of each customer. Of the request, the exact route can be determined by the capacity of transportation and the distance between the DC (Distribution Center) with the customer. The results obtained from the calculations that the route distribution of goods to all the customers there are two routes. Route 1 has route [DC Cab 1, Cab 2, 6 Cab, DC] with a total mileage of 56.2 km. While on route 2 has a route [DC, Cab 5, Cab 3, Cab 4, DC] with a total mileage of 17.2 km to the nearest neighbor method.

Keywords: *Distribution, Transportation, Saving Matrix*

1. INTRODUCTION

PT XYZ is the sole distributor heavy equipment in Indonesia. In the provision or supply spare parts to branches needed a plan that is ripe especially in distribution. Distribution is a process from supplier to delivery into the hands of a company or from the company to the customer. In the distribution of goods, the number of spare parts, shipping distance, shipping destination site conditions, and transportation equipment used greatly affect the delivery lead time. A transport model operated well distribution than a boon for companies that use the transportation system spare parts distribution, also provide good service to customers. With the distribution of spare parts transportation, the company can meet all customer needs, providing good service to customers and improve the efficiency and effectiveness of marketing the company.

Based on the above, the determination of the spare parts distribution routes using Saving Matrix the focus of assessment activities Field Work Practice in PT XYZ. The purpose of this study is to provide information about effective methods of determining the distribution route, so it can be an alternative solution in determining the distribution routes effectively and efficiently.

The purpose of this reseach is to find the route to be taken by each vehicle based on its capacity and get optimal mileage in freight saving method matrix.

2. LITERATURE REVIEW

According Pujawan (2005) in general distribution and transportation is basically deliver a product from the location where the product is produced to where the product will be used. Transportation management and distribution includes physical activity, such as sending and storing products and non-physical functions such as information processing activities and service to customers. Transport and distribution activities can be undertaken by both manufacturing and non-manufacturing firms, by forming a distribution / transport alone or handed over to third parties. Distribution management and transportation in general, perform some basic functions consist of:

1. Determining segmentation and determines the target service level.
2. Determining a transportation model to be used.
3. Consolidation and delivery information.
4. Scheduling and determining the delivery route.
5. Providing value-added services.
6. Store inventory.
7. Handle returns (return).

3. RESEACH METHOD

Steps being taken include data collection, analyze and prepare a report that the process is aided by using literature. Step by step method of saving matrix is described as follows:

1. Making distance matrix (Distance Matrix)
   In this step calculate the distance between warehouse to their each store and the distance between stores. To simplify the problem, we will use the shortest path as the distance between locations. Distance dist (A, B) in a scale between point A with coordinates (X_A, Y_A) and point B with coordinates (X_B, Y_B) is determined by a formula

$$\text{Dist}(A,B) = \sqrt{(X_A - X_B)^2 + (Y_A - Y_B)^2} \quad (1)$$

   If the real distance between the location is known, then the real distance is more used than the theoretical range is calculated using the formula above. By formula (1), will get the distance between each warehouse to store and from store to the store. The results of calculation of the distance at this stage will be used to determine the saving matrix.

2. Making savings matrix.
   Saving Matrix represents the savings due to the merger of two customers in one vehicle. The savings can be distance and time, or cost. Trip is operational sequences will visit a means of transportation. Trip of the Distribution Center (DC) Customer X is started from the Distribution Center to visit Customer X and return to the Distribution Center.

$$S(X,Y) = \text{Dist}(DC,X) + \text{Dist}(DC,Y) - \text{Dist}(X,Y) \quad (2)$$

3. Determination of routes or vehicles to customers.
   When determining the route the vehicle to the customer then a manager will seek to maximize savings. For the purposes of the iteration procedure is done so that the savings can be maximized. Initially each customer served by routes different vehicle, but the two routes can be combined into one route feasible if the total does not exceed the capacity of delivery vehicles. The first step of this iterative procedure is the merging of two routes with the highest savings into a feasible route. This procedure is carried out continuously until no longer found a feasible combination.

4. Determination of customer sequences in a single route.
   When sorting a variety of customers in a single route, a manager will try to minimize the vehicle's mileage. Changing the order delivery can have significant impact on vehicle mileage. Delivery sequences determined by determining the beginning of the route sequences which can then be used for the route repair procedure sequences with distance delivery and lower transportation costs. Several route sequencing procedures can be explained as follows.
   a. Nearest Insert
      Starting from DC, this procedure is performed by inserting a customer with the shortest distance.
   b. Nearest Neighbor
      Starting from DC, this procedure is done by adding a customer that is closest to the last customer visited to extend the trip.

The spare parts on the PT XYZ spelled out very much because of PT XYZ is the largest distributor in Indonesia to date. In the process of delivery of PT XYZ working with expedition was divided into different types of vehicles, namely land, sea and air. Each month, the demand of a branch fluctuated either by land, sea or air. This is evidenced

by the data demand branch in February-April 2012 which can be seen in Table 1.

Table 1. Demand branch in February - April 2012

NO	GOAL	FEBRUARY			MARCH			APRIL		
		SEA	AIR	LAND	SEA	AIR	LAND	SEA	AIR	LAND
1	Banjarmasin	7,182	114	-	7,908	123	-	2,782	106	2,281
2	Balikpapan	14,704	-	-	13,882	112	-	2,644	645	450
3	Pekanbaru	-	105	3,399	-	30	1,559.08	-	24	1,772
4	Surabaya	-	-	7,327	-	8	787	-	36	339
5	Bandar Lampung	-	-	-	-	164	-	-	-	2
6	Pontianak	-	40	-	93	29	-	-	28	-
7	Samarinda	4,318	9	-	4,765	44	-	411	39	1,087
8	Sorong	-	122	-	-	5	-	-	45	-
9	Senakin	-	148	-	-	22	-	-	74	-
10	Sangata	-	144	-	-	68	-	180	62	-
	TOTAL	**26,204**	**682**	**10,726**	**26,548**	**605**	**2,346.08**	**6,017**	**1,059**	**5,931**

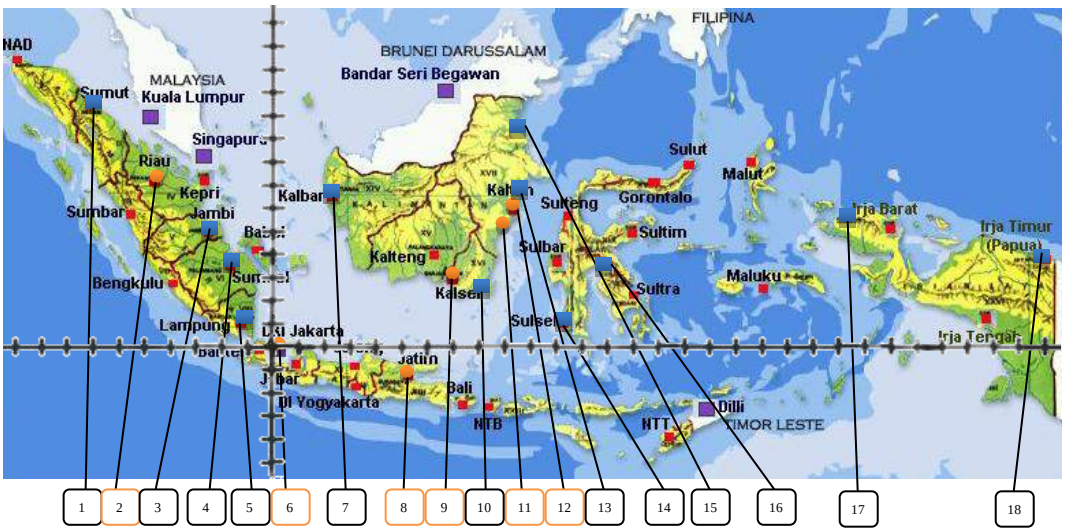

Figure 1. Branch Location of PT. XYZ

Based on the above data it can be seen that the demand for goods from the branch varies by land, sea and air. Each month the delivery of PT XYZ have delivery schedules and routes to the various branches. During the delivery process in the field, do not apply scheduling distribution routes, so any departure must be considered again how many goods, heavy goods vehicle payload capacity and delivery routes. This leads to ineffective and inefficient in the delivery time, so the system needs to be made in scheduling and determining the distribution route so that the delivery time can be run effectively and efficiently. Such conditions lead to branch subscriber or customer can receive the goods in a timely manner in accordance with the lead times specified.

4. DISCUSSION

As has been known that the main objective of the scheduling and delivery route determination is to get the optimal distance for spare parts distribution process.

In this study will be used saving matrix method for determining the route scheduling and delivery of spare parts. The first step that must be done on this method is to make a map of the location of DEPO owned by PT XYZ and branch locations as well as the site of PT XYZ as a customer of DEPO All Makes. DEPO and branch locations can be seen in Figure 1.

In Figure 1, it can be seen that the DEPO and branches of PT XYZ spread throughout Indonesia. Table 1 is a description of the cities into DEPO and branches of PT XYZ.

Table 1. DEPO and branches of PT XYZ

No	Location	No	Location	No	Location
1	Medan	7	Pontianak	13	Sangata
2	Pekanbaru	8	Surabaya	14	Ujung pandang
3	Jambi	9	Banjarmasin	15	Tarakan
4	Palembang	10	Senakin	16	Soroako
5	Bandar Lampung	11	Balikpapan	17	Sorong
6	Jakarta	12	Samarinda	18	Jayapura

Source: Result of data processing

Based on the location of DEPO PT XYZ can be specified distance from each customer location based on XY axis and the number of requests in April. In this study, the authors only take one sample at the DEPO
Jakarta. For the determination of the value of the X and Y axis of the branch locations and the rounding DEPO is a single integer (no fractions). DEPO Jakarta as the DC (Distribution Center). Coordinate data and requests from each branch and DEPO can be seen in Table 2.

Table 2. Distance DEPO and branch locations in the two-point coordinates in the XY axis

Branch	Location	Coordinates		Demand	
		X	Y	Qty (pieces)	Berat (kg)
	DC	0	0	-	-
Branch 1	Banjarmasin	7	3	19,0877	2,281
Branch 2	Balikpapan	9	6	1,210	450
Branch 3	Pekanbaru	-5	7	257,807	1,772
Branch 4	Surabaya	5	-1	10,043	339
Branch 5	Bandar Lampung	1	1	2	2
Branch 6	Samarinda	10	7	91,658	1,087

Source: Result of data processing

By using data from distance matrix distance savings can be made by combining two trips into one trip. For example, the distance between the DC (Distribution Center) to branch 1 and then back to DC and DC to branch 2 and then back to DC. Can be merged into DC to branch 1 and branch 2 and then back to DC. To manufacture this matrix saving calculation is done, the results shown in Table 3.

Table 3.Calculations Saving Matrix file of DEPO and branches

Cabang	Lokasi	1	2	3	4	5	6
Cab 1	Banjarmasin	0.0					
Cab 2	Balikpapan	14.8	0.0				
Cab 3	Pekanbaru	3.6	5.4	0.0			
Cab 4	Surabaya	8.2	7.8	2.0	0.0		
Cab 5	Bandar Lampung	2.7	2.8	1.5	2.0	0.0	
Cab 6	Samarinda	14.8	21.6	5.8	7.9	2.8	0.0

The next step is the determination of the vehicle to the branch. The purpose of the branch is the determination of the vehicle to maximize space savings. At PT XYZ, the expedition freight deliveries to limit the amount of weight 4.000 kg or 4 tons to a means of transport.

The first step of the iterative procedure is to combine the two routes with the highest savings into a feasible route. This procedure is carried out continuously until no longer found a feasible combination. For this study, as shown in Table 3, the highest savings is 21.6, which is merging branches delivery routes 2 and 6 branch. In this iterative process allows the merger because the total delivery made to branch 2 is the number of spare parts ordered were 450 kg and 6 branch number of spare parts ordered is 1.087 kg so the total sum of spare parts ordered were 450 + 1.087 = 1.537 kg, still below the allowable limit of capacity is 4.000 kg, so that the two branches can be combined in one shipment route, the first route (route 1) as shown in Table 4. Further savings are made (21.6) are ignored in the next iteration procedure.

Table 4.Calculations Saving Matrix file of DEPO and branches

Branch	Location	Route	1	2	3	4	5	6
Cab 1	Banjarmasin		0.0					
Cab 2	Balikpapan	1	14.8	0.0				
Cab 3	Pekanbaru		3.6	5.4	0.0			
Cab 4	Surabaya		8.2	7.8	2.0	0.0		
Cab 5	Bandar Lampung	1	2.7	2.8	1.5	2.0	0.0	
Cab 6	Samarinda		14.8	**21.6**	5.8	7.9	2.8	0.0
	Total		2,281	450	1,772	339	2	1,087

Source: Result of data processing

Saving the next highest is 14.8 which is the incorporation of branch 1 and branch 2. The process of merging can be done between branches 1 and 2 for total shipping 1.537 +

2.281 = 3.818 kg, still below 4.000 kg or 4 tons. In this case one branch branch will be merged in the same route with 2 branch as branch 2 has been incorporated with branches 6 and already has a route.

The process of amalgamation is carried out continuously until the combination is not found feasible and to the maximum permitted by the delivery of the expedition. Having not found a feasible combination and load capacity is excessive, then the next route will use a second vehicle routes. For route 1, the means of transportation used already carry as many as 3.818 kg (3.8 tons) of transportation capacity allowed is 4.000 kg (4 tons). To meet the capacity required transport used 4.000 kg - 3.818 kg = 182 kg more. To route a second vehicle, do the same procedure as in the first vehicle routes.

The process of adding routes done until all the existing branches have serviced all. From the calculations to determine the route for each branch and the results obtained DEPO appropriate route can be seen in Table 5.

Table 5. The results of each branch of determining the vehicle routes

Branch	Location	Route	1	2	3	4	5	6
Cab 1	Banjarmasin	1	0.0					
Cab 2	Balikpapan	1	14.8	0.0				
Cab 3	Pekanbaru	2	3.6	5.4	0.0			
Cab 4	Surabaya	2	8.2	7.8	2.0	0.0		
Cab 5	Bandar mpung	2	2.7	2.8	1.5	2.0	0.0	
Cab 6	Samarinda	1	14.8	21.6	5.8	7.9	2.8	0.0
	Total		2,281	450	1,772	339	2	1,087

For the first transportation route serving (Cab 1, Cab 2, Cab 6) can be seen in Table 6.

Table 6. Results of calculation vehicle route

Branch	Location	Route	DC	1	2	4
Cab 1	Banjarmasin	1	7.6	0.0		
Cab 2	Balikpapan	1	10.8	14.8	0.0	
Cab 6	Samarinda	1	12.2	14.8	21.6	0.0
	Total			2,281	450	339

In the second route, do the same procedure as the calculation method of Nearest Neighbor on the first route. Calculations can be seen in Table 7.

Table 7. The calculation result of vehicle 2

Branch	Location	Route	DC	3	4	5
Cab 3	Pekanbaru	2	8.6	0.0		
Cab 4	Surabaya	2	5.1	2.0	0.0	
Cab 5	Bandar Lampung	2	1.4	1.5	2.0	0.0
	Total			1,772	339	2

5. CONCLUSION

The conclusion that can be drawn from the results of the study and discussion of the problem is to increase the distribution of DEPO services to each branch to determine the appropriate delivery route. The results of the data processing is done in the company of PT XYZ known minimum distance for the distribution of spare parts on the route to-1 by having a branch route [DC Cab 1, Cab 2, 6 Cab, DC] with 56.2 total trip, because both methods produce the same total mileage for the route to-1 can use either method. For route-2 with nearest neighbor method, the route branches are [DC, Cab 5, Cab 3, Cab 4, DC] with a total mileage 10.0.

6. REFERENCES

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