Distribution Route of Cement 40's kg Package at PT.XYZ using Saving Matrix

Nur Rahmawati¹, Sinta Dewi², M. Dicky Perdana Putra³
¹,²,³ Industrial Engineering Department, Faculty of Engineering, UPN “Veteran” Jawa timur
rahamawatinur1987@gmail.com

Abstract—Determining the distribution route is one important thing that must be considered by the company to get a cheaper product selling price. PT. XYZ is a cement manufacturing company with consumers spread across several regions. Due to the large number of consumers that must be supplied, the company has problems in determining product distribution routes that can produce a low total cost of distribution. In this method, the saving matrix method is used to obtain distribution routes that can produce the minimum distribution costs. From the results of the study, four sub routes of product distribution were found with distance savings of 1176 Km.

Index Terms—About; Cement; Distribution routes; Saving matrix; Vehicle routing problem.

I. INTRODUCTION

Transportation and distribution management play an important role in logistic management [1]. Transportation and distribution costs contribute a sizeable portion to product costs [2] as well as significantly aggravating air pollution [3] and [4]. Determination of distribution routes is important because consumers want products at reasonable and competitive prices [5]. Therefore, companies that used to compete in terms of their business are now starting to switch to competition in terms of logistics [6].

PT. XYZ is a national private company engaged in the manufacturing industry that produces cement. This company was once managed by a world-class cement supplier company from Switzerland which has now been acquired most of its share by the government. PT. XYZ has several plants including the Narogong Plant, Cilacap Plant and Tuban Plant. The main consumer of PT. XYZ, namely PT. Bumi Pembangunan Pertiwi, PT. Mataram Agung, PT. Makmur Jaya Berkat Bersama and several others spread across Central and East Java. In this study, the object of research is only limited to the Tuban Plant.

The problem currently faced by the company is in terms of product distribution. The problems faced by the company are categorized as CVRP (Capacitated vehicle routing problems) problems. CVRP is development of travelling salerman problem where the transportation vehicle used has a capacity limitation [7]. To solve the problems faced, in this study the saving matrix method is used. Saving matrix is a heuristic method that is usually used to find the distribution route of a product [8]. Saving matrix has a very simple algorithm so that it is easy to apply to vrp problems. This method was chosen because this method is proven to be able to solve the CVRP problem with optimal results as has been done in previous studies.

Previous studies that have used this method include: [9] which uses the method to generate distribution routes based on the google map, in addition there are [10] and [11] which use the same method to obtain optimal distribution routes.

II. RESEARCH METHODOLOGY

The method used in this research is the saving matrix method. The saving matrix steps can be seen in the Figure 1 below [12]:

A. The assumptions used are:
1. Road conditions during delivery are considered normal and there are no traffic jams due to accidents or natural disasters.
2. Vehicles only carries single type of product.
3. The route taken is a highway route that can be accessed by 4-wheeled vehicles with
JBI class III.

B. The limitations used are:
1. The research is only applied to product that used land mode distribution.
2. The type of fleet used in the distribution of GU 40 kg cement products is a 32 ton trailer type truck with 5 axles.

Figure 1: Black and white figure
The distance matrix can be determined using the following equation:

\[ L_{1,2} = \sqrt{(X_d - X_i)^2 + (Y_d - Y_i)^2} \]  

(1)

Where: 
- \( L_{1,2} \) = Distance for location 1 to 2
- \((X_i, Y_i)\) = Original location
- \((X_d, Y_d)\) = Destination location

### III. RESULT AND DISCUSSIONS

Based on the results of calculations using equation (1), the distance matrix is obtained as in Table 1.

<table>
<thead>
<tr>
<th>Origin/Destination</th>
<th>Bojonegoro</th>
<th>Malang</th>
<th>Surabaya</th>
<th>Sidoarjo</th>
<th>Tulungagung</th>
<th>Kediri</th>
<th>Jember</th>
<th>Mojokerto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bojonegoro</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malang</td>
<td>111.3</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surabaya</td>
<td>111.7</td>
<td>237</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sidoarjo</td>
<td>109.3</td>
<td>270</td>
<td>238</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tulungagung</td>
<td>111.3</td>
<td>370</td>
<td>235</td>
<td>311</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kediri</td>
<td>111.3</td>
<td>274</td>
<td>242</td>
<td>317</td>
<td>476</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jember</td>
<td>113.3</td>
<td>331</td>
<td>237</td>
<td>290</td>
<td>282</td>
<td>273</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mojokerto</td>
<td>112.3</td>
<td>304</td>
<td>238</td>
<td>319</td>
<td>357</td>
<td>374</td>
<td>302</td>
<td>0</td>
</tr>
</tbody>
</table>

| Demand             | 62000      | 35560  | 228120   | 93.920   | 184600      | 49880  | 136440 | 48.520    |

After getting the distance matrix then using the nearest neighbor algorithm sub routes is defined. The results can be seen in Table 3 below.

<table>
<thead>
<tr>
<th>Or./Des.</th>
<th>Route</th>
<th>Bojonegoro</th>
<th>Malang</th>
<th>Surabaya</th>
<th>Sidoarjo</th>
<th>Tulungagung</th>
<th>Kediri</th>
<th>Jember</th>
<th>Mojokerto</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bojonegoro</td>
<td>1</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malang</td>
<td>2</td>
<td>111.3</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surabaya</td>
<td>3</td>
<td>111.7</td>
<td>237</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sidoarjo</td>
<td>3</td>
<td>109.3</td>
<td>270</td>
<td>238</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tulungagung</td>
<td>4</td>
<td>111.3</td>
<td>370</td>
<td>235</td>
<td>311</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kediri</td>
<td>4</td>
<td>111.3</td>
<td>274</td>
<td>242</td>
<td>317</td>
<td>476</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jember</td>
<td>2</td>
<td>113.3</td>
<td>331</td>
<td>237</td>
<td>290</td>
<td>282</td>
<td>273</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Mojokerto</td>
<td>3</td>
<td>112.3</td>
<td>304</td>
<td>238</td>
<td>319</td>
<td>357</td>
<td>374</td>
<td>302</td>
<td>0</td>
</tr>
</tbody>
</table>

| Demand     | 62000  | 35560    | 228120  | 93.920  | 184600    | 49880   | 136440 | 48520    |

Based on Tables 3 and 4, the following sub routes are obtained:

a) Route 1: Bojonegoro with a total load of 62,000 kg
b) Route 2: Malang, Jember with a total load of 172,000 kg
c) Route 3: Surabaya, Sidoarjo, Mojokerto with a total load of 370,560 kg
d) Route 5: Kediri, Tulungagung with a total load of 234,480 kg
e) The alternative route has a total distance of 1970.6 km while the actual route is 3146.6 km

### IV. CONCLUSION

Conclusions that can be drawn from the research conducted includes:

1) The resulting sub-routes are four routes from the original eight shipping routes
2) The total saving generated in this research is 1176 Km.
3) The use of transportation vehicles to be more efficient
ACKNOWLEDGMENT

The author would like to thank all those who helped in supporting the data so that this research can be realized.

REFERENCES


