

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

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**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 dan 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 salesman 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

JBK class III.

GU 40 kg cement products is a 32 ton trailer type truck with 5 axles.

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

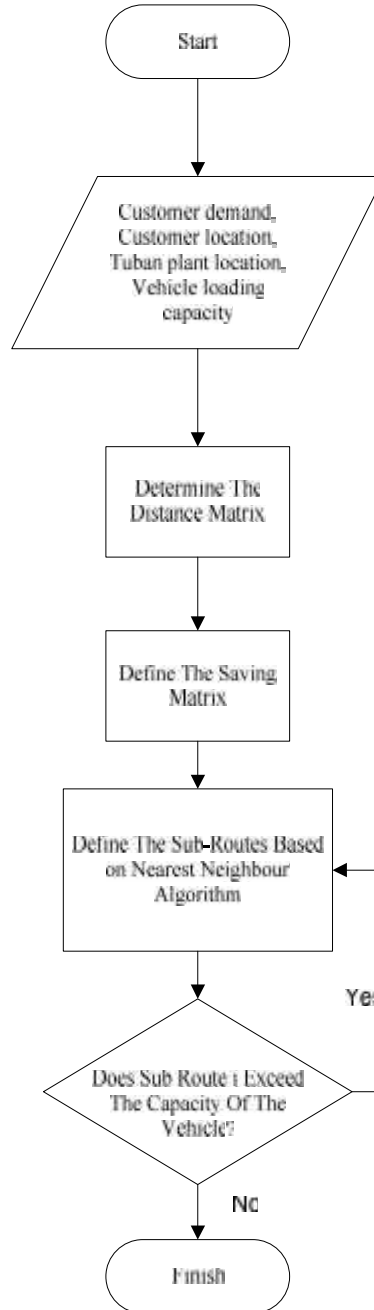


Figure 1: Black and white figure

The distance matrix can be determined using the following equation:

$$D_{1,2} = \sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2} \tag{1}$$

Where:  $D_{1,2}$  = Distance for location 1 to 2  
 $(X_1, Y_1)$  = Original location

$(X_2, Y_2)$  = 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 1. Distance Matrix

Origin/Destination	Bojonegoro	Malang	Surabaya	Sidoarjo	Tulungagung	Kediri	Jember	Mojokerto
Bojonegoro	0							
Malang	111,3	0						
Surabaya	111,7	237	0					
Sidoarjo	109,3	270	238	0				
Tulungagung	111,3	370	235	311	0			
Kediri	111,3	274	242	317	476	0		
Jember	113,3	331	237	290	282	273	0	
Mojokerto	112,3	304	238	319	357	374	302	0
Demand	62.000	35.560	228.120	93.920	184.600	49.880	136.440	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 3. Sub Route formation result (Km)

Or./Des.	Route	Bojonegoro	Malang	Surabaya	Sidoarjo	Tulungagung	Kediri	Jember	Mojokerto
Bojonegoro	1	0							
Malang	2	111,3	0						
Surabaya	3	111,7	237	0					
Sidoarjo	3	109,3	270	<b>238</b>	0				
Tulungagung	4	111,3	370	235	311	0			
Kediri	4	111,3	274	242	317	<b>476</b>	0		
Jember	2	113,3	<b>331</b>	237	290	282	273	0	
Mojokerto	3	112,3	304	<b>238</b>	319	357	374	302	0
Demand		62000	35560	228120	93920	184600	49880	136440	48520

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

- Route 1: Bojonegoro with a total load of 62,000 kg
- Route 2: Malang, Jember with a total load of 172,000 kg
- Route 3: Surabaya, Sidoarjo, Mojokerto with a total load of 370,560 kg
- Route 5: Kediri, Tulungagung with a total load of 234,480 kg
- 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:

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

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## REFERENCES

- [1] Zhang, X. X. Research on logistics distribution routing optimization based on ant colony algorithm. In *Proc. of the Sixth International Forum on Decision Sciences*, Springer, Singapore, 2020, pp. 65-78.
- [2] Nguyen, L., Moseson, A. J., Farnam, Y., and Spatari, S., Effects of composition and transportation logistics on environmental, energy and cost metrics for the production of alternative cementitious binders, *Journal of Cleaner Production*, 2018, Vol. 185, pp. 628-645.
- [3] Salehi, M., Jalalian, M., and Siar, M. M. V., Green transportation scheduling with speed control: trade-off between total transportation cost and carbon emission. *Computers and Industrial Engineering*, 2017, Vol.113, pp. 392-404.
- [4] Kaur, H., and Singh, S. P., Heuristic modeling for sustainable procurement and logistics in a supply chain using big data. *Computers and Operations Research*, 2018, Vol. 98, 301-321.
- [5] Kahraman, A., and Kazanço lu, ., Understanding consumers' purchase intentions toward natural claimed products: A qualitative research in personal care products. *Business Strategy and the Environment*, 2019, Vol. 28 Ed. 6, pp.1218-1233.
- [6] Guo, K., Research on location selection model of distribution network with constrained line constraints based on genetic algorithm. *Neural Computing and Applications*, 2020, Vol. 32 Ed. 6, 1679-1689.
- [7] Heryanto, R., and Steephani, Y., Determination of Distribution Route using Linear Programming Model (Case Study at Washing Jeans Company). In *2019 Ist International Conference on Engineering and Management in Industrial System (ICOEMIS 2019)*, Atlantis Press., Nov. 2019, pp. 253-259.
- [8] Nurprihatin, F., Octa, A., Regina, T., Wijaya, T., Luin, J., and Tannady, H., The extension analysis of natural gas network location-routing design through the feasibility study. *Journal of applied research on industrial engineering*, 2019, Vol. 6 Ed. 2, pp. 108-124.
- [9] Pattiasina, T. J., Setyoadi, E. T., and Wijayanto, D., "Saving matrix method for efficient distribution route based on google maps API" *Journal of Telecommunication, Electronic and Computer Engineering (JTEC)*, 2018, Vol. 10 Ed. 2-3, pp. 183-188
- [10] Rizkya, I., Matondang, N., Yahya, M. D., and Ningsih, M. S., Design of Distribution Routes Using Saving Matrix Method to Minimize Transportation Cost, In *2019 International Conference on Sustainable Engineering and Creative Computing (ICSECC)*, Aug. 2019, pp. 48-51, IEEE.
- [11] Rosanti, A. A., Sutopo, W., and Hisjam, M., Implementation of saving matrix to determine distribution route of Kalog Express Surakarta. In *IOP Conference Series: Materials Science and Engineering*, Apr. 2019, Vol. 495 Ed. 1, pp. 012025). IOP Publishing.
- [12] Perdana, V. A., Hunusalela, Z. F., and Prasasty, A. T., Application of Saving Matrix and Nearest Neighbor to get the distribution route to achieve minimal transportation cost at PT. XYZ. *JATI UNIK: Jurnal Ilmiah Teknik dan Manajemen Industri*, 2020, Vol. 4 Ed.1, pp. 62-77.