A STUDY OF GARBAGE TRUCK BY HEURISTIC APPROACH IN NANGLAE DISTRICT, CHIANG RAI PROVINCE

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Abstract

This independent study presents a study of garbage truck routing by "Heuristic saving matrix" approach. The aim of this study is to develop efficient garbage truck routing in Nang lae district, Chiang Rai province by using Bing map analysis. The study show that costs, distances, and time of the present garbage truck routing is over much by comparing to heuristic saving matrix approach. The key variables involve number of vehicles, capacity of vehicle, amount of garbage, the distance between nodes, costs, and time. The result reveals that the routes are decreased from 10 to 6 (40% decrease), the number of vehicles are decreased from 10 to 6 (40% decrease), amount of employees are decreased from 20 to 12 (60% decrease), the total distance is decreased from 132 to 99 km.(25% decrease), the cost of fuel per trip is decreased from 249 to 182 baths(22% decrease), and the total cycle time is decreased from 244 to 170 minutes (25% decrease); in conclusion, the logistics costs of heuristic saving matrix approach's garbage truck routing are reduced. Otherwise, the efficiency of garbage truck routing is increased.

Keywords: heuristic, saving matrix, garbage truck, Logistics cost

Introduction

This study proposes a cost-saving method of managing a fleet of garbage trucks in Nang Lae district, Chiang Rai province. The study explores the underutilized garbage collection capacity of the garbage trucks on the existing "sub-efficient" routing and then applies "Heuristic saving matrix" approach to develop a more efficient garbage truck routes. The study utilizes satellite images map from Bing map to obtain the routing data to closely mimic the real world's usage.

The key variables include 1) number of vehicles, 2) capacity of vehicle, 3) amount of garbage, 4) the distance between nodes, 5) costs, and 5) time spent on each route.

Methodology

Sampling site

The study is Quantitative Research. The sample of study is Nang lae district, Chiang Rai province and populations are muban (village) 2, 3, 4, 5, 6, 9, 10, 12, 13 and 15

Data analysis

This study used saving equation to solve vehicle routing problem which is

$$S(x,y) = Dist(DC,x) + Dist(DC,y) - Dist(x,y)$$

1. Analyze primary information involve costs of transportation, time, distance, garbage volume, and also vehicle's capacity.
2. Create distance matrix table.
3. Used saving equation to find the lowest saving link(s_{ij}).
4. Find a lower saving link in the saving matrix until all links are adding in routing.
    a. If a total volume of garbage in the link is capacity overload, then assort another lower link.
    b. If a total volume of garbage in the link is not overload, then add new another route in a trip.
5. Create saving routing
6. Compared actual routing and saving routing to conclusion.

Table 1 Garbage volume

Node	Volume
Incinerator	-
2	900
3	5,200
4	2,752
5	2,129
6	1,613
9	2,200
10	4,200
12	2,200
13	6,920
15	2,500

Table 2 Distance Matrix

Node	Incinerator	2	3	4	5	6	9	10	12	13	15
2	3.7	-	1.8	3.8	3	5.5	0.9	7.4	6.4	1.6	4.4
3	3.2	1.8	-	3.6	1.3	4	3.3	5.8	4.7	1	4.2
4	6.6	3.8	3.6	-	3.4	1.2	3.6	8	3.5	4	2.2
5	6.2	3	1.3	3.4	-	3.3	5.3	5	4	3.3	6.3
6	7.5	5.5	4	1.2	3.3	-	4.4	5.6	2.2	4.6	3.1
9	5.6	0.9	3.3	3.6	5.3	4.4	-	8.3	7.7	2.2	4.2
10	11.1	7.4	5.8	8	5	5.6	8.3	-	3.4	6.7	8.8
12	7.1	6.4	4.7	3.5	4	2.2	7.7	3.4	-	3.9	6.1
13	3.9	1.6	1	4	3.3	4.6	2.2	6.7	3.9	-	4.9
15	7.3	4.4	4.2	2.2	6.3	3.1	4.2	8.8	6.1	4.9	-

Results

Table 3 Saving Mtrix

Node	2	3	4	5	6	9	10	12	13	15
2	0									
3	5.1	0								
4	6.5	6.2	0							
5	6.9	8.1	9.4	0						
6	5.7	6.7	12.9	10.4	0					
9	8.4	5.5	8.6	6.5	8.7	0				
10	7.4	8.5	9.7	12.3	13	8.4	0			
12	4.4	5.6	10.2	9.3	12.4	5	14.8	0		
13	6	6.1	6.5	6.8	6.8	7.3	8.3	5.1	0	
15	6.6	6.3	11.7	7.2	11.7	8.7	9.6	3.9	6.3	0

Table 4 Saving routing

Route	Distance (kms.)	Capacity	Utilization (%)	Cost (baths.)		Time (mins.)
				Fuel	labour	
10-12-0-10	21.6	2,000	100	43	600	41
4-6-0-4	15.3	1,455	72.75	31	600	28
9-15-0-9	17.1	1,567	78.33	34	600	31
3-5-0-3	10.7	2,000	100	21	600	21
2-13-0-2	9.2	2,000	100	18	600	18
2-3-5-10-12-13-0-2	21.6	1,183	59.15	34	600	43
Total	**99.2**	**10,205**		**194**	**3,600**	**182**

Table 5. Comparison routing

	Route	Garbage truck	Wages (baths)	Distance (kms.)	Fuel cost (baths)	Time (min.)	Depreciation (kms./baths)
Actual	10	10	6,000	132.2	249	244	0.34
New	6	6	3,600	99.2	194	182	0.26
Trip Saving	4	4	2,400	33	55	62	0.08
Month Saving	-	-	7,200	99	201	186	0.23

Conclusion

The study of garbage truck routing by "Heuristic saving matrix" approach is resulted as the logistic costs reduction developing plan which is as same as the result of the study on Heuristic transportation desire (Chomlaall, 2006) and the study of heuristic transportation decision (Sommut, 2008). The result from "Heuristic saving matrix" approach yields that the number of routes are reduced from 10 to 6 (40% decrease), the number of vehicles are reduced from 10 to 6 (40% decrease), amount of employees are decreased from 20 to 12 (60% decrease), the total distance is decreased from 132 to 99 km.(25% decrease), the cost of fuel per trip is decreased from 249 to 182 baths(22% decrease), and the total cycle time is decreased from 244 to 170 minutes (25% decrease). In conclusion, the logistics costs of heuristic saving matrix approach's garbage truck routing are substantially reduced. And the efficiency of garbage truck routing increases.

Limitations

1. The distance –variation is direct influences to garbage collect cost.
2. If the tour distances have decreased, the time is decreasing as well.
3. The time in each links is constant.
4. In the end, tour garbage truck must return to started node.

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