Vehicle Routing for Delivery of Employee Aapico Hitech Public Company Case Study : Rawisara Express Co.,Ltd.

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Abstract

This research aimed to study the vehicle routing for being efficient and cost effective by using the Capacitated Vehicle Routing Problem (CVRP). Case study was a delivery of Aapico Hitech (PLC) employee, serviced by Rawisara Express Co. Ltd. The comparative study was two routes, designated as Ayutthaya 1 and Ayutthaya 2 which were the new route and current route. Kind of secondary data on the route was obtained from Rawisara Express which compiled from delivery documents, interviewing in-charge administrator, as well as online road map of Thailand used.

Result showed that the network analysis by using CVRP model the new route (Ayutthaya 1) proposed was better than the current route (Ayutthaya 2). As distances between vehicle routing for delivery of employee of Ayutthaya 1 and Ayutthaya 2 route was reduced by 3.8 and 0.25 kilometer. Therefore, monthly expenses decreased for 1,549.83 and 101.96 Baht, and travel time saving was 19 min and 2.2 min, respectively.

Keywords : Capacitated Vehicle Routing Problem, Transportation

1. INTRODUCTION

The bidding process for the transportation service of employees. Each year found that there are bus operators to pick up other employees more tenders for bidding causing the high competition. Especially, the increasing number of new shuttle service. In addition, operators also face to the problem of deterioration factors, driver wage and fluctuations of oil price. Therefore, we are interested to study about the planning of the route to arrange transportation routes for employees for more efficient in order to cost effective to maximize the benefits of both the employer and passenger transportation business.

2. PROROSED SYSTEM

Network analysis is planning quantitative analysis and provide efficient of structure system with analyzing the problem of network such as transportation system and communication, planning about road network large-scale project. [1]

Network- is a diagram including node and edges which every edges has been configured is called “Flow”.

Node- is each point in the network such as road intersection point, picking-up place point, etc.

Edges- is a connect a node which lies in the first note to another node.

Flow- is the weight that is assigned to edges for network as cost of operation, weight or quantity of the products, etc.

The Capacitated Vehicle Routing Problem has been widely used in transportation problems area to logistics and supply chain management. Hence, we try to implement

Capacitated Vehicle Routing Problem (CVRP) Model on vehicle routing for delivery of employee Aapico Hitech (PLC) of Rawisara Express Co., Ltd. Based on vehicle routing for delivery of employee 6 routes includes Ayutthaya 1, Ayutthaya 2, Rangsit, Navaakorn, Bansang and Rojana routes.

Capacitated Vehicle Routing Problem (CVRP) is a problem of finding the shortest path of freight route. In case, multiple cars with the maximum weight limits of each vehicle which uses the same principle as Vehicle Routing Problem (VRP) which constant demand on each node. For each itinerary, the truck must be carried the total cargo does not exceed to the maximum filling weight with truck having same maximum payload and aware exact numbers of k trucks.

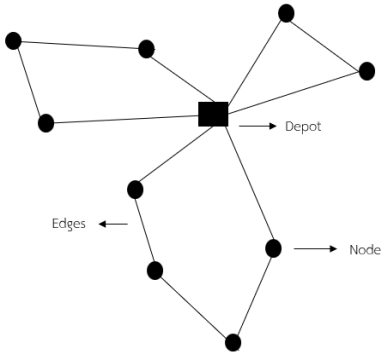


Figure 1. Routing pattern Vehicle Routing Problem (VRP)

3. METHODOLOGY

The various stages that were implemented are given below :

1) Data Collection
2) Analysis
3) Results

3.1 Data Collection

The first step is to collect data. A study the vehicle routing for delivery of employee Aapico Hitech (PLC). Our data set is delivery documents form which is taken from system administrator interview about how to routing solution design, conditional and limitations of various as follows:

Vehicle routing for delivery of employee Aapico Hitech (PLC) has 6 routes includes Ayutthaya 1, Ayutthaya 2, Rangsit, Navaakorn, Bansang and Rojana routes.

Expense estimating provided by Oil prices, Driver Salaries, Car tax, Insurance fee, ACT fees, Car depreciation and Parking Fee which is calculated as follows:

Oil prices per month of each bus.

$$\frac{\text{Distances} \times \text{Oil prices per liter}}{\text{Distance running (Km./liter)}} \times \text{number of days}$$

In this research from diesel prices 29 December 2017 which prices is equal to 27.19 bath per liter and interviewing in-charge administrator that 1 liter of oil, bus is running about 2 kilometer.

Driver for a fixed monthly salary 12,000 bath.

Car tax 4,350 bath/vehicle/year, to calculated equal 362.5 bath/vehicle/month.

Insurance fee 15,000 bath/ vehicle/ year, to calculated equal 1,250 bath/ vehicle/ month.

ACT fees 8,079 bath/vehicle/year, to calculated on a monthly is equal 673.25 bath/ vehicle.

Car depreciation includes tire changes, drain engine oil, maintenance fee which calculated on a monthly is equal 2,750 bath/vehicle.

Parking Fee since bus has different for parking point then the cost varies as follows:

Ayutthaya 1 and Ayutthaya 2 routes use parking spot at Atipattour Co., Ltd. Therefore, there is no charge.

Rangsit route for monthly rate for rental of parking space 1,300 bath/vehicle.

Navaakorn route for monthly rate for rental of parking space 1,000 bath/vehicle.

Bansang and Rojana routes has been parking with home of driver. Therefore, there is no charge.

Distances of travel time for vehicle routing for delivery of employee Aapico Hitech (PLC) within new routes and current routes which is calculated distances of average travel time in online road map of Thailand from 2 April 2018 to 7 April 2018 at 6.40 am.

3.2 Analysis

Evaluation vehicle of Rawisara Express Co., Ltd. which company that has been bidding for vehicle routing for delivery of employee service for Aapico Hitech (PLC). According the present road found that:

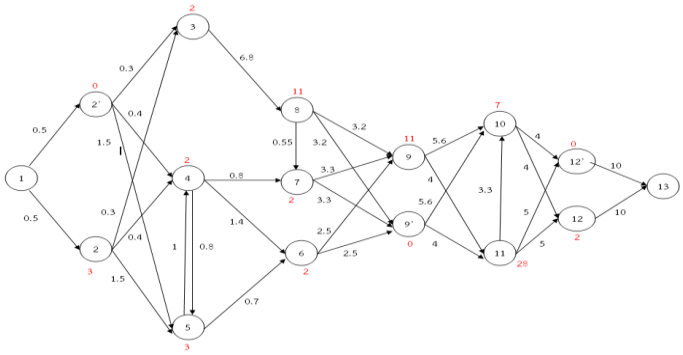
Rangsit and Navaakorn routes was unable to transfer as Phahonyothin Road on the main road and all employee drop off points. So, both routes are suitable.

Bansang route has all employee drop off points on Rojana Road and national highway 3056 on the main roads then cannot make any adjustments. Therefore, it is suitable route.

Rojana route has national highway 3056 better than Asian Highway 1 but this road is a route that U-turn. Therefore, it difficult to drive, Due to the large shuttle buses and when regard to safety using national highway 3056 to reduce the travel distance then not have the appropriate.

Ayutthaya 1 and Ayutthaya 2 routes has multiple pick up points near each other. Ayutthaya 1 is cover their original route and there is more distance than necessary then alternate route shall be considered. Therefore, the concept of network analysis was used to improvement the routes for the employees in these both routes.

From employee transportation Ayutthaya 1, Ayutthaya 2 routes which 2 buses to build network as the shown figure 1:



Note : Numbers (red) that is above the node and the path between nodes are manpower and distance

Figure 2. Network of employee transportation Ayutthaya 1, Ayutthaya 2 routes and all drop off points

The integer linear programming model of the CVRP formulation:

$$\text{Minimize } Z = \sum_{k=1}^{2}\sum_{i=1}^{n}\sum_{j=1}^{n} C_{ij}X_{ijk} \quad \text{---(1)}$$

Conditional equation

$$\sum_{i=1}^{12}\sum_{k=1}^{2} X_{ijk} = 1 \quad \forall_j \in \{2,3,\dots,12\} \quad \text{---(2)}$$

$$\sum_{j=1}^{12}\sum_{k=1}^{2} X_{ijk} = 1 \quad \forall_i \in \{2,3,\dots,12\} \quad \text{---(3)}$$

$$\sum_{i=1}^{12} X_{ijk} - \sum_{i=1}^{12} X_{jik} = 0 \qquad \forall j,k \qquad \text{---(4)}$$

$$\sum_{i=1}^{12} q_i \left(\sum_{j=1}^{12} X_{ijk}\right) \le Q_k \quad \forall_k \in \{1,2\} \qquad \text{---(5)}$$

$$\sum_{j=2}^{12} X_{1jk} = 1 \qquad \forall_k \in \{1,2\} \qquad \text{---(6)}$$

$$\sum_{i=2}^{12} X_{i13k} = 1 \qquad \forall_k \in \{1,2\} \qquad \text{---(7)}$$

$$X_{ijk} \in \{0,1\} \qquad \forall\, i,j,k \qquad \text{---(8)}$$

The objective function (1) minimizes the total travel cost. The model constraints (2) and (3) are the degree constraints and except starting node (node 1) and end node (node 13) each bus travel into each note and only be issued to a single node at a time. The flow constraints (4) the number of the vehicles arriving at every customer and entering drop off point is equal to the number of the vehicles leaving. In the constraints (5) the capacity constraints are each bus the sum of the demands of load in a route is less than the number of seats (Not exceed 45 seats). The constraints (6) and (7) show that each bus leave starting node (node 1) and enter end note (node 13) is Aapico Hitech (PLC). The remaining obligatory constraints (8) specify the definition the only possible values are 0 and 1.

Results for Ayutthaya 1 and Ayutthaya 2 routes of Aapico Hitech (PLC) using following formula previous with MATLAB shown on the network in Figure 3.

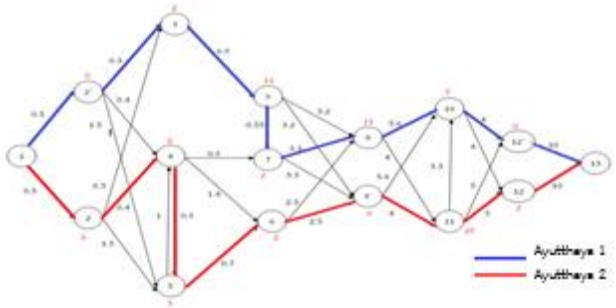


Figure 3. Vehicle routing for delivery of employee Ayutthaya 1 and Ayutthaya 2 routes

3.3 Results

Table 1. Comparison results using CVRP

List	Ayutthaya 1 route		Results	Ayutthaya 2 route		Results
	Current route	New route		Current route	New route	
Distance (km.)	34.85	31.05	3.8	24.15	23.9	0.25
Time	1 h 10 m.	51 m.	19 m.	45 m.	42.8 m.	2.2 m.
Oil prices (bath)	14,213.57	12,663.74	1,549.83	9,849.58	9,747.62	101.96

Thus, from table 1, we can observe comparison results of Ayutthaya 1 and Ayutthaya 2 routes as follows:

As Ayutthaya 1 route has been reduced by 3.8 kilometer by changing the route from the original Soi. Chikun, U Thong Road, Pa Thon Road, Rojana Road and Asian Highway 1 to U Thong Road, Rojana Road, National highway 3477, Bang Pa-in– Ayutthaya and Asian Highway 1. Ayutthaya 2 route has been reduced by 0.25 kilometer. However, for Ayutthaya 2 slight reduction distance from the original Soi. Chikun, Pa Thon Road, Bang lan Road, Ho Rattanachai Road, Naresuan Road, U Thong Road to Soi. Chikun, Bang lan Road, Khlong Makham Liang Road and After that travel along the same route. From estimating expenses that according to distances of travel, therefore monthly expenses decreased 1,549.83 and 101.96 Bath respectively. And to calculated average travel time in online road map of Thailand from 2 April 2018 to 7 April 2018 at 6.40 am. found that this new route distances of travel time saving was 19 min. and 2.2 min. respectively as Ayutthaya 2 route distances of the original and new route are very little difference.

4.CONCLUSIONS

According to our previous discussion, we attend to the present analysis in routing optimization using network analysis with Capacitated Vehicle Routing Problem (CVRP) to develop a vehicle routing system of reduced travel distance which will least expense and saving time.

5. ACKNOWLEDGMENTS

For large vehicle routing problems this method is not suitable then consists of multiple nodes or problems that transfer points to a frequent when there is a change or create a new point will to do a new network. Hence this waste of time and caused an error.

6. REFERENCES

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