



## **On Transportation Performance Measurement for Truck Route Selection: the Econo-Logistics Perspective**

**Apichat Sopadang<sup>1</sup>, Sermkiat Jomjunyong<sup>1</sup>, Salinee Santiteerakul<sup>1</sup>,  
Sakgasem Ramingwong<sup>2\*</sup>**

<sup>1</sup>Department of Industrial Engineering, Faculty of Engineering, Chiang Mai University

<sup>2\*</sup>Faculty of Engineering, Chiang Mai University

<sup>2\*</sup>Email sakgasem@eng.cmu.ac.th, Tel: 66-53-944125, Fax: 66-53-944185

### **ABSTRACT**

Thai government is studying on developing the truck route to cut the logistics cost. From 41 potential routes across the countries, only 5 routes were selected as for the final selection. The deeper consideration using Transportation Performance Measurement Model (TPMM) with 5 criteria of econo-logistics, including 1) operation efficiency, 2) accessibility, 3) mobility, 4) quality of life and 5) environmental impact, are used in order to reflect and evaluate the potential benefit of the truck route development. The result revealed that route Phetchaburi, ie, TR5 of the consideration is the most beneficial route where it can save cost at the highest rate, increase speed, improve quality of life and produce the least environmental impact among peers. The result is suggestive that this route should be selected as for the development of Thai truck route pilot project.

**Key Words:** truck route, transportation performance measurement

### **1. INTRODUCTION**

In Thailand, more than 84% of commodities are moved from point to point within its supply chain via road transportation. In Thailand in year 2006, more than 425 million tons of goods were transport via the route. The utilization rate is already high and is still growing with an average rate of 1.28%. The reason why this mode has been used extensively is because of its accessibility from the supply to the demand due to the well-connected road network, covering all area. The comparatively small unit load also makes delivery possible in many diverse places. Today, more than 51,777 km of road is providing such mass transportation. From the statistical dated year 2005, more than 675,000 transportation trucks are registered in Thailand ranged from 6 wheelers to 22 wheelers. [1]

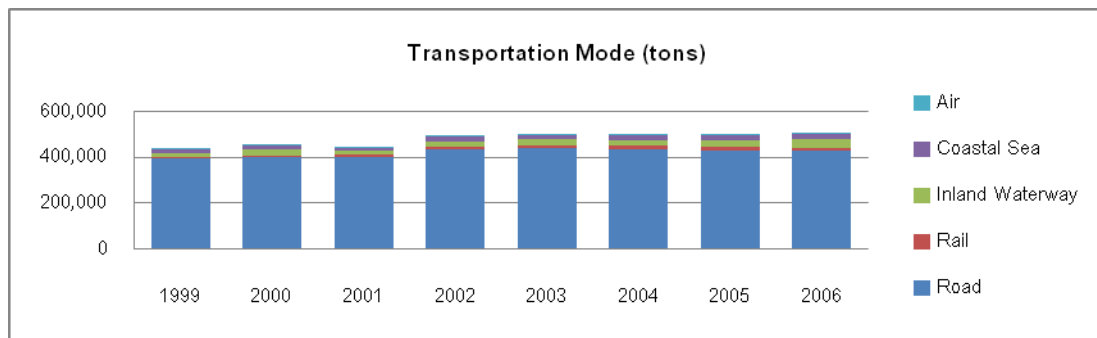


Figure 1: Transportation Mode Share in Thailand

Source: Ministry of Transportation

However, the road mode is logistically considered expensive due to its relatively-high fuel consumption, if compared to rail or water related mode. The emission is also high and therefore considered environmental-unfriendly. Yet the truck transportation is still favorable from the business and supply chain perspective where other modes in Thailand are still not quite ready for the full utilization.

## 2. TRUCK ROUTE CONCEPT

As discussed, It therefore require a management of the road transportation as well as its facilities. Good management can result in better efficiency of the movement and therefore increase the competitiveness of the business and supply chain where they can compete with other multi-national, low-cost firms. One of the initiatives by Thai government is the development of "Truck Route" where truckers can travel more efficiently, resulting in better logistics efficiency. The concept is today as simple as to split the normal highway into passenger lanes and truck lanes where trucks and passenger cars can travel independently to each others. In addition, truck management including IT implementation and developing facilities are of interest where it can minimize stops and inspections due to transportation regulations. Therefore, the direct expected benefits of the truck route or truck lane are that trucks can travel more efficiently with lower fuel consumption due to lesser formality stops and freedom of travel with zero passenger cars in truck lanes. The lesser emission rate is also expected where the trucks can travel with smoother speed with quicker and lesser stops. Also, other indirect impacts are expectable including the better quality of life for local communities along the route as well as travelers on the route. Lesser car and pedestrian accidents are also expected to decrease so. In addition, the consideration of adopting the concept of B-triple and B-double is feasible where fuel consumption and emission can reduced into more than half. [2]

However, prior to the truck route development, the study must be conducted first. The study includes design of truck route, impact assessment, economic assessment, management and IT for truck route, etc. Whereas the route selection is among the top criteria bywhich an appropriated section of development can be identified. Of interest of the paper is the selection of



the route where 41 potential routes across the country must be screened and therefore a suitable route are identified.

Truck route model was developed based on related literatures focusing on freight modeling as well as National Model of Transport Data and Model Center by the Office of Transport and Traffic Policy and Planning. The development was based on the macro-scale model. Output of the model was not only the scenarios and their reflection, if there is and there is no truck route, but also the prediction on the supply and demand driven by the supply chain expansion due to truck route development. The current situation was monitored as well as the forecasting within the next 20 year. Among the indicators generated by the model, eg, car-flow, freight, truck, capacity, travel time, speed, volume per capacity, freight cost, etc, only selected indicators are used for the economic consideration. The of-interest indicators are to be discussed in section 4. (It shall be highlighted here that the model and its result generation are not the key focus of this paper.)

### 3. TRUCK ROUTE PRELIMINARY SELECTION

Upon 41 available routes/ sections across Thai highway, only 5 routes are preliminarily selected based on regional logistics demands, current trade and transportation statistics, environmental feasibility as well as engineering feasibility. Here, it shall be noted that 1) the selection of 5 routes is based on 5 regions in Thailand and 2) the preliminary selection is not of interest of the paper but its result, ie, 5 potential truck route candidates.

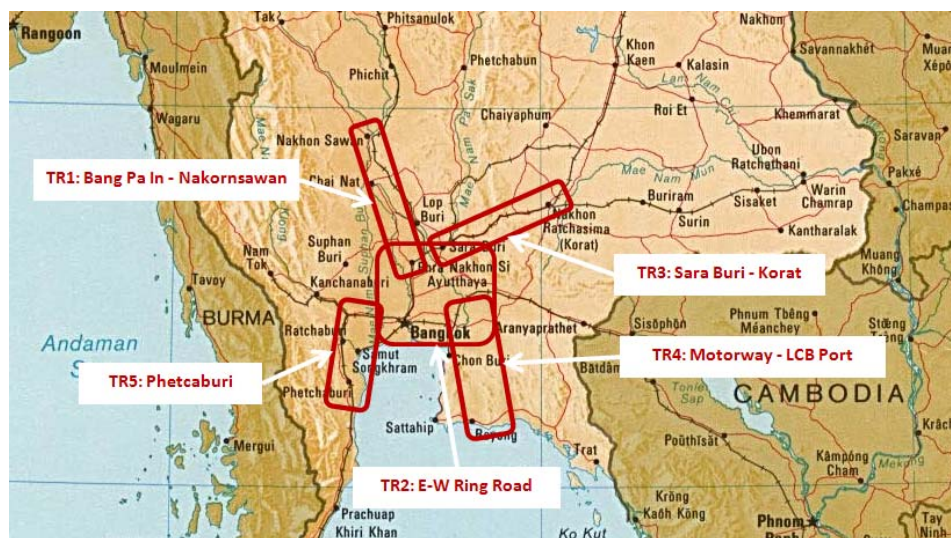


Figure 2: Truck Route Candidates

The selection was concluded where 5 routes are nominated and shown in Figure 2. Their details are also shown in Table 1.



Table 1: Truck Route Candidates

Section	Route Code	Description	Distance (km)
Northern Thailand	TR1	Bang Pa In-Nakornsawan	500
Central Thailand	TR2	East-West Ring Road	382
North-Eastern Thailand	TR3	Sara Buri-Korat	480
Eastern Thailand	TR4	Motorway-Lam Cha Bang Port	240
Southern Thailand	TR5	Phetchaburi	244

#### 4. ECONO-LOGISTICS EVALUATION USING TRANSPORTATION PERFORMANCE MEASUREMENT MODEL (TPMM)

Of interests are the impact of the truck route development to the macro- and micro-economics system and to the logistics system of Thailand. As one of the benefits of truck route development is the econo-logistics efficiency, it is expected to be increased due to the assumption discussed earlier. Therefore, in order to evaluate the benefits of truck route development on the econo-logistics perspectives, the factor of interest must be defined first. Here, 5 criteria are of interest, ie, 1) operation efficiency, 2) accessibility, 3) mobility, 4) quality of life and 5) environmental impact. Here, the model, named Transportation Performance Measurement Model (TPMM), is illustrated in Figure 3.

Each criterion are evaluated using performance indicators taken from the model indicating the status with 25-year prediction, comparing in case of “AS IS” and “if there is truck route” developed.

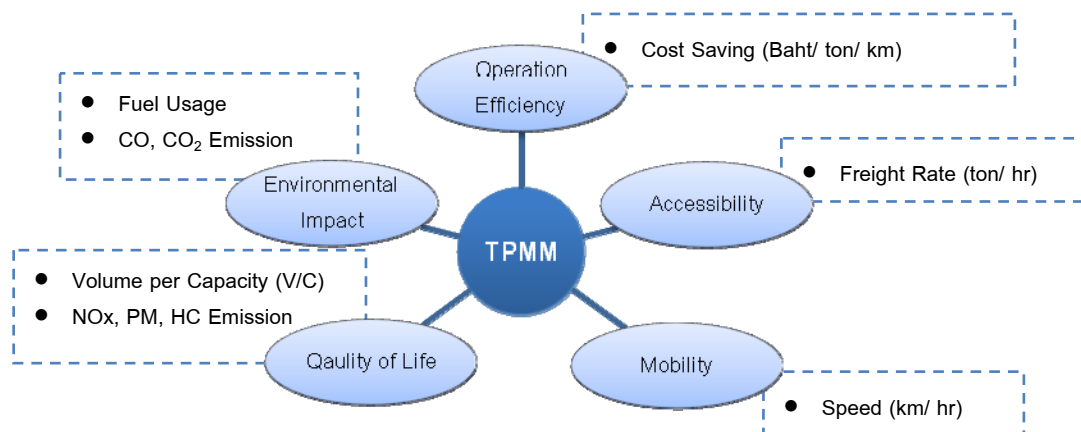


Figure 3: Transportation Performance Measurement Model (TPMM)

Criterion 1, ie, “Operation Efficiency” is determined using cost saving in a unit of Baht/ ton/ km. It shall indicate the econo-logistics efficiency where the truck route is developed and the saving are to be met. Criterion 2, ie, “Accessibility” is determined using freight rate in a unit of ton/ hr where it is assumed that truck route might attract more utilization as well as promoting the supply chain efficiency. Criterion 3, ie, “Mobility” is determined using speed in a unit of km/ hr indicating the



better mobility due to truck route development. Therefore, expected freight rate and speed can be compared if with or without truck route.

Criterion 4, ie, "Quality of Life", is determined using 1) volume per capacity (V/C) and 2) NO<sub>x</sub>, PM, HC emission. Criterion 5, ie, "Environmental Impact" is determined using 1) fuel usage and 2) CO, CO<sub>2</sub> emission. As the assumptions were priorly made, should the truck route increase the quality of life and minimize environmental impact. The following result presentation is then to confirm the assumption and to determine if which route is more suitable than others. Then it can be selected for further consideration for the development.

## 5. RESULT PRESENTATION

The following section is to demonstrate the consideration on the of-interest criteria. However, due to the extensive information used for the evaluation, only one criterion are shown here in the paper, bywhich Criterion 1 is selected. Table 2 and 3 demonstrates the consideration in Criterion 1: Operation Efficiency for 5 truck route candidates. As the "Cost Saving" is of interest, the comparison on freight cost is made as priorly.

Table 2: Freight Cost Comparison on 5 Truck Route Candidates

Year	Freight Cost (Baht/ ton/ km)									
	TR1		TR2		TR3		TR4		TR5	
	AS IS	Truck Route	AS IS	Truck Route	AS IS	Truck Route	AS IS	Truck Route	AS IS	Truck Route
2007	4.76	4.76	2.89	2.89	6.17	6.17	7.00	7.00	4.21	4.21
2012	4.94	4.21	2.94	2.41	5.97	4.97	7.48	6.37	4.48	3.20
2017	5.10	4.42	2.68	2.27	6.29	5.24	8.13	6.93	4.86	3.42
2022	5.29	4.61	2.89	2.45	6.60	5.49	8.78	7.50	5.25	3.65
<b>Average</b>	<b>5.02</b>	<b>4.50</b>	<b>2.85</b>	<b>2.51</b>	<b>6.26</b>	<b>5.47</b>	<b>7.85</b>	<b>6.95</b>	<b>4.70</b>	<b>3.62</b>

Table 3: Cost Saving Comparison on 5 Truck Route Candidates

Route	Freight Cost (Baht/ ton/ km)		Cost Saving (Baht/ ton/ km)	% Cost Saving	Score* (max 100)
	AS IS	Truck Route			
TR1	5.02	4.50	0.52	10%	<b>30.09</b>
TR2	2.85	2.51	0.34	12%	<b>19.90</b>
TR3	6.26	5.47	0.79	13%	<b>45.72</b>
TR4	7.85	6.95	0.90	11%	<b>52.15</b>
TR5	4.70	3.62	1.08	22%	<b>62.36</b>

Note: \* Score determined using Vector Normalization, ie,  $f_i = \frac{W_i}{\sqrt{\sum W_i^2}}$



Here, upon the investigation on this demonstration perspective, it can be seen that TR5, ie, Phetchaburi route possesses the highest benefit on cost saving. The saving of 1.08 Baht/ ton/ km or 22% are dominant and therefore results in the highest score, using vector normalization at 62.36 out of 100. TR2, ie, East-West Ring Road, on the other hand gains the lowest score due to lowest saving.

Such consideration is completed with other 4 perspectives and therefore the benchmarking can be proceeded. Here, upon the discussion with stakeholders and experts, the weight of each criterion are determined, giving operation efficiency at 25%, accessibility at 25%, mobility at 20%, quality of life at 20% and environmental impact at 10%. The simple Additive Weighting was therefore used in order to convert the score and weight into a total-score-of-100 consideration as follow.

Table 4: Summary of the Evaluation

Route	Operation Efficiency (max 25)	Accessibility (max 25)	Mobility (max 20)	Quality of Life (max 20)	Environmental Impact (max 10)	Total (100)
TR1	7.52	11.00	8.67	4.39	1.88	33.46
TR2	4.97	11.16	8.75	8.92	4.56	38.37
TR3	11.43	11.30	8.79	6.44	2.50	40.46
TR4	13.04	11.38	8.65	7.12	3.17	43.36
TR5	15.59	11.06	9.81	13.75	7.66	57.87

Note: Score determined using Simple Additive Weighting.

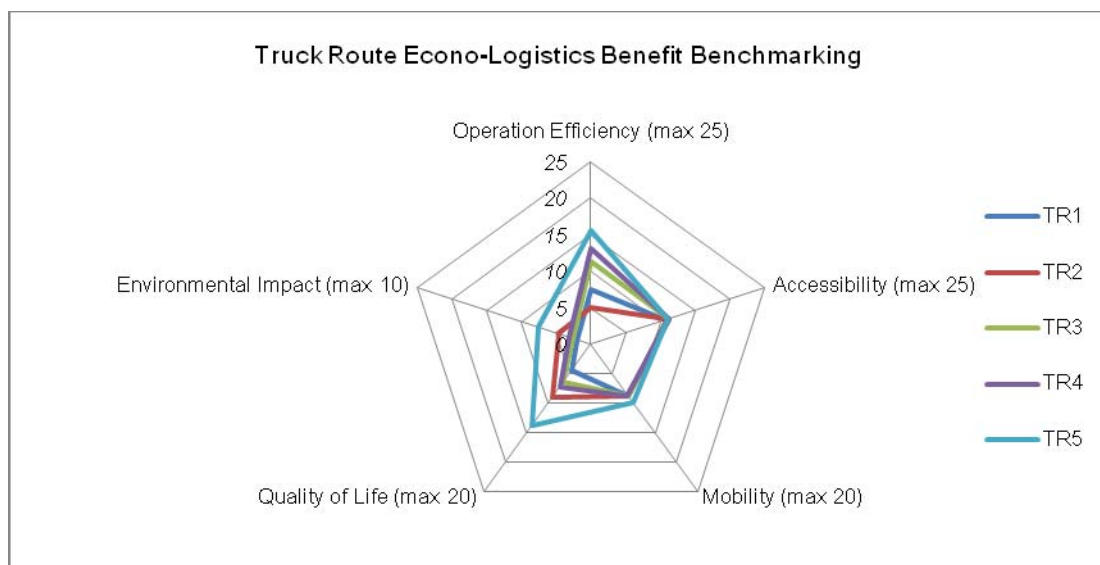


Figure 4: Radar Chart Representing the Econo-Logistics Benchmarking



Table 4 and Figure 4 summarize the key information for the consideration. It is therefore conclusive if TR5, ie, Phetchaburi, is the most suitable route to develop truck route where the route provides the most benefit in 4 considered perspectives, ie, operation efficiency, mobility, quality of life and environmental impact. It is therefore suggestive if the consideration on develop truck route must be proceeded, TR5, ie, Phetchaburi, should be considered as the most suitable one.

## 6. CONCLUSION

The paper presents the methodology that determine the suitability of route if it shall be developed as the truck route. Where the benefits of the development are widely expected including direct and indirect benefits, the indicators must be nominated and therefore the comparison can be made. Transportation Performance Measurement Model was used for the case where one truck route must be developed in Thailand and there are preliminarily 5 potential route. Using 5 criteria of interest on the econo-logistics perspectives including 1) operation efficiency, 2) accessibility, 3) mobility, 4) quality of life and 5) environmental impact with the measurement indicators taken from the reliable model and prediction, the comparison can be made. After the consideration based on the assumptions made, it can be concluded that TR5, ie, Phetchaburi, is the most suitable if the truck route must be developed. The route possess the highest benefits including cost saving, speed, quality of life and environmental impact. The model is strong and well coverage, however adaptable. Weights and criteria of interest can be modified upon the need of use. The paper only demonstrates the attempt of traceable and reliable performance measurement and the result is only preliminary as presented.

## REFERENCE

- [1] Asian Development Bank, Country Assessment Report: Thailand (Draft), 2008
- [2] Chiang Mai University, The Development of Truck Route and Management for Intermodal Transportation (Progressive Report 2), 2008
- [3] Chiang Mai University, The Development of Truck Route and Management for Intermodal Transportation (Interim Report), 2008