THE IMPACT OFTRAIN SAFETY ON THE WILLINGNESS TO PAY FOR THE FARE ON A DOUBLE TRACK RAILWAY ROUTE, NAKHON RATCHASIMA – NONGKHAI, THAILAND

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Abstract: In the study, the willingness to pay for the train fare on a double track railway route Nakhon Ratchasima–NongKhai is investigated. 400 respondents were selected by quota sampling to answer closed-ended single bounded questions on fares of THB 240, 260, 280 and 300. The willingness to pay was analyzed by the CVM Linear WTP Function by addingthe safety of the train service factor into the analysis. The study found initial offer price, age, education significantly affect the willingness to pay whereas the safety of train service factor alsosignificantly affects the willingness to pay. It is confirmed that Thailand's passengers recognize transport safety in double track railway decision making. The average fare that passengers are willing to pay for the double track train fare is about THB 252/ person/trip. Therefore,the State Railway of Thailand should enhance the safety policy, such as life and property safety.

Keywords: Double track railway; Willingness to pay; Safety.

INTRODUCTION

Generally, Thailand is a country in which people mainly use road transportation. Secondly, railway transport can be divided into 2 types: diesel trains and electric trains. The two types have been employed in Thai public transport for a long time. However, Thai trains are still outdated, and this includes security standards, as there have been some negative situations recently which drastically impacted the State Railways of Thailand. This results in the unpopularity of train travel. Recently, the government has made efforts to improve the image of Thai trains many times by changing the locomotives and managing mass rapid transit up until the current plans for double track railways.

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At the meeting of the National Council for Peace and Order (NCPO) 19 July 2014, the NCPO approved the development starting from the fiscal year 2014-2015 under the development strategy for transportation infrastructure by improving the infrastructure of double track railways on 8 routes. Two 2 routes are new standard gauge rapid transit projects with 1.435 metre double track railways: NongKhai-Nakhon Ratchasima-Laem Chabang Port at a distance of 737 km., with a budget of THB 392,579 million, and Chiang Khong-Denchai-Ban Pachee at a distance of 655 km., with a budget of THB 348,890 million . The two projects will provide electric trains to support future rapid transit (Bangkok Business News, 2015).

For the 355 km. long Nakhon Ratchasima-NongKhai double track railway (Figure 1), the project is undergoing a feasibility and design studyfor high-speed rail on the Bangkok-NongKhai of Nakhon Ratchasima-NongKhai line. The benefit of the project is worthy and suitable in economic terms, resulting in a reduction of travel and goods transport cost, the time of travel, accidents in transportation, and pollution. Additionally, it increases revenue from travel, fares and goods delivery (Korat Startup, 2015). The project will also enhance the efficiency of public transport in rural, urban and international areas and will persuade people to use railway services more. The government has urged the completion of the double track railway, Bangkok-NongKhai, by 2019 (Royal Thai Government, 2016).

Rail transport is viewed as much safer than road transportation. Table 1 presents the statistics of accidents categorized by the type of transportation during 2010-2014. There are fewer injuries and deaths in rail accidents than road accidents. It reflects that, for land transportation in Thailand, rail transport is the safest type compared to the others. As Nuttyi (2013) explained about the 7 reasons to select rail transport, 1 of 7 reasons is this transport providesmore safety than coaches. Moreover, MEEPANDA (2014) wrote on its website, "the railway is a one way track, with fixed schedules. To run services on the track while engineers are monitoring it is safer than road or air transport because its services race with no one".

Table 1
Statistics of Accidents Categorized by Type of Transportation

|	*Number of accidents (cases)*				*Number of injuries (cases)*				*Number of deaths (cases)*			
Types of transport	2011	2012	2013	2014	2011	2012	2013	2014	2011	2012	2013	2014
Road	68,781	61,194	61,323	62,745	22,346	22,344	20,906	20,760	9,496	8,745	7,364	6,370
Train	492	486	455	175	228	233	222	111	104	107	89	50
Water	20	31	16	19	0	7	33	15	18	13	12	5
Sea	5	2	0	0	0	0	0	0	0	0	0	0
Air	11	7	14	5	4	6	16	7	2	1	1	1
Total	69,309	61,720	61,808	62,944	22,578	22,590	21,177	20,893	9,620	8,866	7,466	6,426

Source: Ministry of Transport (2015)
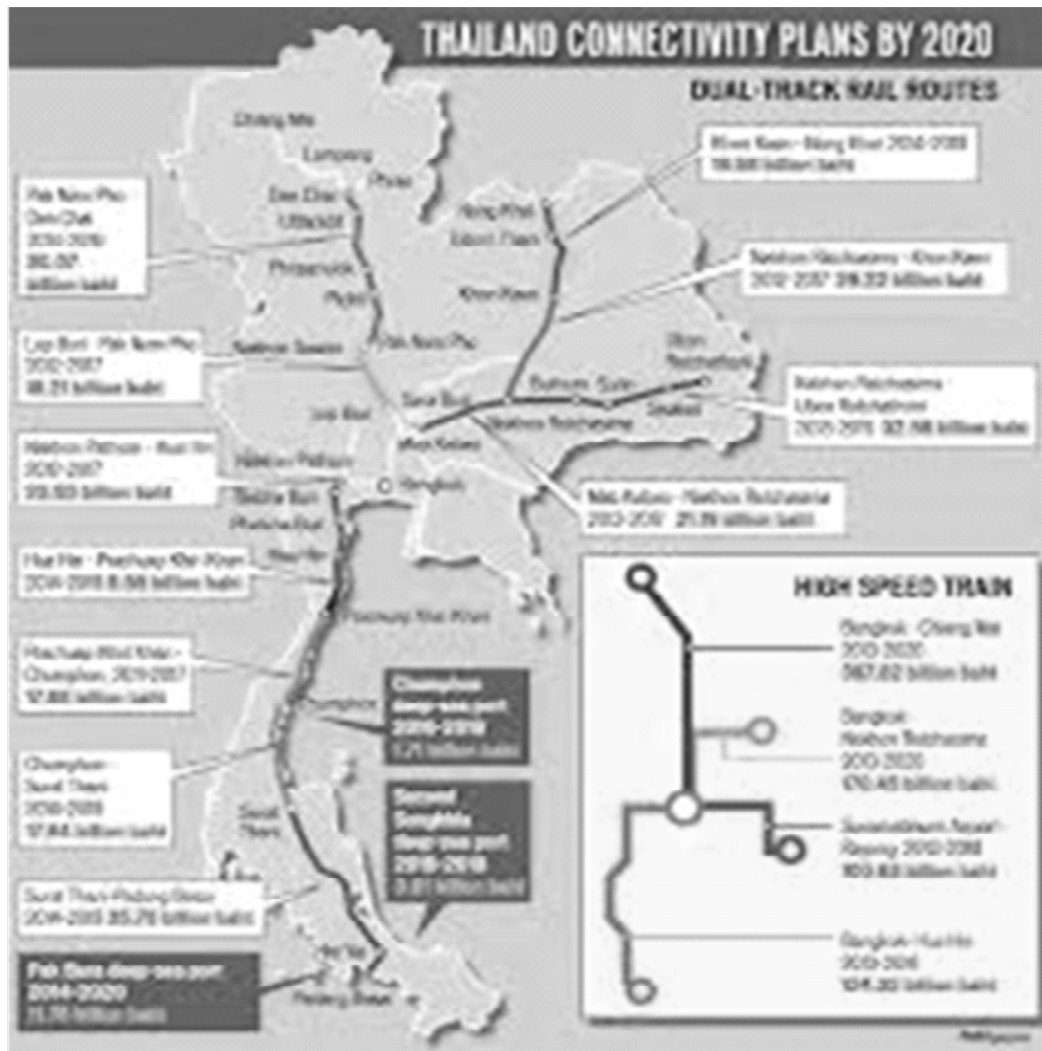
Figure 1: Double Track Railway Map (Bangkok Post, 2014)

For Nong Khai, there will be a railway project linked to the line heading to China, resulting in the development of commerce, investment, travel and transportation of the province and becoming the gateway to ASEAN. If this railway is completed, it will connect Thailand and Laos, which has a population of about 5 million people, and provide access to five provinces of China with a population of approximately 250 million. Goods transportation and transfer will become faster and more convenient, which increases the capacity of national and ASEAN logistics (Thairath, 2014).

As previously mentioned, the Thai government has supported the project double track railways while NongKhaihas also responded positively to the project in order to

promote its travel, commerce and investment. In addition, according to the statistics on accidents categorized by type of transportation, the railway service provides more safety than road transportation. However, this study appliessafety variables which have never appeared in previous studies, especially in ASEAN countries.

As a result, this study intends to examine the willingness to pay and the factors influencing the willingness to pay the double track railway fare, Nakhon Ratchasima-Nong Khai line, as a guideline to set the faresfor double track rail routes by estimating willingness by CVM and Single Bound Dichotomous Choice, and analysis with the Linear WTP Function considering safety, based on Mitchell and Carson (1989); Anderson, (2007) and Vanny *et al* (2015), who studied the willingness to pay for public transportation.

The study result will be of benefit to the related units who are working on this policy and planning to provide this service, especially the State Railways of Thailand, in order to set fare rates and provide services to meet the demand of users. This study is divided into four sections. Section two contains the literature review. The data and empirical results are discussed in Section three. Finally, this paper presents conclusions and policy implications.

2. LITERATURE REVIEW

Generally, the analyses for the estimation of the costs and benefits resulting from the reduction of mortality risks are investigated. The individual's willingness to pay (WTP) or willingness to accept (WTA) is employed to explain the risk or benefit of many situations.There are previous studies on the willingness to pay fares. Most are about the influencing factors affecting the willingness to pay by simulating situations to estimate CVM, which is a popular method to estimate the value of an environment. The situation model uses, for example, open and closed-ended questions, Single Bound Dichotomous Choice, and questions in an increasing or bidding game. The research of Mitchell and Carson (1989); Anderson, (2007) and Vanny *et al*. (2015) studied the willingness to pay for public transportation. They inquired about the willingness to pay by employing CVM and Single Bound Dichotomous Choice.

In fact, there is not a market price. There are many studies which employed WTA or WTA to explain mortality-risk reduction such as Schelling (1968); Mishan (1971) and Johansosn, 2002. In addition, Anderson, (2007) explained that the risk of transportation could be reduced by improving air quality (*i.e.* decreasing pollution)

Over the last three decades, a number of techniques have been developed toplace a valueon the environmental impacts of road and air transportation. Two kinds of valuation are used to indicate risk:the willingness to pay (WTP) and the willingness to accept (WTA). Such approaches are termed as Contingent Valuation Methods (CVM) and have been developed to place values on environmental impacts (Mitchell and Carson. (1989); Anderson(2007) and Vanny *et al*. (2015).

However, Anderson, (2007) examined the willingness to pay for road safety in Sweden by using the CVM method. The result demonstrated that support the WTP declines with age and background, but health status is not supported. In contrast, the measurement of WTP was investigated ina SMART project in Surabaya, Indonesia in 2016 byVannany *et al.* (2015) using a Random Utility Model (RUM). The model was used to measure and analyze three options of the SMART project. The model wasdesigned by using the collected data from direct surveys to 264 respondents in 31 regions of Surabaya City. The result revealed that most of the respondents preferred the route from Boyorial to Surotrem. However, Vannany *et al*. (2015) did not address the safety factor in the analysis. Therefore, this study will include the safety factor in the analysis.

3. METHODOLOGY

3.1 Scope of Work

3.1.1 Content

The Nakhon Ratchasima–Nong Khai line is a close distance where the users mostly prefer third class rapid train travel (according to the interview of the station master of NongKhai Train on 12 November 2015). The standard fare rate of third class is THB 220/passenger/trip. However, the study was conducted is during the time when the government's policy allowed people to use the service for free; therefore, it is difficult to determine the hypothesis price. The study selects to interview passengers using the third class rapid Nakhon Ratchasima-NongKhai and Nongkhai-Ratchasima line because most people prefer to use this line.

3.1.2 Time

June 2015 to December 2015

3.1.3 Places

Nakhon Ratchasima Train Station and NongKhai Station (Depart-Destination)

3.2 Population and Sample Group

The sample group in the study is passengers who use Nakhon Ratchasima-NongKhai railway services, using W.G. Cochran's formula (Cochran, 1977 cited in Kraiwan, 2008) for the case of the unidentified number of passengersat 95 percent reliability to determine an appropriate sample as follows:

$$n = \frac{p(1-p)z^2}{e^2}$$

$$n = \frac{0.5(1-0.5)1.96^2}{0.05^2}$$

$$n = 384.16$$

Therefore, in order to receive more reliable data, the sample group is 400 samples.

3.2 Tools

The tool applied in the study is a questionnaire which is divided into 1) General information about railway users:

1. General characteristics, *i.e.*, gender, age, status, educational level, career and hometown, and two Economic characteristics, *i.e.*, income and fare rate.

2. Willingness to pay for the double track railway fare on Nakhon Ratchasima-Nong Khai.

3.3 Data Collection

The collected data from the sample group is aboutabout their willingness to pay for the double track railway fare service by hypothesizing a situation by offering a flat fare rate at THB 220 and then setting the fare for the double track railway by adding 10%-40% as follows:

Case 1 is 240 baht (10%)

Case 2 is 260 baht (20%)

Case 3 is 280 baht (30%)

Case 4 is 300 baht (40%)

After that, using the quota sampling method, the sample group is divided into 200 samples for the departure trip (Nakhon Ratchasima-NongKhai 50%) and 200 samples (NongKhai-Nakhon Ratchasima 50%) for the destination trip,so the total number is 400 samples collected by accidental sampling.

3.4 Analysis and Statistics

The data for analysis come from a survey using questionnaires with the sample group. The analysis consisted of descriptive analysis and quantitative analysis. This study estimated the value of users' willingness to pay for the double track railway fare on the Nakhon Ratchasima-Nong Khai line, and reflects their opinions on the train service by hypothesizing a situation to evaluate the value from closed-ended questions and to test their willingness to pay for the fare, by employing the Logit Model and the SPSS program for data processing to test reliability. The details are as follows:

3.5 Descriptive Analysis

This type of analysis analyzes and concludesthe basic information of the sample group about the relationships between basic related factors by calculating frequency and percentages in order to examine the general information of those who use the Nakhon Ratchasima-Nong Khai line.

3.6 Quantitative Analysis

The quantitative analysis in the study analyzes the willingness to pay in accordance with the simulated situation from the survey information, including the relationships between the factors that influence willingness. The survey specified the starting fare rate of the double track railway at only one price. Regarding the sample groups, the respondents are willing to pay and unwilling to pay, respectively. Moreover, section 2 will analyze the validity and reliability with Cronbach's alpha.

The equation to study the factors which impact willingness is that ofAnderson (2007); KochapornandKanjana (2012), added the variable of safety in the consideration as presented in equation (1).

$$WTP = \alpha + \beta_1 Bid + \beta_2 Age + \beta_3 Study + \beta_4 Safety + \varepsilon_i \tag{1}$$

Setting

WTP is the willingness to pay (Accept = 1, Non-Accept = 0)

α is a constant

$\beta_1 - \beta_4$ is the coefficient of independent variables

ε is the error term

The variables for the study of the willingness to pay for the double track railway fare can be described as follows:

Bid is the proposed price at THB 240, 260, 280 and 300Age is age Study is the level of education Safety is the average of safety factors from many explanatory variables which are related to safety factors, such as security policy, accidents, life safety and property safety.

For the analysis of the willingness to pay, the mean of willingness to pay can be calculated by employing the Linear WTP Functionas follows:

$$E(WTP) = \frac{\beta_0}{(-\beta_1)} \tag{2}$$

$$\beta_0 = \alpha + \beta_2 Income + \beta_3 Occu + \beta_4 Edu \tag{3}$$

4. RESULTS

4.1 General Information about the Users of the Double Track Railway on the Nakhon Ratchasima – Nong Khai Line

With regard to the questionnairescompleted by 400 passengers who use the Nakhon Ratchasima-Nong Khai railway, it was found that most users are female (58%), aged 20-29 and single (57.5%). 55.5% have an educational level lower than undergraduate degree. Most are governmental officers/state enterprise officers or own a business at 78.5%, and 75.2% of them earn income lower than THB 10,000/month, while most live in the north eastern region.

4.2 Willingness to Pay for the Fare of Passengers who Use Double Track ailways on Nakhon Ratchasima – Nong Khai line.

According tothe validity and reliability test, the questionnaire has validity in accordance with Cronbach's alpha at 0.74, which means it is valid. Furthermore, the study also tested outliers and multicollinearity. To find β_0 in equation 1 by considering the education factor and safety factor, Table 2 presents the results of equation 4.

Table 2
The analysis of the willingness to pay

Independent Variables	Coefficient	S.E.	Wald	df	Sig.
Age	−0.520	0.142	13.398	1	0.00
Study	1.036	0.448	5.352	1	0.02
Bid	−0.025	0.009	7.470	1	0.01
Safety	0.829	0.315	6.919	1	0.01
Constant	7.567	2.691	7.908	1	0.01

Source: Calculation

$$\beta_0 = 7.567 - 0.520 \text{ Age} + 1.036 \text{ Study} + 0.829 \text{ Safety} \tag{4}$$

Therefore, according to the equation 4, when we find β_0, the mean of β_0 from 400 samples is 6.295. The willingness to pay can be calculated from

$$\text{WTP} = 6.295 - 0.025 \text{ Bid} \tag{5}$$

Regarding the estimation of the Logit Model coefficient and the study of the relationships between independent variables on the willingness to pay for double track railways on the Nakhon Ratchasima-Nong Khai line, it was found that 'bid'is related to the willingness to pay at a statistical significance of 0.01, which means if the bid increases, the chance that users willpay for the service will decrease. Similarly, age is also related to the willingness to pay at the statistical significance of 0.01, while study and safety are related to thewillingness to pay at astatistical significance of 0.01 as shown in Table 2.

4.3 Analysis of the Mean of the Willingness to Pay

This section explains the results from the mean of the willingness by employing the Linear *WTP* Function

Received
$$E(WTP = \frac{\beta_0}{(-\beta_1)}$$

From Equation 2 $E(WTP) = 7.565 - 0.025$ Bid

$$= \frac{7.565}{-(-0.025)}$$

$$= \text{THB } 251.83/\text{Person}/\text{Trip}$$

According to the interview of a station master at Nong Khai Station on 12 November 2015, there were 23,725 passengers who used the Nakhon Ratchasima-Nong Khai railway service in 2014.

Total value of double track railway users is

$$= 23{,}725 \text{ persons} * \text{THB } 251.83 = \text{THB } 5{,}974{,}666.75$$

5. DISCUSSION AND CONCLUSION

This research purposed to study the willingness, and the factors that influence willingness, to pay for the fare by railway users of the Nakhon Ratchasima-NongKhai by employing the Linear WTP Function method and Single Bounded CVM.

The study of the willingness to pay for the double track railway fare on the Nakhon Ratchasima-NongKhai line with Single bounded CVM is consistent with the methods of Anderson, (2007) and Vanny *et al.* (2015). The final results for Thailand conformed to the study of Nattakit (2012), on the willingness to pay for the reduction in air pollution in the polluted control area of Rayong, in which it was found that factors such as age, education and marital status correlate with the willingness to pay.

As a consequence, these factors are applied in the study, and the author added safety and willingness to pay the railway fare factors in the analysis as there has been no previous research on this. This study found that 'bid' is related to the willingness to pay at 0.01 statistical significance, which means if the price increases, the chance that users will pay for the fare will decrease. Age is related to the willingness to pay at a 0.01 statistical significance level, while study is related to the willingness to pay at a 0.01 statistical significance level. Education and career conform with the study of Kochaporn and Kanjana (2012) whereas age conformswith Anderson (2007).

The safety variable of the railway service is related to the willingness to pay at a 0.01 statistical significance level. This results contrasts with Anderson (2007). It confirms

that Thailand's passengerstake into account transport safety in double track railway decisions. In addition, for the estimation of the willingness to pay the double track railway fare, it was found that the mean from the Linear WTP Function method is TH/B251.83/person/trip.

6. SUGGESTIONS

In this study, it was found that, on average, passengers are willing to pay approximately THB 252 by employing the Linear WTP Function. Therefore, the State Railways of Thailand should not set the fare rate of the double track railway on the Nakhon Ratchasima-Nong Khai line over the aforementioned mean. This conforms to the demand of the users.

Due to the strong relationship between safety and the willingness to pay, the State Railways of Thailand should enhance security, especially the security policy regarding accidents, life safety and property safety for the passengers so that they will trust the service more. It should have efficient signaling for trains and road crossings and should add more security officers on the train. Signage warning passengers about property safety should also be displayed. This will help reduce the threats to users.

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