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## RESEARCH ARTICLE

### Decision-making on Public Transportation Services Based on the Socio-economic, Psychological, and Environmental Concern Factors

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#### Abstract:

##### *Aim:*

This research aims to study the socio-economic, psychological, and environmental factors which affect the decision making of passengers with regard to the use of public transportation route from Nong Khai province, which is considered as the border area of Thailand and Laos, to many destinations.

##### *Methods:*

The study was initially carried out by collecting data from 450 passengers using two public transportation services and 200 passengers using private cars. An analysis was conducted by means of descriptive statistics, factor analysis and binary logistic regression.

##### *Results:*

The results showed that the status, age, domicile, self-satisfaction and accomplishment, safety of life and property, and self-consciousness and environmental conservation practice influenced the choice of both the alternatives.

##### *Conclusion:*

To develop a service model, a variety of bus and van services must be provided to match the varied demand of passengers with different levels of purchasing power. It is also important to consider the impact of various factors that affect the public bus service selection, which may result in improved public transport systems. As a consequence, the well-being of border area citizens can be improved.

**Keywords:** Public transport, Mode choice, Border area, Binary logit, Reveal Preference, Environmental concern, Human values.

#### Article History

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## 1. INTRODUCTION

Nowadays, travelers have more choices of transportation than before as a result of enhanced technology and innovation. For these reasons, the number of people traveling has increased significantly and supports the economic development of rural areas like Nong Khai province, Thailand. Nong Khai is considered as an important northeastern border province of Thailand with territory adjacent to the neighboring country, Laos. Therefore, this place is a gateway to the Association of Southeast Asian Nations (ASEAN) as it is a route following Asian Highway No. 12 (AH12) to Vientiane, the capital of Laos. In addition, there is a road from Nong Khai along the Mekong River running parallel to the Asian Highway No. 11

(AH11) in Laos [1]. These roads can be used to travel to several countries in ASEAN and southern China with ease. Fig. (1) shows how AH11, AH 12 and AH15 are connected and how Nong Khai city (blue star) is an important city because if travelers want to enter into Thailand, they need to pass through Nong Khai. In this border area, the number of tourists has significantly increased from 2.07 to 5.04 million people between 2009 and 2015 [2]. Moreover, the border trade between Thailand and Laos showed the second-highest trading value for Thailand, which was 16,674.71 million baht [3].

To harmonize with the geographic, economic, and tourism issues and to link AH routes 11, 12, 15 with two branch roads in the two countries, international bus and domestic bus services are provided to meet the increased demand for services. The major public transportation services are categorized as air-conditioned buses and vans. Based on survey

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data, Table 1 presents the information about bus and van service companies in Nong Khai and many important provinces in Thailand such as Bangkok, UdonThani, Chiang Mai, Phuket, Rayong *etc.* It is noted that the main destination of domestic bus services is Bangkok, the capital city of Thailand, which is a 620-kilometer journey while the most popular van service is to Udon Thani province, which is about 50-kilometers. Additionally, Udon Thani province is one of the three largest provinces in the northeastern region of Thailand. It has an international airport and is the starting point of the AH15 route to Vietnam. Moreover, AH12 and AH15 are in the East-West Corridor development project that aims to build transportation networks in the ASEAN peninsular countries [4]. (Fig. 1).

The bus service data reveal that the number of companies and the number of trips per day slightly decreased between 2017 to 2019 on domestic routes. However, the number from Nong Khai province to Luang Prabang province, Laos increased. In addition, the most attractive tourist destinations in Laos are Vientiane, the capital city of Laos, and Luang Prabang, which is a United Nations Education, Scientific and

Cultural Organization (UNESCO) world heritage town [5]. These places have many tourist attractions such as: Pha That Luang, Morning market, Wat Xieng Thong *etc.* Therefore, the number of passengers for international buses is continuously increasing because of tourism. On the other hand, the number of van service companies increased between 2017 and 2019 because Nong Khai to Udon Thani is a short distance, has a high-frequency timetable, and fewer stop points than local buses. It is also easy to reach the Udon Thani international airport by paying a small additional fee.

The number of passengers who traveled between Thailand and Laos increased from 4.37 million in 2008 to 5.58 million in 2018. The number of private cars that crossed the Thailand-Laos Friendship Bridge increased continuously (except in 2017) from 209,000 cars in 2008 to 1,109,460 cars in 2018 (Fig. 2). This situation was affected by many factors such as increasing tourism in both countries, increasing trade value, a sustainable infrastructure policy, ease of access and extended opening and closing times at the Thai-Laos Friendship Bridge [6, 7].



Fig. (1). ASEAN highways no. 11,12 and 15 connectivity.

Table 1. Information on bus and van services from Nong Khai to many provinces in Thailand.

Company Name	2017			2019		
	Number of Trips (time/day)	Timetable	Destination (Province)	Number of Trip Frequency Per Day	Timetable	Destination
Bus service						
1.Chaiyaphom Chong-Cha Reang	2	9.00, 11.00	Chaiyaphom	2	9.00, 11.00	Chaiyaphom
2.Chatkapong tour	1	19.00	Chiang Mai	Out of business		

(Table 1) cont.....

Company Name	2017			2019		
	Count	Services	Location	Count	Services	Location
3. Transportation company	2	20.00, 20.20	Bangkok	2	20.00, 20.20	Bangkok
	6	7.30, 9.30, 12.40, 14.30, 15.30, 18.00	Vientiane (Laos)	6	7.30, 9.30, 12.40, 14.30, 15.30, 18.00	Vientiane (Laos)
	Services not yet enabled			3	7.30, 12.40, 15.30	Louang Prabang (Laos)
4. Sawatdee E-san	2	19.30, 20.00	Bangkok	1	19.30	Bangkok
5. Air Udon	4	9.00, 19.10, 20.15, 20.30	Bangkok	4	9.00, 19.10, 20.15, 20.30	Bangkok
6. Chad Chai tour	1	19.45	Bangkok	1	19.45	Bangkok
7. Or. Suesa tour	1	19.00	Bangkok	1	19.00	Bangkok
8. Budsarakom tour	1	20.00	Bangkok	1	20.00	Bangkok
9. 407 Pattana	3	7.00, 9.00, 20.30	Bangkok	3	7.00, 9.00, 20.30	Bangkok
	9	7.00, 15.30, 16.30, 17.00, 17.30, 18.00, 18.20, 19.00, 19.20	Rayong	9	7.00, 15.30, 16.30, 17.00, 17.30, 18.00, 18.20, 19.00, 19.20	Rayong
10. Chan tour	3	20.00, 20.15, 20.45	Bangkok	3	20.00, 20.15, 20.45	Bangkok
	2	12.00, 14.00	Phuket	3	12.00, 14.00, 14.30	Phuket
11. Sri Mong Kon	1	18.30	Kanchanaburi	1	18.30	Kanchanaburi
12. Rung Pra Sert tour	1	20.25	Bangkok	Out of business		
13. Sa-ng Chai tour	3	7.30, 9.00, 11.00	Ubonratchatani	3	7.30, 9.00, 11.00	Ubonratchatani
	1	8.30	Sri Sa ket	1	8.30	Sri Sa ket
14. Green bus	1	9.15	Chaing Rai (Mea Sai)	Out of business		
15. Nakorn Chai air	4	10.00, 19.45, 20.00, 20.30	Bangkok	3	10.00, 19.45, 20.30	Bangkok
Van service						
1. Pet Tawee air	13	6.00-18.00	Udon Thani (Bus station)	13	6.00-18.00	Udon Thani (Bus station)
2. Kittipon Pa Roue	13	6.00-18.00	Udon Thani (Central)	13	6.00-18.00	Udon Thani (Central)
3. Chaiyaphom Chong Cha Reang	Services not yet enabled			13	6.00-18.00	Udon Thani (Central)

From: Survey data From: <http://www.dannongkhai.com/>.

After the Air Quality Index (AQI), PM2.5 became a matter of concern in Thailand from 2016. Nong Khai province also collected data on PM2.5. The data for Nong Khai (Thabo district point) revealed that AQI had a seasonal pattern and the whole-year average for 2018 was 37.2  $\mu\text{g}/\text{m}^3$ . This level is unhealthy for sensitive groups [8]. One of the main pollution sources is the increasing use of cars in Nong Khai province. Moreover, because the international trade value of Thailand and Laos increased year-on-year, the number of trucks increased dramatically. Every day, long lines of trucks waited to cross the Thai-Laos Friendship Bridge, which wasted time and increased air pollution in this area. If passengers can be persuaded to use public transport services, it should help to reduce air pollution in this area. Therefore, the research question of this study is ‘what are the important factors that affect the decision making of passengers who travel by public transportation? With this information, the important factors can be identified, and ways to encourage passengers to use public transportation can be suggested. Therefore, this study aims to study the factors that affect decision-making on public transportation service usage in the border areas in Nong Khai. By conducting socio-economic, psychological and environmental analysis, guidelines can be suggested to improve the quality of public van and bus services in the Thailand-Laos border area.

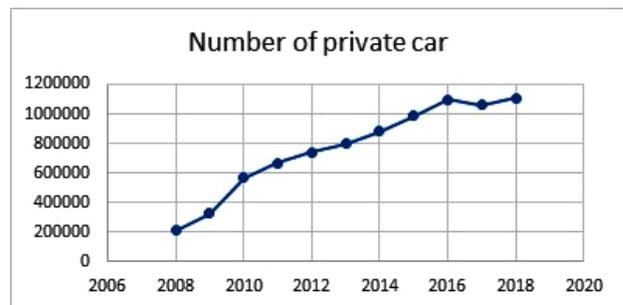


Fig. (2). Number of private cars that crossed the Thailand / Laos border in Nong Khai province [7].

2. LITERATURE REVIEW

For studying modes of transportation, many studies have focused on stated and revealed preference. In general, the Stated Preference (SP) method is based on microeconomic theory, where respondents are required to state their preference in a hypothetical situation. A utility function is then estimated from the SP survey data taken from the respondents, and the behavior is predicted from the estimated utility function [9]. Therefore, the SP survey is conducted to estimate the subsequent travel probability choice and the stated choice is a theoretical choice behavior-typically composed in a survey situation under one or more detailed theory. Most studies

focused on new policies, new technologies or improvement of services such as [10 - 14] *etc.* However, SP still has weaknesses as the estimation is based on theoretical concepts.

On the other hand, the Revealed Preference (RP) survey assesses passenger's behavior when choosing the mode of transport at a particular time but does not include rare or nonexistent options like SP [15]. Most studies focused on deeply understanding the choice behavior of passengers such as [15 - 17] *etc.* However, RP data cannot be analyzed in many research contexts.

Because SP and RP studies have both weaknesses and strengths, many studies employ both SP and RP by assuming that there is a trade-off between the significant attributes such as price, quality *etc.* [18 - 20]. RP data concerns recent choices of the mode of transportation and SP data concerns the choice between new services and old services. New services in these studies represent new topics that have been considered but have not been introduced in the places of study, such as carpooling systems, new business models, better services *etc.*

Based on previous studies related to the factors affecting public transport service preference, most investigations were conducted in capital cities or major cities and were both quantitative and qualitative [17, 21 - 24]. However, there have been few studies conducted in rural areas, especially in border areas like Nong Khai province.

Numerous studies principally used personal and socio economic variables to perform decision analysis [16, 25] for example, using personal and socio-economic data such as gender, age, education level, occupation, income, car in possession *etc.* Moreover, several studies employed a latent variable model [16, 19, 26] by employing three, five, or six-point rating scale questions in the questionnaire. However, every study employed different theoretical concepts to formulate questions based on various theories.

In addition, some studies included social and psychological factors in the analysis [19, 23, 27]. They used these factors to explain individual attitudes and behaviors to assess the influence of values on individual travel behaviors. Based on a study [28], the values in this study include security, hedonism, and power and [26] also social status and prestige, control or dominance over people and resources, pleasure, sensuous gratification for oneself, safety, harmony, and the stability of society.

It seems that a combination of SP and RP is a good choice in this study. However, this study does not include new transportation choices at present or in the near future and we collected detailed data of passengers at low cost. Moreover, the suggestions of each passenger who uses both public transportation and private cars were obtained to determine ways to encourage the use of public transportation in the future, which revealed that the preference survey is an appropriate method to adopt, using a simple technique like binary logistic regression analysis, which is presented in the methodology section.

### 3. METHODOLOGY

#### 3.1. Sample Size

The sample used in this study included 450 Thai and foreign passengers who use public transportation in Nong Khai province as an origin or terminal station, and 200 Thai and foreign passengers who use private cars in Nong Khai province as an origin, destination or transit. Only two types of public vehicles, buses and vans were included in this study. Questionnaires were initially examined by three experts and 30 passengers for each type of vehicle before conducting data collection.

#### 3.2. Query Structure

In this study, data were collected by means of questionnaires in Thai, Lao, and English which were divided into three parts:

##### 1. Socio-economics data about passengers:

- Gender (Male, Female).
- Age (passenger's age)
- Level of education (primary school, secondary school, vocational certificate, diploma, bachelor or higher).
- Status (single, married, widowed or divorced).
- Occupation (student, government officer, private company, business owner, farmer, unemployed or retiree, other).
- Net income (passenger's net income).
- Domicile (in the area of Nong Khai, out of Nong Khai).
- Nationality (Thai, Lao, other).
- Car or motorcycle ownership (yes/no).
- Possession of driving license (yes/no).

This information represents variables in the model's specification except for car and driving license ownership. A nominal scale was employed for these variables, such as the male is zero, and the female is one. In contrast, ratio scale data was provided by the passengers, such as the age and income of the passenger.

2. Information on social, psychological and environmental concerns was obtained by noting passengers' opinions on the importance of public transport by means of a six-point Likert-scale questionnaire (strongly agree, agree, slightly agree, slightly disagree, disagree, strongly disagree) which is divided into 11 sub-questions related to the basic human values [26] and we also studied some environmental concerns [29] by asking the opinions of passengers on the importance of the following issues:

- The stability of the passenger.
- The security of the passenger.
- The happiness of the passenger's life and friendships.
- The harmony of the passenger's family.
- The satisfaction of the passenger's life.

- The social reputation of the passenger.
- The social prestige of the passenger.
- The social status of the passenger.
- The passenger’s behavior in regard to reducing and reusing resources and goods.
- The passenger’s love of nature.
- The belief that fossil fuels are a cause of global warming.

For these 11 questions, a latent variable was used to interpret this information by using the factor analysis technique to reduce the number of significant factors in the model, as mentioned in the discussion of the model specifications. The measurement scale for the attitudes of passengers was a Likert scale where strongly agree, agree, and slightly agree have 6, 5, and 4 points, respectively, and strongly disagree, disagree, and slightly disagree have 1, 2, and 3 points, respectively.

3. Passengers were asked an open-ended question “What would make you use public transportation in the near future” and what would encourage them to use public transportation in the future. This question aimed to elicit information about what could be improved and how to encourage or push passengers who use private cars to use public transportation in the near future, and for passengers who have used public transportation to use this kind of service again.

**3.3. Utility, Demand for Transportation, and Revealed Preference in Microeconomic Theory**

To illustrate the microeconomic theory (Fig. 3) that is related to this study, budget constraint is included, which is at the core of economics. This focuses on how to manage limited resources, which in this case means the budget of consumers. Consumers choose the best service they can afford [30]; this consumer preference concept aims to study how consumers make such a selection. “Utility” is an economics concept that measures the benefits that a service user obtains based on the assumption that the consumer will maximize their utility by making a choice that attempts to maximize utility under a budget constraint, thereby combining the two theories. Moreover, the optimal choice of consumers depends on many factors such as the cost of transportation, consumer income, quality or service . The “demand for transportation” will be considered as derived demand in this study (for example, we want to go to shopping, so we need a car to drive to the department store).

However, it is often difficult to determine consumer preferences because, in real life, preferences are not directly observable. The demand of consumers is the key to the study because it reveals information about their preferences. We can determine consumer preferences by observing their real behavior or we can call it “revealed preference”. We can also study their decision-making process because after consumers rationally consider each choice of transportation, they make a decision under the best affordable concept, as previously mentioned.

**3.4. Transportation Utility Function**

From utility theory, we can express the utility function as follows:

$$U_n^i = V_n^i + \varepsilon_n^i \tag{1}$$

Where  $U_n^i$  is the utility of transportation mode i gained by passenger n.  $V_n^i$  is the systematic component of the utility of transportation mode i gained by passenger n, and  $\varepsilon_n^i$  is the disturbance of utility of transportation mode i gained by passenger n [31, 32].

The utility function for public transportation and private cars can be constructed in several forms depending on the variables as mentioned in the query structure section, which are combined in the utility function. Therefore, any variable that plays a role in the selection of the travel pattern was used to explain the behavior of the passengers. The utility functions for travel by alternative passenger transportation are as follows:

$$V_n^{pt} = \beta_1 X_1^{pt} + \beta_2 X_2^{pt} + \dots + \beta_k X_k^{pt} \tag{2}$$

$$V_n^{pc} = \beta_1 X_1^{pc} + \beta_2 X_2^{pc} + \dots + \beta_k X_k^{pc} \tag{3}$$

Where  $V_n^{pt}$  and  $V_n^{pc}$  are linear parametric function, taking into account computable appearances of the particular mode of passenger n.  $\beta$  is the coefficient of variables in each transportation mode (If we denote  $\beta = [\beta_1, \beta_2 \dots \beta_k]$  as a vector of k unknown parameters). X is an independent variable for general information, socio-economics and latent variables of the particular mode that was applied [31].

Due to a large number of variables in this analysis, the reduction in specific variables by using the factor analysis method for the social and psychological variables was carried out to investigate the latent variables and to analyze the factors affecting preferences for public transport services. General passenger information and the latent variables for the social and psychological aspects were analyzed to determine the particular variables affecting decision-making on public transport services by means of binary logistic regression analysis.

**3.5. Model Specification**

The principle of the logit model assumes that the random component of utilities or  $\varepsilon_n^i$  is independently and identically distributed (IID). Therefore, the model estimates the proportion of passengers n choosing transportation mode i as follows:

$$P_n(i) = \frac{e^{V_n^i}}{e^{V_n^{pt}} + e^{V_n^{pc}}} \tag{4}$$

When  $P_n(i)$  is the probability or proportion of passenger n will choose transportation mode i.  $V_n^i$  is the utility function of the transportation mode i of passenger n, and  $i$  is any type of

vehicle which is categorized as a member of all vehicles, including public transportation and private cars (Applied from [32]).

For the transportation mode choice model, a binary logistic model is employed, which provides alternatives to vehicles for public transport services (public transportation is the focused group by giving value 1) or private cars (using private cars as a reference group by giving value 0).

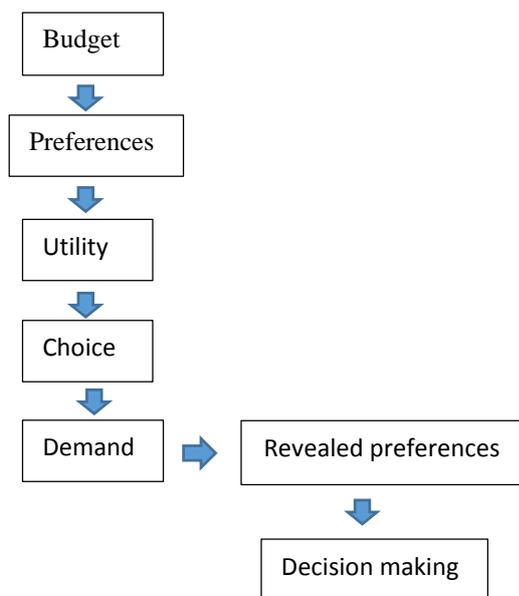


Fig. (3). The path of microeconomics theory applied from [30].

## 4. RESULTS

### 4.1. Validity and Reliability

The results of the content validity analysis revealed that the IOC value was between 0.5 and 0.9, indicating that the questionnaire was accurate and comprehensive with regard to all aspects and objectives of the study.

The questionnaire’s reliability was tested by means of the Cronbach Alpha coefficient. The result was 0.825, which indicates that this survey possesses a high level of reliability.

### 4.2. Personal Information of Respondents

The study was conducted by collecting general information from passengers who traveled from/to Nong Khai province as the origin, destination or in transit, as shown in Table 2

According to Table 2, more females used public transportation services than males, with an average age of 23.6-year-old, who were younger than the passengers traveled by private cars. Passengers who were single had a higher percentage of traveling by public transportation with more number of students. The passengers with a low income had more percentage to travel by public transportation and passengers who were living in Nong Khai province also had more percentage to use public transportation as well. Most of all the respondents owned motorcycles, while only 39.8 percent of the respondents used public transportation owned cars.

### 4.3. Results of Factor Analysis

Due to the number of variables used in the analyses, in particular, the social, psychological and environmental variables (11 variables), the analysis of element factors is crucial to remove the non-significant variables. The latent social, psychological and environmental variables were determined to analyze the factors that affected the selection of the mode of public transport service. The results are summarized in Table 3 as follows.

Table 2. General passenger information of passengers.

General Information of Passengers (Variable)	Details	Public Transportation		Private Car	
		Number of Passengers	Percentage	Number of Passengers	Percentage
Destination (DT)	Udon Thani	356	79.1	79	39.5
	Other provinces or Laos	94	20.9	121	60.5
Sex (SE)	Male	169	37.6	178	89
	Female	253	56.2	21	10.5
	LGBT	28	6.2	1	0.5
Age	under 20 years old	97	21.6	0	0
	21-30 years old	174	38.7	48	24
	31-40 years old	86	19.1	112	56
	over 41 years old	93	20.7	40	20
Educational Level (EL)	Primary School	58	12.9	5	2.5
	Secondary School	60	13.3	22	11
	Higher Secondary School or Vocational Certificate	168	37.3	65	32.5
	Diploma or High vocational certificate	36	8.0	35	17.5
	Bachelor degree or higher	128	28.4	73	36.5

(Table 2) cont.....

General Information of Passengers (Variable)	Details	Public Transportation		Private Car	
		Number of Passengers	Percentage	Number of Passengers	Percentage
Status (ST)	Single	291	64.7	81	40.5
	Married	140	31.1	114	57
	Windowed or Divorced	19	4.2	5	2.5
Occupation (OC)	Student	142	31.6	6	3
	Government officer or State enterprise officer	45	10.0	36	18
	Private company officer	115	25.6	39	19.5
	Business Owner	66	14.7	95	47.5
	Farmer	45	10.0	18	9
	Unemployed or Retiree	16	3.6	3	1.5
	Other	21	4.7	3	1.5
Net Monthly income (NI)	Less than 4,000 baht	156	34.7	37	18.5
	4001-7,000 baht	101	22.4	32	16
	7,001-10,000 baht	95	21.1	75	37.5
	More than 10,001 baht	98	21.8	56	28
Domicile (DO)	In the area of Nong Khai	266	59.1	49	24.5
	Out of Nong Khai	184	40.9	151	75.5
Nationality (NA)	Thai	374	83.1	119	59.5
	Lao	55	12.2	65	32.5
	Other	21	4.7	16	8
Car Ownership (CO)	Yes	179	39.8	200	100
	No	271	60.2	0	0
Automobile driving license in possession (AD)	N/A	20	4.4	0	0
	Yes	178	39.6	118	59
	No	252	56.0	2	1
Motorcycle ownership (MO)	Yes	353	78.4	125	62.5
	No	97	21.6	75	37.5
Motorcycle driving license in possession (MD)	N/A	20	4.4	0	0
	Yes	267	59.3	96	48
	No	163	36.2	104	52

Source: Calculation

**Table 3. Results of the study of factor analysis for social, psychological and environmental aspects.**

Lists	Composition		
	1	2	3
Life with stability	.792		
Life with security	.811		
Couple life and friendship with happiness	.813		
Family with harmony	.738		
Life Satisfaction	.618		
Social reputation		.796	
Social prestige		.811	
Proper social status		.801	
Reduce and reuse resources			.817
Being a nature lover			.766
Fuel is a cause of global warming			.734
Eigenvalues	5.941	1.501	1.232
Percentage of variance	46.875	11.007	9.047
Cumulative percentage	46.875	57.882	66.929
KMO	.891		
Chi-square	2851.207		

Source: calculation.

According to Table 3, it was found that the Kaiser-Meyer-Olkin (KMO) test for sampling adequacy was equal to 0.891. Consequently, this high value was considered suitable for factor analysis. The Chi-square was 2851.207 (test of sphericity) at the significance level of 0.000, implying that some variables are interlinked.

Composition no.1 consisted of five variables: life with stability, life with security, couple life and friendship with happiness, and family with harmony and life satisfaction. The Eigenvalue was equal to 5.941, with loading factors between .618 and .813. This composition was called Safety in life and property (SLP).

Composition no. 2 consisted of three variables: social reputation, social prestige and proper social status. The Eigenvalue was equal to 1.501, with loading factors between .796 and .811. This composition was called Self-satisfaction and accomplishment (SSA).

Composition no.3 consisted of three variables: reduce and

reuse resources, being a nature lover, and the belief that gasoline is a cause of global warming. The Eigenvalue was equal to 1.232, with loading factors between .734 and .817. This composition was called Self-consciousness and environmental conservation practice (SEC).

#### 4.4. Results of the Analysis of Factors Affecting Decision-making on Public Transport Service Usage

After obtaining data on the latent variables from the analysis of social, psychological and environmental factors, which consisted of three variables (SLP, SSA, SEC), the factors were analyzed that affected decision-making preferences by applying 10 passengers' general information variables (DT, SE, AG, EL, ST, OC, NI, DO, MO, MD) to conduct the analysis. To perform investigation, the Forward Selection (Wald) method - Binary Logistic Regression was adopted, given that passengers using private cars and public transportation were 0 and 1, respectively. The results of the study are shown in Table 4.

**Table 4. The results of factors affecting decision making to use public transportation.**

Variables	Meaning	B	S.E.	Wald	Df	Sig.	Exp(B)
ST	Status			12.563	2	0.006***	
ST (0)	Married						
ST (1)	Single	2.104	0.662	3.277	1	0.001***	8.199
ST (2)	Windowed or Divorced	1.347	1.091	1.523	1	0.217	3.844
AG	Age of traveler	-0.207	0.090	5.293	1	0.021**	0.813
DO (1)	Domicile of traveler is out of Nong Khai	1.171	0.317	13.639	1	0.000***	3.226
SSA	Self-satisfaction and accomplishment	-0.469	0.166	7.948	1	0.005**	0.625
SLP	Safety in life and property	-0.539	0.138	15.385	1	0.000***	0.583
SEC	Self-consciousness and environmental conservation practice	0.283	0.112	7.438	1	0.006***	1.514
C	Constant	6.223	1.272	23.918	1	0.000***	504.087
Predicted	Predictive ability of model						73.2
-2Log likelihood	Concordance of data and model						424.132
Cox&Snell R square	Ability to explain dependent variable from independent variable						0.291
Nagelkerke R square							0.389
Hosmer&Lemeshow test significance	Goodness of fit test model						0.915

Note: \* level of significance 0.1; \*\* level of significance 0.05; \*\*\* level of significance 0.01.

According to Table 4, it can be concluded that single passengers tended to use public transportation more than married people by 8.199 times, with statistical significance.

As the passenger's age increased, there is a tendency to decrease public transportation use at 18.7 percent  $(1-0.813)*100$  with statistical significance.

Passengers who live outside Nong Khai province were more likely to use public transportation than passengers who were domiciled in Nong Khai province by 3.226 times, with statistical significance.

For passengers who took self-satisfaction and accomplishment into account, it could be inferred that in every elevated level of priority for this variable, the likelihood of public transportation service usage decreased by 37.5 percent  $(1-0.625)*100$ .

Passengers who took safety of life and property into

account, it could be inferred that in every elevated level of priority for this variable, the likelihood of public transportation service usage decreased by 41.7 percent.

Passengers who took self-consciousness and environmental conservation practice into account, it could be inferred that in every elevated level of priority for this variable, the likelihood of public transportation service usage increased by 1.514 times.

With regard to the overall forecasting model results, the actual results when compared to the results obtained from the forecasting process showed accuracy of 73.2 percent, which can be considered suitable to perform prediction at a high accuracy level.

The results of Cox & Snell and Nagelkerke  $R^2$  were 0.291 and 0.389, respectively, indicating the ability to be independent of the dependent variables, which included status, age of traveler, the domicile of traveler, SSA, SLP and SEC. The

percentage of the factors affecting decision-making on public transport services was 29.1 and 38.9, respectively.

The results of the Hosmer and Lemeshow test revealed that the statistical significance was 0.915, which is greater than 0.05, indicating that the logistic regression model was functionally appropriate.

## 5. DISCUSSION

The results revealed that most respondents who would use public transportation service were unmarried, 21-30 years old, women, with high school education level / vocational certificate and were students with less than 4,000 baht per month income and had been living in Nong Khai. In addition, 83.1%, 12.2%, and 4.7% were Thai, Lao and other passengers who used Thai public transport, respectively.

The status and age of passengers were found to be related to decision making on public transportation especially for bus services (Fig. 4). Discounted tickets should be offered for passengers who travel as a family. Moreover, baby and elderly facilities should be provided, such as priority seats, magnifying glasses, facilities inside the toilet to handle babies, toys, and children's books . to encourage more passengers to travel with their family by bus. These suggestions are related to the cost of installation facilities in vehicles that businesses may take into consideration. However, based on the answers of passengers in the open-ended question in part three, businesses can also make extra money and attract new groups of passengers by offering baby wipes, disposable diapers for babies and the elderly, on the bus as well.



**Fig (4).** Show interior and exterior of public bus and van service in Nong Khai province bus station.

Safety of life and property was also found to be a concern of passengers. Based on data from the Thailand Road Accidents Data Center for Road Safety Culture (Thai RSC) [33], the number of accidents from 2010 to 2019 in Nong Khai province was 12,886 (1,289 person per year) which is a low rate compared to the average for the whole country (3,646 person per province per year). Therefore, the safety of overland transportation should be a major concern in the government policy to enhance the safety of public and private transportation as:

- [1] Encourage businesses to have not only compulsory motor insurance but also voluntary motor insurance for public transportation services with optional additional fees for passengers.
- [2] Encourage drivers to enhance the safety of passengers by driving the bus or van more carefully. Drivers can also make announcements about safety issues.
- [3] Encourage the use of VIP public transportation vehicles with improved active and passive safety systems in vehicles for optional extra fees.

Based on the answers of passengers in part three of the questionnaire, active safety systems such as Tire Pressure Monitoring Systems (TPMS), Driver Monitoring Systems (DMS), Blind-Spot Detection (BSD) and passive safety systems such as whiplash protection systems, airbags *etc.* can be improved. These improvements should be focused on van services because vans are smaller than buses (Fig. 4) and the chance of serious accidents is greater. This type of van should be promoted with extra charges for enhanced safety.

## CONCLUSION

The self-consciousness and environmental conservation factors depend on the feelings of individual passengers. However, environmental problems are a global issue so public awareness of such issues should be raised. In summary, the development of public transportation must take into account various factors that affect the passenger's demand. Bus and van services must offer services that reflect the various types of passengers' demands and reflect the different levels of affordability .

## CONSENT FOR PUBLICATION

Not applicable.

## AVAILABILITY OF DATA AND MATERIALS

Not applicable.

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None.

## CONFLICT OF INTEREST

The author declares no conflict of interest, financial or otherwise.

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