

A Factor Analysis for Bus Choice Based on Structural Equation Modeling – A case study of Ho Chi Minh City, Vietnam

(構造方程式モデリングに基づくバス選択行動の要因分析 – ベトナム・ホーチミン市のケーススタディ)

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1. Introduction

1.1 Background

In Vietnam, the increased usage of personal vehicles has made huge pressure on transport infrastructure and the urban environment. How to improve traffic congestion is a challenging question in big cities such as Ho Chi Minh City (HCMC).



Traffic congestion in HCMC has spread to be a widespread societal concern, which has slowed down economic activity, increased travel time and expense, and decreased quality of life. To address the issues with the present transportation system, it is crucial to analyze traffic behavior, customs, and culture. Additionally, it is vital to create measures to encourage the use of buses and discourage the use of personal automobiles in HCMC.

1.2 Research Objective

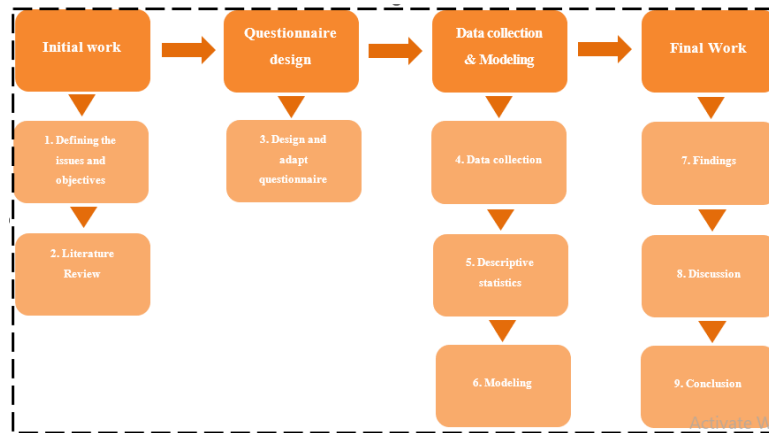
This study aims: (1) To find out the indicators relating to the city bus service in the context of HCMC; (2) To identify the important factors which affect users' perception and expectation of the city bus service; (3) To identify the relationship between users' perceptions and overall satisfaction with the service and their intention to use the bus.

2. Methodology

2.1 Research Framework

The methodical procedure consists of the following four main tasks: **1) Initial work:** First, the problem description was figured out, and then the research objectives were determined; **2) Questionnaire design;** **3) Data analysis and modeling:** This section contains four preliminary efforts. First, a survey was utilized to collect data. After collection, the data were recorded and checked. Thirdly, the reliability test, standard

deviation was tested using descriptive statistics. Finally, the data were analyzed using Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA) and Structural Equation Model (SEM); **4) Final work:** This part included an overview of the study's results, the discussion, policy implement and future works.



2.2 Data Collection

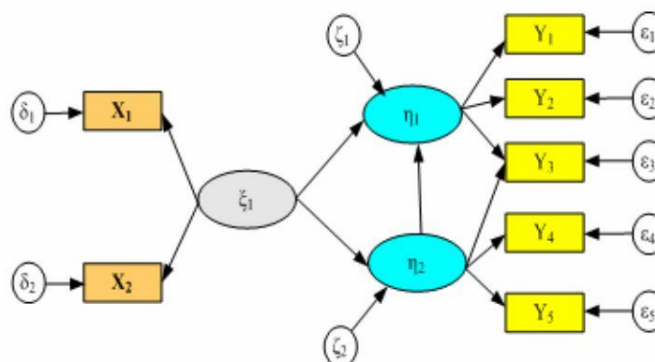
Survey area: HCMC’s population is more than 9,1 million people (2021). Data was collected by interviewing. The individuals who participated in this study were randomly chosen from bus stops and nearby areas of many urban districts in HCMC. The sample size is 550 samples.

The questionnaire survey includes 4 parts: Personal data (age, gender, education level, occupation, monthly income, vehicle ownership), Travel data (trip purpose, mode, frequency of use, travel distance), passenger’s perception and overall satisfaction, passenger’s expectation and intention to use bus as commuting.

2.3 Data analysis

Descriptive analysis is used to analyze the respondents’ characteristics. EFA and CFA were conducted to identify the latent variables which are input in SEM. SEM is an effective technique used to explain the connection between many different factors. It was created using theories that demonstrate the relationships between unobserved variables and the correlation between unobserved variables and observable variables. SEM was used in this study to investigate the connection between observed variables as bus’s attributes, users' perceptions, satisfaction, and intention.

The figured below shows the standard structural equation modeling. Structural Equation can be exemplified as structural equation (3.1) and measurement equation (3.2)



From the figured, which may be represented as

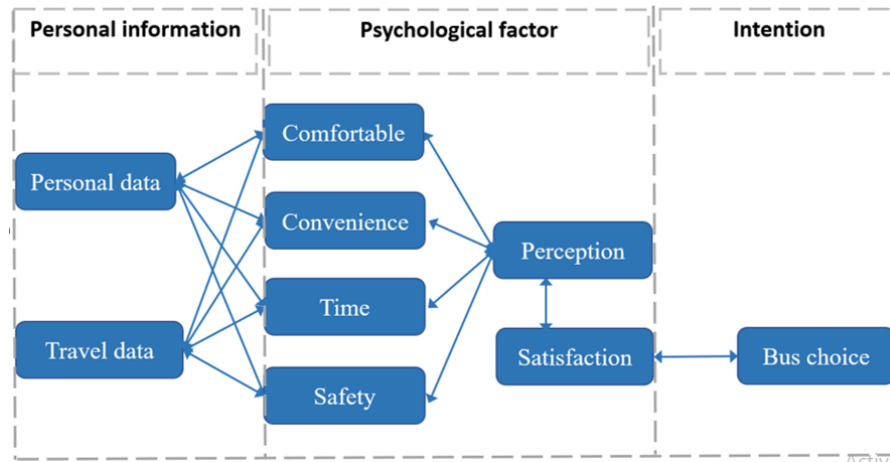
$$\eta_{(mx1)} = B_{(mxm)}\eta_{mx1} + \Gamma_{mxn}\xi_{nx1} + \zeta_{mx1} \dots \dots \dots (3.1)$$

$$\left. \begin{aligned} y_{px1} &= \Lambda_{y(pxm)}\eta_{mx1} + \varepsilon_{px1} \\ y_{qx1} &= \Lambda_{x(qxm)}\eta_{mx1} + \delta_{qx1} \end{aligned} \right\} \dots \dots \dots (3.2)$$

Where, $\eta' = (\eta_1, \eta_2, \eta_3 \dots \dots \dots \eta_m)$ and $\xi' = (\xi_1, \xi_2, \dots \dots \dots \xi_n)$ are latent dependent and independent variables respectively. Similarly, vectors $y' = (y_1, y_2, \dots \dots \dots y_p)$ and $x' = (x_1, x_2, \dots \dots \dots x_q)$ are observed as dependent and independent variables respectively. $B_{(mxm)}$ and $\Gamma_{(mxn)}$ are coefficient matrices and $\zeta' = (\zeta_1, \zeta_2, \dots \dots \dots \zeta_m)$ is a random vector of residuals. The vectors of errors of measurement in y and x are ε and δ , respectively. The matrices $\Lambda_y(p \times m)$ and $\Lambda_x(q \times n)$ are regression matrices of y on η and of x on ξ , respectively.

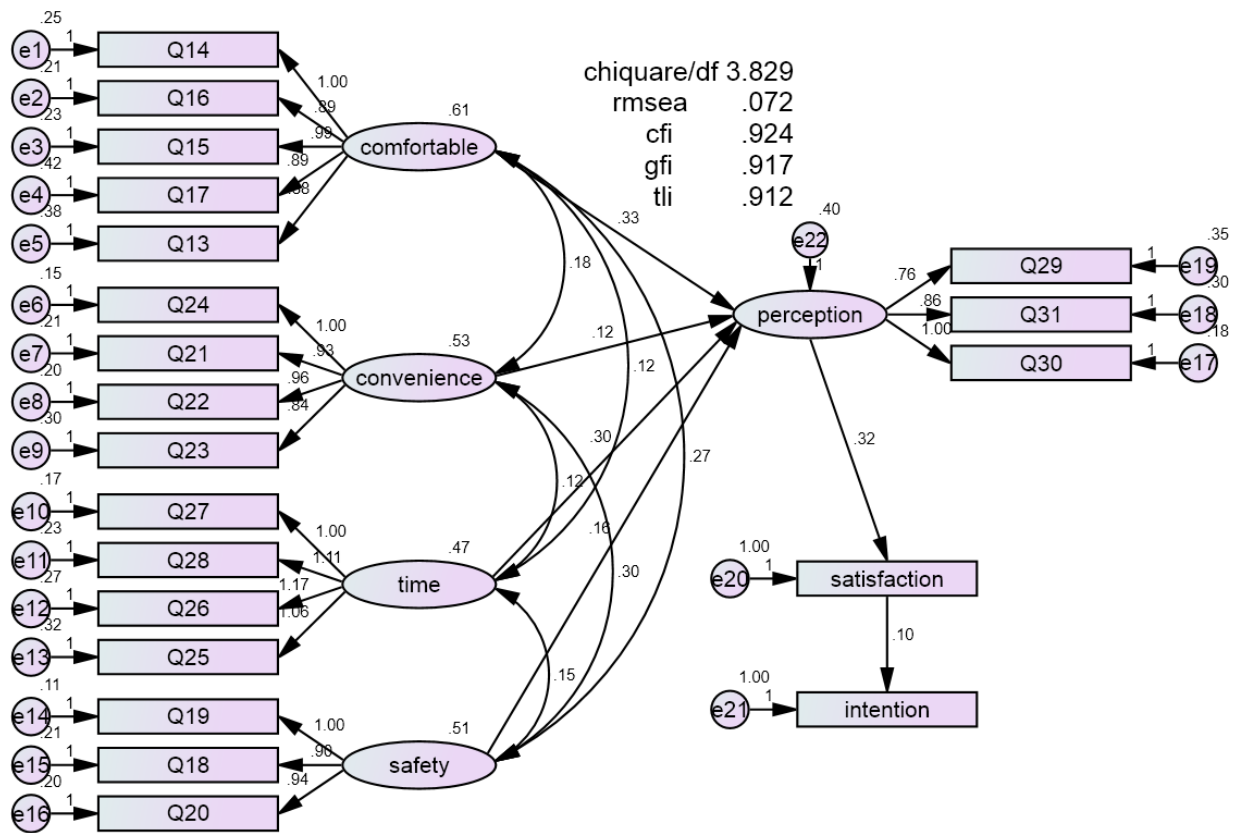
2.4 Research Hypothesis

The bus quality service and passengers' perceptions, which are related to satisfaction and bus choice, are the main points of the hypothesis. The comfortable and convenience, time and safety of bus are the aspects of passengers' perceptions as shown in the figure below.



3. Result and Discussion

	Relationship	St. factor loading	P-value
Comfortable	→ Perception	0.326	***
Time	→ Perception	0.299	***
Safety	→ Perception	0.162	0.14
Convenience	→ Perception	0.118	0.41
Perception	→ Satisfaction	0.322	***
Satisfaction	→ Intention	0.101	0.15



The factors "Comfortable" (Q13-Q17) had five variables, "Safety" (Q18-Q20) had three variables, "Convenience" (Q21-Q24) had four variables, and the factor "Time" had four variables (Q25 – Q28). Using Exploratory Factor Analysis (EFA), 16 qualitative characteristics of the city bus service were divided into four categories that most significantly influenced passengers' perceptions: Comfortable, Safety, Convenience, and Time. The second-order Confirmatory Factor Analysis (CFA) was employed to assess whether the factor structure was sufficient.

The result show that Comfortable has a substantial role, followed by Time, Safety, and Convenience, in that order. According to the result, there was a little statistically significant association between satisfaction and intention as well as a positive significant relationship between perceptions and satisfaction.

As the previous research, if existing goods or services please clients, they would continue to re-purchase or support a service or preferred items in the future. However, the findings showed that "Satisfaction" had little influence on the respondents' "Intention" to choose a bus. This result may imply that, in the context of HCMC, just enhancing bus service and boosting customer happiness would not greatly affect citizens' decisions to use a bus. This may be explained by the fact that individuals in HCMC specifically and in Vietnam in general have a strong habit of using personal vehicles and believe that owning a personal vehicle makes moving around more convenient. Therefore, in addition to improving bus service and increasing passenger satisfaction, the government needs to take simultaneous actions to change people's personal vehicle use habits.