

**THE UNIVERSITY OF DANANG
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**ANALYSIS OF FACTORS AFFECTING URBAN
RAIL TRANSIT USAGE IN MAJOR CITIES OF
VIETNAM AND PROPOSED MEASURES TO
INCREASE THE NUMBER OF USERS**

**Major : Transport Engineering
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SUMMARY OF DOCTORAL THESIS

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ABBREVIATIONS

	Vietnamese Term	English Term
AIC	Tiêu chuẩn thông tin Akaike	Akaike Information Criterion
ATT	Thái độ	Attitude
AVE	Phương sai trích trung bình trong đánh giá mô hình đo lường	Average Variance Extracted
BIC	Tiêu chuẩn thông tin Bayesian	Bayesian Information Criterion
BRT	Lý thuyết lý do hành động	Behavioral Reasoning Theory
CA	Hệ số tin cậy trong phân tích nhân tố	Cronbach's Alpha
CFA	Phân tích nhân tố khẳng định	Confirmatory Factor Analysis
COM	Tiện nghi	Comfort
COS	Tiết kiệm chi phí	Cost Saving
CRC	Điều kiện đông đúc	Crowded Conditions
ENB	Lợi ích về môi trường	Environmental Benefits
EFA	Phân tích nhân tố khám phá	Exploratory Factor Analysis
PT	Giao thông công cộng	Public Transport
HEB	Lợi ích về sức khỏe	Health Benefits
HTMT	Tỷ lệ đặc điểm dị biệt - đặc điểm đơn nhất trong đánh giá giá trị phân biệt	Heterotrait-Monotrait Ratio
INC	Sự bất tiện	Inconvenient
INA	Ý định sử dụng	Intention to Adopt
INR	Rủi ro truyền nhiễm	Infection Risk
LAA	Thiếu sự kết nối	Lack of Accessibility
LOY	Lòng trung thành	Loyalty

	Vietnamese Term	English Term
PBC	Kiểm soát hành vi được nhận thức	Perceived Behavioural Control
PHS_OB	Môi trường vật lý – trên tàu	Physical Servicescape (Onboard)
PHS_ST	Môi trường vật lý – tại nhà ga	Physical Servicescape (Station)
PSA_OB	Nhận thức về sự an toàn – trên tàu	Perceived Safety (Onboard)
PSA_ST	Nhận thức về sự an toàn – tại nhà ga	Perceived Safety (Station)
PSE_OB	Cảm nhận về an ninh – trên tàu	Perceived Security (Onboard)
PSE_ST	Cảm nhận về an ninh – tại nhà ga	Perceived Security (Station)
PLS-SEM	Mô hình phương trình cấu trúc theo phương pháp bình phương tối thiểu riêng phần	Partial Least Squares Structural Equation Modeling
SAT_OB	Sự hài lòng – trên tàu	Satisfaction (Onboard)
SAT_ST	Sự hài lòng – tại nhà ga	Satisfaction (Station)
SER	Rủi ro an ninh	Security Risk
SOR	Lý thuyết phản ứng của chủ thể với kích thích	Stimulus-Organism-Response Theory
SUN	Chuẩn mực chủ quan	Subjective Norm
TPB	Lý thuyết hành vi có kế hoạch	Theory of Planned Behavior
TRS	An toàn	Traffic Safety
VAC	Giá trị tương thích	Value Compatibility
WOP	Hiệu suất kém	Worst Performance
URT	Đường sắt đô thị	Urban Rail Transit
ATGT	An toàn giao thông	

INTRODUCTION

1. Rationale of thesis

The rapid urbanization process in Vietnam is putting significant pressure on urban transport infrastructure, leading to congestion, pollution, and energy consumption. In this context, public transport (PT) is considered a key solution, with urban rail transit (URT) playing the role of the “backbone” due to its large passenger capacity, safety, reliability, and environmental friendliness. However, in major cities such as Hanoi and Ho Chi Minh City, the share of PT usage remains low, at around 10–15% of total travel demand, mainly from buses, while the URT system is still in its early development stage. Some newly operated lines, such as the Cat Linh–Ha Dong line in Hanoi or Metro Line 1 (Ben Thanh–Suoi Tien) in Ho Chi Minh City, have begun to attract passengers but have yet to reach their full potential and expected targets.

According to the railway network plan for the period 2021–2030, with a vision to 2050, Hanoi is expected to develop 14 lines (~619 km) and Ho Chi Minh City 12 lines (~510 km). These aim to expand and modernize the public passenger transport network, while effectively connecting urban cores with suburban areas, satellite towns, and inter-provincial economic corridors. However, to make these goals a reality, an approach from the user perspective is required, focusing on two main groups: (1) potential passengers (those who have never used URT) – identifying motivating factors and barriers to encourage their use; and (2) current passengers – identifying factors that maintain loyalty and promote long-term commitment to using URT.

Currently, domestic studies on URT usage behavior are still

limited, particularly with no research providing a comprehensive analysis of both usage intention and loyalty, while also considering the influence of the physical servicescape at stations and on trains. This gap calls for a study with a solid theoretical foundation and practical relevance, providing scientific evidence for policy-making and solutions to enhance URT usage in major cities.

Based on this analysis, the doctoral dissertation titled “*Analysis of factors affecting urban rail transit usage in major cities of Vietnam and proposed measures to increase the number of users*” is necessary and holds both theoretical and practical significance.

2. Research objectives

General objective: The study aims to examine the factors influencing the intention to use among people who have never used urban rail transit (URT), as well as the factors affecting loyalty among current users. Based on these findings, it proposes appropriate policies and solutions to both increase the intention to use and strengthen user loyalty, thereby contributing to raising the proportion of URT users.

Detailed objectives:

- + To develop a research model on the factors influencing the intention to use and loyalty toward URT services, based on fundamental theoretical frameworks and tailored to the context of Vietnam, ensuring both scientific rigor and practical applicability.

- + To develop a standardized survey questionnaire as a research tool, building upon validated measurement scales from reputable studies, while adjusting the content to suit the behavioral characteristics, language, and culture of urban residents in Vietnam.

- + To identify and analyze the factors affecting the intention to use URT among potential passengers and the loyalty of passengers

who have already used the service.

+ To propose policy solutions based on the research findings to promote the intention to use and strengthen user loyalty toward URT services.

3. Subject and scope of the research

- **Research Subject:** The subject of research is the factors influencing the intention to use and loyalty toward URT services, as well as the relationships between these factors.

+ **Survey subjects:** Two groups of passengers:

(1) Potential passengers (those who have never used URT)

(2) Passengers who have already used URT

- **Scope of the Research:** The URT systems in two major cities of Vietnam: Ho Chi Minh City and Hanoi.

- **Scope of application:** As the measures are based on context-specific empirical results, their effectiveness may vary with changing conditions and resources. Assessing effectiveness and feasibility requires rigorous, post-intervention evaluation; therefore, the dissertation provides directional recommendations only.

4. Scientific and practical significances

- **Scientific Significance:** This study expands the understanding of URT user behavior in Vietnam by developing and validating a theoretical model, clarifying the factors that influence usage intention and loyalty. The findings provide empirical evidence to support behavioral theories within the specific context of Vietnam.

- **Practical Significance:** The study results offer a scientific basis for formulating policies and solutions for the development of URT, focusing on improving service quality, enhancing passenger experience, and encouraging sustainable usage.

5. Research methodology and research framework



Figure II – Research framework

Research Methodology: This study applies a quantitative, explanatory research approach. The research model is based on the Behavioral Reasoning Theory (BRT) for the group that has not used urban rail transit (URT), and the Stimulus–Organism–Response (SOR) theory for the group of existing users. Data were collected through direct questionnaire surveys, using convenience sampling with quality control of responses. Data analysis was conducted using SPSS and SmartPLS, following steps including descriptive statistics, reliability testing of measurement scales (Cronbach’s Alpha, Composite Reliability), assessment of convergent and discriminant validity (AVE, HTMT, Fornell–Larcker), and structural equation modeling (SEM) to test causal relationships among variables.

6. New contributions of thesis

The study develops and validates a model of URT user behavior based on consumer behavior and transportation behavior theories, tested in Vietnam - where the service is still new and habitual use has not been widely established. The main contributions include:

(1) Adding theoretical and methodological foundations to research on public transport user behavior, particularly regarding the intention to use and loyalty to URT in the context of a new service.

(2) For potential passengers, applying the BRT to comprehensively analyze the formation process of behavior, from motivating and against reasons to attitudes and behavioral intentions.

(3) For current users, focusing on analyzing the effects of the physical servicescape at stations and on trains on perceived safety, satisfaction, and loyalty.

(4) Developing measurement scales and survey questionnaires suited to the Vietnamese context to assess factors influencing intention

to use and loyalty toward urban rail transit, and to inform solution directions based on empirical findings and international experience.

7. General layout of thesis

The dissertation is structured with an Introduction, five chapters (Chapter 1 – 31 pages, Chapter 2 – 53 pages, Chapter 3 – 30 pages, Chapter 4 – 26 pages, and Chapter 5 – 40 pages), and a Conclusion and Recommendations section. It includes 36 tables and 30 figures. The total length is 201 A4 pages, excluding references and appendices.

CHAPTER 1: LITERATURE REVIEW

This literature review systematizes the factors influencing the intention to use and loyalty toward URT, identifies research gaps, and provides directions for expanding research in the context of Vietnam's urban transportation. In addition, several policies and solutions are analyzed and synthesized to serve as a foundation for proposing suitable measures for Vietnam.

1.1. Overview of research on intention to use

International research on the intention to use public transport, especially URT, has examined influencing factors from various perspectives such as attitudes, social norms, service quality, environmental aspects, and psychological factors. In high-income countries, the common approach is SEM based on the TPB, sometimes combined with other theories such as the TAM, CST, and PRT. In middle- and low-income countries, where PT and URT are less prevalent, most studies are quantitative, applying SEM or regression to analyze factors such as service quality, satisfaction, perceived value, travel behaviour, and perceived risks.

In Vietnam, most studies have focused on buses, applying TPB, logistic regression, or integrated models. Only a few studies address

URT, mostly at an initial stage, analyzing factors like travel time, cost, and seat availability. Overall, research on behavioral intention and psychological factors influencing URT choice in Vietnam remains very limited.

1.2. Overview of research on loyalty

Studies on loyalty to URT, have been widely conducted internationally. In high-income countries, SEM is typically used to analyze relationships among service quality, satisfaction, and loyalty, often expanded to include brand image, emotions, and word-of-mouth. In middle- and low-income countries, research is more limited, mostly concentrated in Asia, applying SEM or regression and increasingly integrating emotional and brand-related factors into models. In Vietnam, loyalty studies have so far been conducted only on buses, identifying key factors such as service quality, safety/security, image, satisfaction, and perceived health and environmental benefits. There is still no in-depth research on loyalty toward URT, making it essential to address this gap to inform public transport development policies.

1.3. Overview of policies and measures to increase PT/URT usage

The dissertation synthesizes international experience on policies and measures to enhance the use of public transport and URT, grouped into four main categories: (1) Communication to change perception and service image through education campaigns, promotions, and community partnerships; (2) Station space design and integrated experiences with added amenities and improved multimodal connectivity; (3) Safety and security assurance via lighting, cameras, security staff, and emergency drills; (4) Usage incentives including integrated ticketing, discounted fares, loyalty points, commercial perks, and support for vulnerable groups.

These solutions are illustrated with successful cases from both high- and middle/low-income countries, highlighting the need for a comprehensive, coordinated strategy that influences both public perception and real-life travel experiences to promote URT adoption.

1.4. Research gaps

Research has shown that the intention to use public transportation and passenger loyalty are influenced by numerous factors, varying across different transportation contexts. From this, several research gaps are identified:

- URT has not been extensively studied in the context of Vietnam's transportation system.
- Few studies on factors affecting URT usage intention emphasize the role of motivating and inhibiting reasons in shaping user attitudes, intentions, and behaviors.
- Research on loyalty to PT, particularly URT, has not simultaneously and comprehensively examined the influence of the physical servicescape at both stations and onboard trains.
- No comprehensive study has addressed policy directions and solutions to promote URT usage in Vietnam, based on the perspectives and practical needs of both current and potential users.

CHAPTER 2. THEORETICAL FOUNDATIONS, MODEL DEVELOPMENT, AND RESEARCH METHODS

2.1. Theoretical Foundations

This dissertation applies two main theoretical frameworks to analyze user behavior in URT services:

- *Behavioral Reasoning Theory (BRT)*: explains behavioral intention based on both “reasons for” and “reasons against,” in addition to traditional factors such as attitude, social norms, and perceived

behavioral control. BRT clarifies the origins of attitudes and decision-making, particularly relevant in the context where URT

- Stimulus–Organism–Response (SOR) theory is applied to study passenger loyalty, where the physical servicescape of URT (Stimulus) influences passenger satisfaction (Organism), which in turn leads to the behavioral response of continued usage (Response).

Using both BRT and SOR provides a comprehensive analytical framework, explaining the usage intentions of potential passengers and clarifying the mechanisms behind loyalty formation among current passengers in the context of URT development in Vietnam.

2.2. Research Model Development

The research outlines the development of two research models: (1) a model identifying factors influencing the intention to use URT among potential passengers and (2) a model identifying factors affecting loyalty among current passengers. These models were developed based on established theoretical foundations in user behavior and loyalty, while also incorporating findings from previous studies. Observable variables and hypothesized relationships were then defined, serving as the basis for questionnaire design and data analysis, ensuring both relevance and reliability when applied to the Vietnamese context.

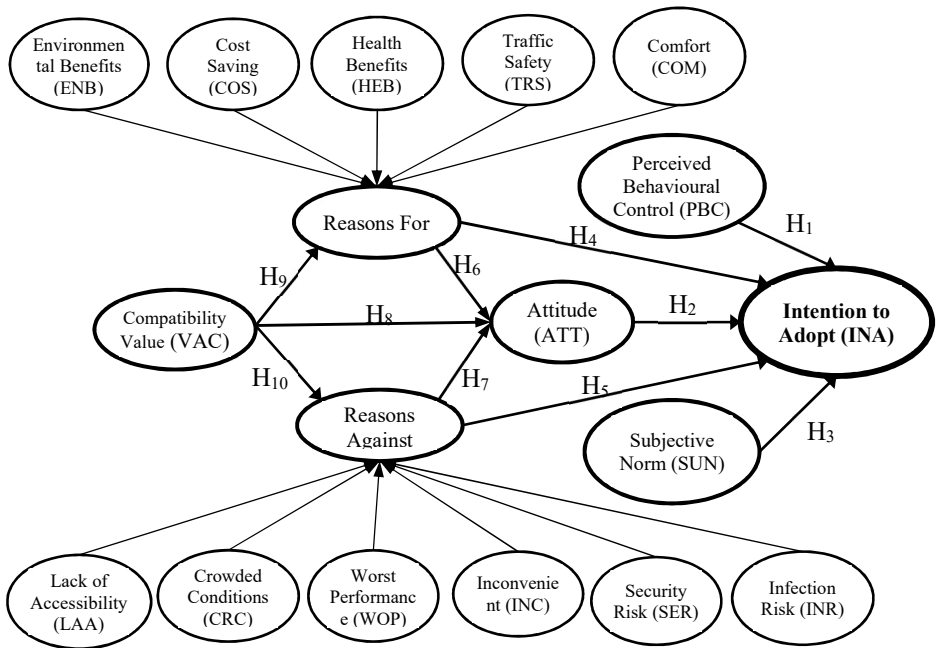


Figure 2.3 – Research model of urban rail transit usage intention

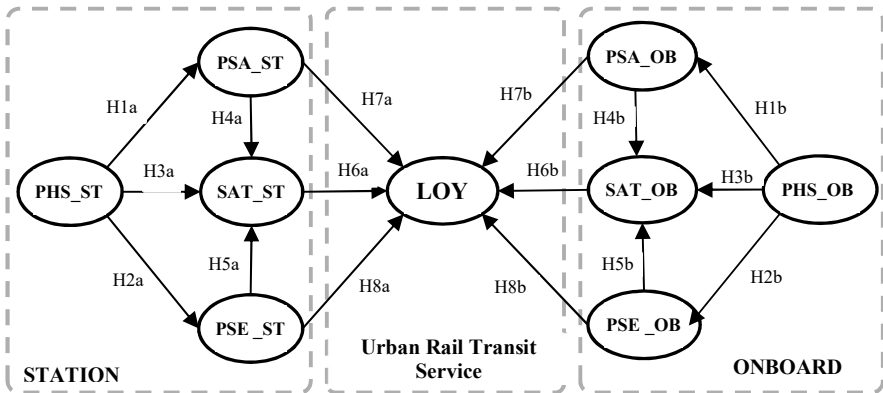


Figure 2.5 – Conceptual framework illustrating the relationships among safety perception, security perception, satisfaction, and loyalty

Notes:

PSA_ST: Perceived Safety (Station)
 PHS_ST: Physical Servicescape (Station)
 PSE_ST: Perceived Security (Station)
 SAT_ST: Satisfaction (Station)

PSA_ON: Perceived Safety (Onboard)
 PHS_ON: Physical Servicescape (Onboard)
 PSE_ON: Perceived Security (Onboard)
 SAT_ON: Satisfaction (Onboard)

2.3. Research Methodology

The quantitative research methodology was implemented following a structured sequence of specific steps: (1) questionnaire design, (2) data collection and preparation, and (3) data analysis.

(1) *Questionnaire design*: The research developed two distinct questionnaires:

- Target passenger group: A questionnaire designed to identify factors influencing intention to use URT (Questionnaire No. 1)
- Current user group: A questionnaire designed to analyze factors affecting customer loyalty (Questionnaire No. 2)

The questionnaires were refined based on expert opinions and pilot testing to ensure reliability and validity.

(2) *Data Collection and Preparation*

In this study, a random sampling procedure was employed to ensure the objectivity and representativeness of the dataset. Responses obtained from the two survey instruments underwent a systematic preprocessing protocol comprising the following stages: *data coding, data screening and verification, error detection and handling of outliers, data normalization and structuring*.

Table 2.3 – Summary of research data preparation

Content	Study Identifying Factors Influencing Intention to Use URT	Study Identifying Factors Affecting Passenger Loyalty to URT
Data Collection Method	Survey questionnaire (Questionnaire No. 1)	Survey questionnaire (Questionnaire No. 2)
Respondent Group	Potential urban rail transit users	Current urban rail transit users
Survey Area	Public areas within a 1 km radius of stations	Passengers waiting at stations and passengers onboard the train

Sample Size	Hanoi: 541 Ho Chi Minh City: 416	Hanoi: 445
Sampling Method	Random sampling	Random sampling
Measurement Scale	7-point Likert scale	7-point Likert scale
Data Analysis	- Descriptive statistics. - SEM	- Descriptive statistics. - SEM
Data Collection Period	Hanoi: 01/2024 Ho Chi Minh City: 10/2024	Hanoi: 4/2023

(3) Data Analysis

Initially, the dataset was cleansed, normalized, and encoded in accordance with the predefined research framework. Descriptive statistics were then computed to characterize the sample profile. Scale validation was conducted via reliability analysis and exploratory factor analysis to assess convergent and discriminant validity. Subsequently, the primary analytical technique (partial least squares structural equation modeling (PLS-SEM)) was applied to test the hypothesized causal relationships among the latent constructs. Data processing and analysis were facilitated by SPSS and SmartPLS, thereby leveraging the advantages of the PLS-SEM approach in behavioral research.

CHAPTER 3. FACTORS INFLUENCING CITIZENS' INTENTION TO USE URBAN RAIL TRANSIT

This chapter examines the determinants of prospective passengers' intention to use urban rail transit (URT). Descriptive statistics were generated with SPSS, and SmartPLS was employed to conduct PLS-SEM for evaluating the relationships among model constructs. The empirical findings are interpreted in the context of extant theory and prior studies.

3.1. Data preparation

A seven-point Likert questionnaire comprising 60 observed indicators measuring 16 theoretical constructs (adapted from previous research) served as the data collection instrument. After data cleaning and validation, 541 valid responses were obtained from Hanoi and 416 from Ho Chi Minh City.

3.2. Descriptive Analysis

Demographic profiling reveals that the Hanoi sample contained a higher proportion of female respondents (52,5%), an older average age, a greater share of married individuals (68,4%), and a larger percentage of university graduates (43,3% vs. 39,4%). Moreover, monthly incomes above VND 15 million were more prevalent in Hanoi (34,2%), as was full-time employment (66,9%). Conversely, the Ho Chi Minh City sample exhibited a higher postgraduate rate (18,0% vs. 8,3%), more respondents earning below VND 5 million per month (29,1%), and elevated proportions of students (19,7%) and part-time workers. Overall, Ho Chi Minh City's cohort tended to be younger, more frequently single, and more educationally diverse, whereas Hanoi's respondents reported higher median incomes and primarily full-time employment.

3.3. Results of the research model analysis on factors influencing URT usage intention

3.3.1. Measurement Model

- *At the first order*, confirmatory factor analysis (CFA) demonstrated that most observed indicators loaded above 0,70, except for WOP3 in Hanoi and SUN4 in Ho Chi Minh City, which were removed. Cronbach's Alpha, composite reliability (CR), and average variance extracted (AVE) for all constructs exceeded recommended

thresholds (0,70, 0,70, and 0,50), confirming reliability and convergent validity. Discriminant validity was established via the Fornell-Larcker criterion and HTMT ratios below 0,85.

- *At the second order*, the Hanoi model eliminated constructs ENB, CRC, INC, SER, and INR due to loadings below 0,50. In Ho Chi Minh City, the TRS indicator within “reasons for” was removed for nonsignificance, and within “reasons against” only CRC and SER were retained following iterative eliminations of underperforming factors.

The results indicate that both refined models satisfy the criteria for reliability, convergent validity, and discriminant validity, thereby clarifying the principal constructs influencing intention to use URT.

3.3.2. Structural Model

- Direct effects analysis indicated that in Hanoi, six of ten hypotheses were supported (H2, H3, H4, H6, H7, H9). Specifically, intention was positively influenced by attitude ($\beta = 0,191$), subjective norm ($\beta = 0,113$), and reasons for ($\beta = 0,160$). Reasons for significantly enhanced attitude ($\beta = 0,570$), whereas reasons against diminished it ($\beta = -0,142$). In Ho Chi Minh City, six hypotheses were likewise supported (H1, H2, H4, H6, H9, H10): attitude ($\beta = 0,300$), reasons for ($\beta = 0,344$), and perceived behavioral control ($\beta = 0,129$) exerted positive effects on intention, while compatibility values reduced reasons against ($\beta = -0,227$). Some relationships attained significance in one city but not the other, reflecting contextual perceptual differences.

- Total effects analysis identified reasons for as the strongest predictor in both contexts (Hanoi $\beta = 0,269$; Ho Chi Minh City $\beta = 0,524$), followed by attitude (Hanoi $\beta = 0,191$; Ho Chi Minh City $\beta = 0,300$)

and compatibility values (Hanoi $\beta = 0,062$; Ho Chi Minh City $\beta = 0,148$). Perceived behavioral control was only significant in Ho Chi Minh City, whereas subjective norm held significance solely in Hanoi. These results denote a common core of influential constructs alongside city-specific effect magnitudes.

Table 3.10 – Total effects of factors on usage intention in the proposed model

Path Relationships	Hanoi				Ho Chi Minh City			
	Coefficient	t-value	p-value	Result	Coefficient	t-value	p-value	Result
PBC → INA	0,053	1,135	0,257	Rejected	0,129**	2,208	0,027	Accepted
ATT → INA	0,191***	3,157	0,002	Accepted	0,300***	4,853	<0,001	Accepted
SUN → INA	0,113**	2,502	0,012	Accepted	0,036 ^{ns}	0,956	0,339	Rejected
REF → INA	0,269***	5,246	<0,001	Accepted	0,524***	9,445	<0,001	Accepted
REA → INA	0,001	0,031	0,976	Rejected	-0,040 ^{ns}	0,863	0,388	Rejected
VAC → INA	0,062***	3,211	0,001	Accepted	0,148***	3,727	<0,001	Accepted

Note: ^{ns} non-significant; *** $p < 0,01$; ** $p < 0,05$; * $p < 0,1$

3.4. Discussion

The study's comparative analysis of psychological determinants on URT usage intention between Hanoi and Ho Chi Minh City confirms the high applicability of the BRT model in the Vietnamese urban context, highlighting the prominent roles of attitude, perceived behavioral control, subjective norm, personal values, and both reasons for and against.

In Ho Chi Minh City, perceived behavioral control and compatibility values assume greater importance, indicative of residents' pragmatic flexibility. Conversely, in Hanoi, system performance and lack of accessibility more strongly affect attitude, suggesting a local preference for operational efficiency over personal perceptions. These findings highlight the necessity of tailoring URT policy and system deployment to each city's unique characteristics to optimize user acceptance.

CHAPTER 4. FACTORS INFLUENCING PASSENGER LOYALTY TOWARD URBAN RAIL TRANSIT

4.1. Data Preparation

The study employed a seven-point Likert questionnaire comprising 91 observed indicators measuring 15 theoretical constructs derived from prior literature. Respondents were selected via random sampling at stations and onboard along the Cat Linh-Ha Dong line. Of 450 distributed questionnaires, 445 valid responses remained for analysis after excluding incomplete or invalid data.

4.2. Descriptive Analysis

The demographic profile of the 445 survey participants was as follows: gender was evenly distributed (female 51,7%, male 48,3%); marital status comprised 52,6% single and 47,4% married; age groups were predominantly 16–25 years (192 respondents) and 26–35 years (90 respondents). Educational attainment included 40,9% university graduates, 29,0% high-school graduates, 24,72% postgraduate; the remainder held secondary (3,6%), college (0,67%), or below-secondary (0,45%) qualifications. Occupational status comprised 198 full-time workers and 172 students. Monthly income distribution was skewed toward under VND 5 million (38,4%), followed by VND 10–15 million (20,7%) and above VND 15 million (22,5%).

4.3. Results of the research model analysis of factors influencing URT usage loyalty

4.3.1. Measurement Model

The measurement model was evaluated at two levels:

- **First-order level:** (1) Indicator reliability was confirmed, as the majority of observed items loaded above 0,708; five items failed to meet this threshold and were removed, with remaining loadings

ranging from 0,706 to 0,968. (2) Internal consistency reliability was satisfactory, with all 15 latent constructs exhibiting Cronbach's Alpha and composite reliability exceeding 0,70. (3) Convergent validity was established, with average variance extracted (AVE) values for all constructs above 0,50 (range 0,612–0,909), indicating that the indicators adequately explained the intended constructs. (4) Discriminant validity was confirmed, with all HTMT ratios below 0.85, demonstrating distinctiveness among constructs.

- **Second-order level:** The physical servicescape construct comprised two higher-order dimensions (station environment and onboard environment) each with four subdimensions: ambient conditions (AMC), spatial layout and functionality (SLF), signage and wayfinding (SSA), and safety and security equipment (SSE). Multicollinearity diagnostics indicated all VIF values below 3,0, confirming the independence of subdimensions. In the station environment, the strongest contributors were AMC_ST (0,499), followed by SLF_ST (0,296), SSA_ST (0,247), and SSE_ST (0,221). In the onboard environment, SLF_OB (0,392) and AMC_OB (0,390) were most influential, followed by SSE_OB (0,271) and SSA_OB (0,261).

Overall, the measurement model satisfied all reliability, convergent, and discriminant validity criteria and clarified the role of each second-order dimension, providing a robust foundation for subsequent analyses.

4.3.2. Structural Model

Structural model evaluation revealed that 12 of the 16 hypothesized paths were supported.

- Direct effects: The physical servicescape(both at stations and

onboard) positively influenced perceived safety and perceived security, with a stronger effect on perceived safety. Passenger satisfaction was significantly affected by the physical servicescape, perceived safety, and perceived security; at stations, perceived security exerted the strongest influence, whereas onboard, the physical servicescape had the greatest effect. Furthermore, onboard satisfaction exerted a stronger effect on loyalty than station satisfaction.

- Total effects: Onboard factors (particularly satisfaction and physical servicescape) demonstrated substantially greater influence on loyalty than station factors. Onboard satisfaction emerged as the most potent predictor ($\beta = 0,439$), followed by onboard physical servicescape ($\beta = 0,346$) and onboard perceived safety ($\beta = 0,211$). Station-level effects were lower, with station physical servicescape registering $\beta = 0,094$.

Table 4.6 – Total effects

Total effects	Loading Coefficient	SD	t-value	p-value
Physical Servicescape (PHS_ST) → Loyalty(LOY)	0,094**	0,045	2,113	0,035
Satisfaction (SAT_ST) → Loyalty(LOY)	0,159**	0,066	2,398	0,017
Perceived Safety(PSA_ST) → Loyalty(LOY)	0,068 ^{ns}	0,067	1,020	0,308
Perceived Security (PSE_ST) → Loyalty(LOY)	0,012 ^{ns}	0,067	0,183	0,855
Physical Servicescape (PHS_OB) → Loyalty (LOY)	0,346***	0,055	6,233	<0,001
Satisfaction (SAT_OB) → Loyalty (LOY)	0,439***	0,064	6,846	<0,001
Perceived Safety(PSA_OB) → Loyalty(LOY)	0,211***	0,071	2,955	0,003
Perceived Security (PSE_OB) → Loyalty (LOY)	0,082 ^{ns}	0,062	1,323	0,186

Note: ^{ns} non-significant; *** $p < 0,01$; ** $p < 0,05$; * $p < 0,1$

4.4. Discussion

The findings indicate that the onboard physical servicescape, especially ambient conditions and spatial layout, is the principal driver of passenger satisfaction. Although safety and perceived security did not directly influence loyalty, they exerted indirect effects via satisfaction. Therefore, to enhance loyalty, practitioners should prioritize optimizing the physical servicescape, strengthening safety and security measures, and implementing customer-loyalty programs. These results offer scientific guidance for developing passenger retention and attraction policies, improving service quality, and expanding public transit accessibility.

CHAPTER 5. MEASURE TO INCREASE URBAN RAIL TRANSIT USER

5.1. Measures to enhance intention to use URT

This dissertation proposes a comprehensive set of measures to enhance citizens' intention to use urban rail transit, focusing on individuals who have never or infrequently used the service. These measures are grounded in the empirical findings of the research model and international best practices. Cross-cutting solutions for both cities target the primary determinants of usage intention, namely: reasons for (comfort, cost saving, improving safety, delivering health and environmental benefits, and increasing connectivity with other public transport modes); attitude (broadly communicating URT benefits, organizing free trial experiences, and integrating public transit education into school curricula); and compatibility values (tailoring services to travel habits and needs, ensuring flexible scheduling, and integrating convenient payment technologies).

The measures are prioritized and sequenced as illustrated in Figure 5.1 (based on the study’s total effects results in Table 3.10), to be implemented in concert so as to attract new users while reinforcing the confidence of existing passengers, thereby supporting the sustainable development of the URT system.

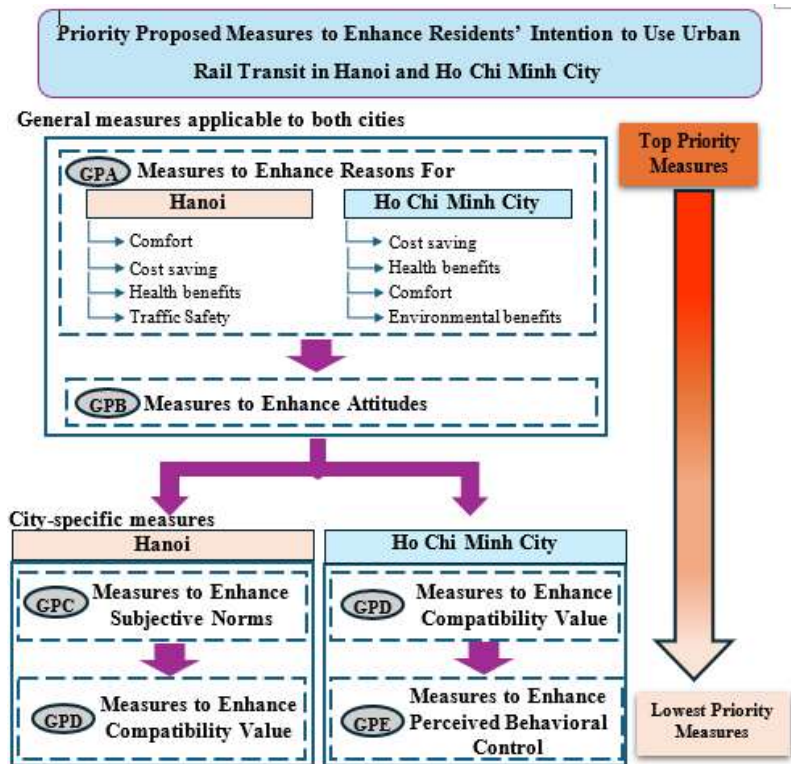


Figure 5.1 – Proposed measures diagram to enhance Intention to use Urban Rail Transit

5.2. Measures to enhance passenger loyalty

Based on experimental results identifying onboard satisfaction as the strongest loyalty driver (followed by the onboard physical servicescape and perceived safety), this dissertation

recommends targeted interventions to bolster passenger loyalty. Priority is given to improving the direct travel experience, including: elevating onboard satisfaction through enhanced services and amenities; upgrading the physical servicescape (spatial layout, functionality, ambient conditions, safety equipment, and signage) to increase comfort and reassurance; and strengthening perceived safety to meet passengers' rising security expectations. Although station-level effects were less pronounced, the measures also advocate for enhancing station satisfaction and investing consistently in station physical servicescapes to project a professional, modern, and cohesive system image.

These measures are prioritized and organized as depicted in Figure 5.7 (based on the study's total effects results in Table 4.6), concentrating resources on the most impactful factors while ensuring coherence and consistency in the passenger experience. The ultimate goal is a stepwise enhancement of service quality and passenger satisfaction, thereby cultivating and consolidating customer loyalty.

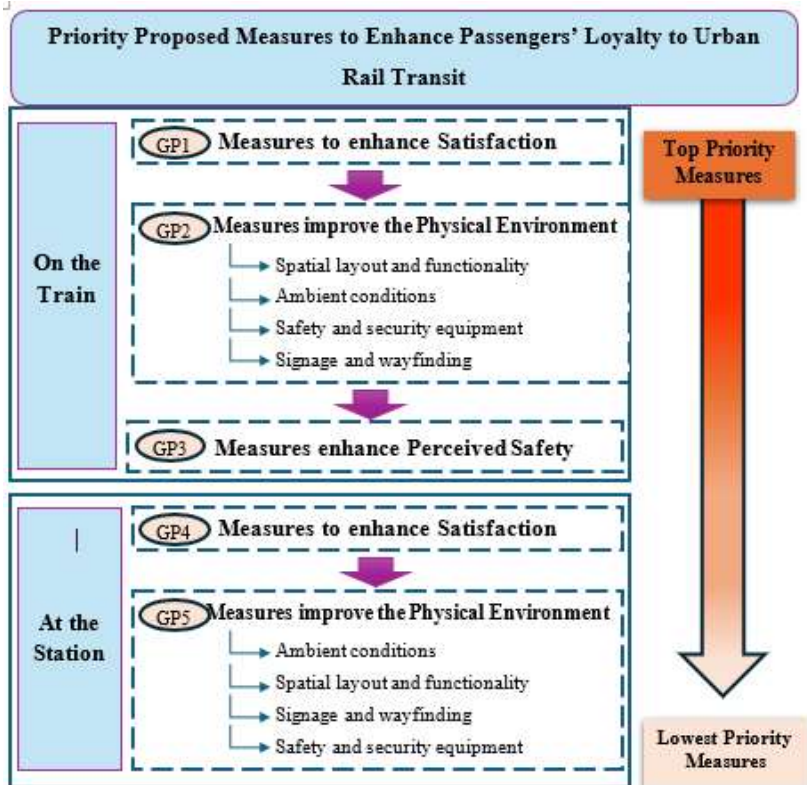


Figure 5.7 – Proposed measures diagram to enhance Passenger Loyalty in Urban Rail Transit

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS: This study has achieved its objectives, contributing both theoretically and practically to the Vietnamese urban transit context, which is under substantial pressure. The dissertation focuses on URT users, aiming to encourage non-users and infrequent users to adopt the service and to reinforce loyalty among current

passengers.

The principal contributions are as follows:

(1) Development of comprehensive, systematic research models that integrate previously under-examined determinants.

Model construction was based on a synthesis of multidimensional theoretical foundations, tailored to the Vietnamese context, thereby innovating and extending the scope of consumer behavior research in public transit and URT specifically.

(2) Creation of standardized measurement scales and survey instruments. The dissertation assembled and refined a scale of measures and questionnaires by selectively adapting established scales from reputable studies and adjusting them to align with the behavioral, linguistic, psychological, and cultural characteristics of Vietnamese urban residents. These instruments offer flexible applicability across contexts and time periods.

(3) Provision of a generalized procedure for formulating efficient, feasible policies grounded in empirical analysis and comparative review of prior research findings. By analyzing the effects of various determinants on URT intention and behavior, the dissertation proposes targeted policies to optimize implementation efficacy while ensuring compatibility with the sociocultural and urban mobility features of specific cities.

The findings not only inform present-day practice but also guide future urban transit planning and regional integration, particularly for major projects such as the Danang-Hoi An-Chu Lai line and the Thu Thiem-Long Thanh corridor, and support integration with the national high-speed rail network to establish a sustainable, highly connected public transit ecosystem.

RECOMMENDATIONS:

- **For regulatory authorities:** Intensify communication of URT benefits (cost savings, time efficiency, health, and environmental benefits), tailoring messages to local conditions; expand network coverage; promulgate service quality standards; and conduct regular satisfaction surveys to drive continuous improvement.
- **For operating enterprises:** Prioritize passenger satisfaction by enhancing the physical servicescape, safety systems, onboard amenities, and digital technologies (real-time monitoring, electronic payment, online ticketing). Concurrently, implement monthly-pass incentives and support programs for targeted user groups to improve accessibility, attract new riders, and strengthen loyalty.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

This research exhibits four principal limitations to be addressed in subsequent studies. First, loyalty surveys were conducted solely in Hanoi, precluding comparative validation in Ho Chi Minh City. Second, the closed-ended questionnaire method limits in-depth insight and underrepresents residents living farther from stations; thus, qualitative methods and broader sampling are recommended. Third, multi-group analysis (MGA) to explore differences by gender, age, or residential area was not performed. Fourth, the analysis focuses exclusively on users, omitting investor, operator, technical, and multimodal-connectivity perspectives.

These limitations suggest valuable avenues for future research, including extending surveys to other urban areas, integrating qualitative approaches, applying MGA techniques, and incorporating system-level, technical, and operational factors from investor and regulator viewpoints.

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- [2]. **Pham, Son. T.**, Nguyen, B. V., Le, M. T., Nguyen-Phuoc, D. Q., (2024). Sự hài lòng của hành khách sử dụng đường sắt đô thị bị ảnh hưởng như thế nào bởi các yếu tố xã hội và môi trường?. *Tạp chí Khoa học Công nghệ Giao thông Vận tải (ACI)*. Vol 75, Issue 07. (điểm HDGSNN 1.25)
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