DEVELOPING INDICATORS FOR SERVICE QUALITY IN URBAN RAIL TRANSPORTATION IN THAILAND

NATTIYA WONGLAKORN

A Thesis Submitted in Partial Fulfillment of the Requirements for the
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การพัฒนาตัวชี้วัดคุณภาพการให้บริการของรถไฟฟ้าในเขตเมือง ในประเทศไทย

นางสาวณัฐิญา วงละคร

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมศาสตรดุษฎีบัณฑิต
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DEVELOPING INDICATORS FOR SERVICE QUALITY IN URBAN RAIL TRANSPORTATION IN THAILAND

Suranaree University of Technology has approved this thesis submitted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy.

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ณัฐญา วงละคร: การพัฒนาตัวชี้วัดคุณภาพการให้บริการของรถไฟฟ้าในเขตเมืองในประเทศไทย (DEVELOPING INDICATORS FOR SERVICE QUALITY IN URBAN RAIL TRANSPORTATION IN THAILAND) อาจารย์ที่ปรึกษา: ศาสตราจารย์ ดร.วัฒนวงศ์ รัตนวราห, 112 หน้า.

คำสำคัญ: คุณภาพการให้บริการ/รถไฟฟ้าในเมือง/ตัวชี้วัด/การวิเคราะห์องค์ประกอบ/สมการโครงสร้าง/แบบจำลองมิมิค

การพัฒนาระบบโครงสร้างพื้นฐานการคมนาคมขนส่งและระบบขนส่งสาธารณะที่หลากหลาย อาทิ ระบบการขนส่งทางอากาศ ทางถนน และทางราง ฯลฯ ซึ่งระบบการขนส่งทางรางเป็นหนึ่งในระบบขนส่งสาธารณะที่ได้รับการสนับสนุนและถูกพัฒนาอย่างต่อเนื่อง โดยเฉพาะอย่างยิ่งรถไฟฟ้าในเขตกรุงเทพและปริมณฑลที่ประสบปัญหาการจราจรติดขัด การสนับสนุนและส่งเสริมให้คนเดินทางด้วยระบบขนส่งสาธารณะจึงเป็นสิ่งที่จำเป็นเพื่อลดและแก้ไขปัญหาดังกล่าว ดังนั้นการศึกษานี้จึงมีวัตถุประสงค์เพื่อศึกษาตัวชี้วัดคุณภาพการให้บริการของรถไฟฟ้าในเขตเมืองในประเทศไทย เพื่อกำหนดแนวทางในการกำหนดนโยบายและบริหารจัดการการให้บริการรถไฟฟ้าเพื่อตอบสนองต่อความต้องการของผู้ใช้บริการได้อย่างมีประสิทธิภาพและเหมาะสม

ในการศึกษานี้ได้ดำเนินการสอบถามความคิดเห็นของผู้ใช้บริการรถไฟฟ้าในเขตกรุงเทพและปริมณฑล โดยใช้แบบสอบถามที่พัฒนาขึ้นสำหรับการวิเคราะห์องค์ประกอบ (Factor Analysis) และการวิเคราะห์สมการโครงสร้าง (Structural Equation Modeling) ผลการวิเคราะห์ข้อมูลพบว่าคุณภาพการให้บริการของรถไฟฟ้าชานเมือง (Commuter Line) สามารถวัดได้จากความน่าเชื่อถือในการให้บริการ (Reliability) และคุณภาพการให้บริการของรถไฟฟ้าในเมือง (Urban Line) สามารถวัดได้จากความเอาใจใส่ในการให้บริการ (Empathy) และเมื่อพิจารณาภาพรวมของการบริการรถไฟฟ้าในพื้นที่ศึกษายังพบว่าความถี่ในการเดินทางไม่มีอิทธิพลผลต่อความภักดี ความพึงพอใจ และความผูกพันของผู้ใช้บริการ แต่การรับรู้คุณค่า (Perceive Value) ความไว้วางใจ (Trust) และการรับรู้คุณภาพการให้บริการ (Perceive Quality) มีอิทธิพลต่อความภักดี ความพึงพอใจ และความผูกพันมากที่สุด ดังนั้น การพัฒนาด้านคุณภาพการให้บริการของการขนส่งรถไฟในเขตเมืองควรตั้งของสถานีรถไฟฟ้าสามารถเชื่อมต่อกับการเดินทางกับการขนส่งอื่นๆ ได้อย่างสะดวก มีการตอบสนองต่อการจัดการเดินรถเมื่อมีปัญหาด้านการเดินรถและการบริการจะต้องมีการแจ้งข้อมูลสาเหตุและการดำเนินการให้ทราบ หน่วยงานภาครัฐและหน่วยงานเอกชนที่ร่วมลงทุนสามารถนำแนวทางไปใช้ในการกำหนดนโยบายการให้บริการได้

สาขาวิชา วิศวกรรมเครื่องกล ลายมือชื่อนักศึกษา.....

ปีการศึกษา 2565 ลายมือชื่ออาจารย์ที่ปรึกษา.....

ลายมือชื่ออาจารย์ที่ปรึกษาร่วม.....

NATTIYA WONGLAKORN: DEVELOPING INDICATORS FOR SERVICE QUALITY IN URBAN RAIL TRANSPORTATION IN THAILAND. THESIS ADVISOR: PROF. VATANAVONGS RATTANAVARAHA, Ph.D., 112 PP.

Keyword: Service Quality/City rail/Indicators Factor/Analysis/SEM/MIMIC Model

The development of transportation infrastructure: air, road, and rail, holds significant implications for areas with prevalent traffic congestion, such as Bangkok and its metropolitan region. A pivotal aspect of addressing this congestion lies in facilitating and promoting the adoption of public transport systems, which are considered crucial to effective mitigation strategies. In this respect, the 'City Train' presents itself as a viable transportation alternative that can contribute substantially to this mitigation effort. The aim of this research is to scrutinise the quality-of-service indicators associated with City Trains operating in urban areas of Thailand. By developing a thorough understanding of these indicators, the research aims to contribute to the enhancement of these services and, consequently, to the broader discourse on public transportation solutions.

In the context of this research, a comprehensive survey was administered among the users of the 'City Train' within Bangkok and its metropolitan vicinities. Empirical evidence was obtained via the employment of factor analysis and structural equation modelling techniques. The findings suggest that service reliability appears to be a decisive factor in gauging the quality of service on the commuter line. Conversely, service empathy emerged as the fundamental measure of service quality on the urban line. A holistic examination of the service quality indicators revealed that the frequency of travel does not materially influence the facets of loyalty, satisfaction, and commitment of these service users. Instead, perceived value, trust, and quality perception are what primarily shape these facets. Therefore, the enhancement of service quality within city railway transportation mandates the facilitation of seamless intermodal connections at stations. The strategic response to transportation incidents or disruptions in service ought to be characterised by timely notification, causative analysis, and decisive action. As part of the policy-making process, governmental bodies and private stakeholders investing collaboratively should implement

comprehensive guidelines ensuring that these standards are met and consistently maintained.

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Student's Signature.....
Advisor's Signature.....
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CHAPTER I

INTRODUCTION

1.1 Rationale for the Research

Traffic congestion problems in Bangkok and metropolitan areas are important problems that need to be resolved urgently. Due to these areas are the center of country's prosperity where located of government administration, commercial center, factory industry, transportation including educational center and social services which can be seen that the government has consistency realized and emphasized on solving these issue including developing the transport infrastructure to support the economic expansion and population growth rapidly, also reduce the travel time for the population better life quality. At present, consumers emphasize on the speed of travel, convenience, safety, and quality of services.

Currently, Thailand has developed the transport infrastructure system also the various choices of public transport such as air transport, road transport, water transport, and rail transport, etc. Rail transport is one of the transport systems which Ministry of Transport gives precedence to. The 20 years' Thailand Transport System Development Strategy (B.E. 2560-2579) focuses on transport infrastructure development especially rail transport network which is not covered and still incomplete (Ministry of Transport, 2016). Rail transport in Thailand can be divided into 2 categories which are Intercity Rail, that provides services for transporting passengers and goods between the cities within the country, and City Rail, provides passenger transport services in Bangkok and metropolitan areas.

Mass Rapid Transit Authority of Thailand was established according to Mass Rapid Transit Authority of Thailand Act B.E. 2543 and the objective is to operate the electric train business in Bangkok and metropolitan areas including the other provinces as prescribed by the Royal Decree. Mass Rapid Transit Authority of Thailand is responsible for studying, analyzing including preparing projects and plans which related to electric train business for modernly improvement and development in order to the

beneficial of organizations and people who use the electric train business services. When retraced back before the establishment of Mass Rapid Transit Authority of Thailand, the first electric train line in Thailand has been operating since B.E. 2542 was called Bangkok Mass Transit System Skytrain operated by Bangkok Mass Transit System Public Company Limited (BTS) who has the right to fully construct and manage the operation by the private sector. After Mass Rapid Transit Authority of Thailand was established and actuated aforesaid missions and lunched Blue Line (Ratchamongkon Line), followed with another electric train services by the State Railway of Thailand which named Airport Rail Link, provides routes where connects Suvarnabhumi International Airport with commercial center in Bangkok. This can be seen that the electric train system in urban areas has been continuously supported and developed in order to cover all essential urban areas. People who live in this area have changed their travel behavior pattern from private vehicle, public transport, and taxi to use more electric train services to avoid the traffic congestion which can be seen from the number of the passengers in urban areas who use the electric train services that increase every year, for example in B.E. 2561 BTS Skytrain has an average of 650,000 passengers who use the system a day and Metropolitan Rapid Transit (MRT) has an average of 312,000 passengers per day, etc. Therefore, public transport services are an important factor that will attract more passengers to use the services. Parasuraman, Zeithaml, and Berry (1985) found that the perception of the service quality of the passengers or customers can be assessed by comparing the needs or expectations with the actual services received and the perceived quality is a measure of customer satisfaction. Therefore, the service providers should study the customer satisfaction to be used as a guideline for quality improvement and service standards to enhance the quality of life and create the customer satisfaction, this can be applied for marketing strategy planning or determined the service policies also.

Therefore, this research aims to study the service quality indicators of City Rail in urban areas which can help the relevant organizations to know what the passengers expect from their service quality, perception, and satisfaction to be as a guideline of good quality management which appropriate and advert to passenger needs, also enlarged the opportunity of returning to services. Moreover, this is also a guideline for planning policies formulation, improvement, and development including strategic

arrangement for public sector and private sector who operate the City Rail in urban areas. Due to the different economic and social characteristics of Thai people such as gender, age, education level, income, etc. it is necessary to prudently study the relevant factors for the maximum benefit in order to apply the results of this research. The researcher defined the conceptual framework of the City Rail service quality in urban areas into 2 parts which are the service quality from facilities including infrastructure activities and the service quality from SERVQUAL, according to Parasuraman et al. (1985) to design the service quality measurement model, Causal Relationship model, travel behavior towards passenger loyalty, satisfaction and engagement, and perceived services quality model of City Rail in urban areas towards passenger loyalty. The results of research can summarize the importance indicators of the electric train service quality in urban areas.

1.2 Purpose of the Research

1.2.1 To develop the model for the service quality measurement of the City Rail transport.

1.2.2 To develop the Causal Relationship model of travel behavior toward the loyalty, satisfaction, and engagement of the passengers.

1.2.3 To develop the model to measure the passenger loyalty who use the City Rail transport.

1.2.4 To create the conceptual framework of the City Rail service quality toward the passenger loyalty.

1.3 Scope of the Research

This research has the following scopes:

1.3.1 Sample group: Study the group of people who experienced the electric train services in Bangkok and metropolitan areas.

1.3.2 The dimension of service quality: The service quality from facilities and infrastructure activities including the service quality from SERVQUAL.

1.3.3 Location: Study of the electric train system in urban areas at BTS Skytrain stations, Metropolitan Rapid Transit stations, and Airport Rail Link stations including the bus stops nearby.

1.3.4 Study period: February-March 2020.

1.4 Research Questions

1.4.1 What factors can be measured in the City Rail service quality in urban areas?

1.4.2 How are the traveling behaviors related to the passenger loyalty, satisfaction, and engagement?

1.4.3 How attitude related factors affect to the passenger loyalty of using City Rail transport in urban areas?

1.4.4 What should be the development of service quality model for City Rail transport in urban areas?

1.4.5 What should be the indicator development guidelines for passenger loyalty to City Rail transport in urban areas?

1.5 Contribution of the Research

The results of this research focus on the service quality of City Rail transport and passenger loyalty who experienced the services which this information can be used for planning, improving, and developing for City Rail services as follows:

1.5.1 The service quality measurement model of City Rail transport can be applied as a guideline support the development policy in order to the efficiently and appropriately respond to the needs of passengers.

1.5.2 The measuring passenger loyalty model who use the City Rail transport can be used as a guideline to increase the service potential to meet the passenger needs with efficiently, appropriately, and also enlarged the opportunity of returning to services.

1.5.3 The factors influencing passenger loyalty which obtained from this study can be applied in terms of planning policies formulation, improvement, and development including strategic arrangement for public sector and private sector who operate the electric train in urban areas.

1.5.4 Acknowledge for the personal factors which affect passenger satisfaction and passenger loyalty in terms of apply this as a guideline to increase the service potential to efficiently meet the passenger needs.

1.6 Organization of the Research

Chapter I: Mentioned about background of the study, research objectives, research boundary, and the expected benefits.

Chapter II: Exploring Passenger Loyalty and Related Factors for Urban Railways in Thailand.

Chapter III: A Measurement Model of the Service Quality of Electronic Trains in Bangkok and Its Neighborhoods.

Chapter IV: Travel Behavior Model Development and Attitude to the Loyalty, Satisfaction, and Commitment of Sky train Passengers in Urban.

Chapter V: Summarize the study result from 3 studies (Chapter II-IV).

1.7 References

Ministry of Transport. (2016). The 20 Years' Thailand Transport System Development Strategy (2017–2036). Retrieved from http://wise.co.th/wise/References/Supply_Chain/Transportation_Strategy_20_Year.pdf

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). A conceptual model of service quality and its implications for future research. Journal of marketing, 49(4), 41-50. doi:https://doi.org/10.2307/1251430

CHAPTER II
EXPLORING PASSENGER LOYALTY AND RELATED FACTORS FOR URBAN RAILWAYS IN THAILAND

2.1 Abstract

The research investigates the relationships among indicator related to loyalty of urban railways passenger in Thailand at 3 routes which consisted of BTS Sky train, MRT, and Airport Rail Link. The research instrument were 600 questionnaires, and the purpose was to study the indicator which affect to perceived service quality and the passenger loyalty by using the structure equation modeling. The analysis of influence information that affect to the passenger loyalty revealed that trust, satisfaction, appreciation, cost of service changing, and relationship have affected to the passenger loyalty with the statistically significant at 0.01 level. The satisfied variable was an important variable which affect to the passenger loyalty and was directly influenced from trust, appreciation, and perceived service quality. The perceived service quality was measured from 36 indicators and grouped into 5 complement groups which were station, news, services, staffs, and vehicle, respectively. Research finding was the cooperation concern with urban railways service can bring the result to apply with the marketing development strategy for being the sustainable method of standardized service and urban railways system improvement.

2.2 Introduction

Thailand has developed transport infrastructure and public transport systems, such as air, road, water, and rail transports on varying levels. Rail transport is one of the public transportation systems prioritized by the Ministry of Transport in Thailand. The 20 Years' Thailand Transport System Development Strategy (2017–2036) (Ministry of Transport, 2016), which focuses on developing transport infrastructure, especially rail transport that remains an incomplete network, supports this initiative. The rail transport system in Thailand can be categorized into intercity rail, which provides

services for passengers and goods transportation between cities, and urban rail, which offers services for passengers in Bangkok and its vicinity.The government has continually provided support and developed the urban elec-tric train system to ensure that routes cover essential metropolitan areas. People living in areas with access to electric trains have increasingly changed their means of transport from personal cars, public buses, and taxis to electric trains. The reason for this change is that they can avoid traffic jams and experience convenience in traveling, as evidenced by the increasing number of passengers using the electric train system in urban areas per year. For instance, in 2018, the Bangkok (Mass) Transit System Skytrain (BTS Skytrain) recorded an average of 6.5 million passengers per day. In the same manner, the Metropolitan Rapid Transit (MRT) pointed to an average of 3.1 mil-lion passengers per day. Consequently, public transport service is a crucial factor in attracting more passengers. (Anantharanthan Parasuraman, Zeithaml, & Berry, 1985) argued that passengers or us-ers' perceived service quality can be assessed by comparing their needs or expectations to the actual service received with perceived quality as an indicator of passenger sat-isfaction. Therefore, service providers examine passenger satisfaction to apply im-provements to quality and service standards for sustainable urban electric trains be-cause these aspects can enhance the quality of life and satisfaction of passengers. Furthermore, regarding Thailand Transport System Devel-opment plan, the urban electric trains system is considered and mentioned to develop covering in Bangkok and counties, as well as the major cities in every region in Thai-land. Thus, the findings can be applied to the formulation of marketing strategies or policies for various services in the future.

2.3 Literature Review

2.3.1 Service Quality

Service quality is a tool used to measure efficiency in meeting customer needs in the service business. A customer or service recipient will evaluate service quality based on experience versus expectation before using the service (Anantharanthan Parasuraman et al., 1985). According to the theo-retical framework of (Ananthanarayanan Parasuraman, Zeithaml, & Berry, 1988), the criteria for assessing service quality, namely, SERVQUAL, consists of five dimensions, namely, tangibles,

reliability, responsiveness, assurance, and empathy. A review of the previous literature indicates that studies on service quality are based on measurements that reflect the operating circumstances under consideration where service quality is hypothesized to exert a direct effect on perceived value (Bolton & Drew, 1991) (Zeithaml, Berry, & Parasuraman, 1988) and positive behavioral intentions (Kim, 2013). However, service quality is expected to exert an indirect effect (Andreassen & Lindestad, 1998) (Ostrowski, O'Brien, & Gordon, 1993) (Patterson & Spreng, 1997) (Pritchard & Howard, 1997) and a direct effect on loyalty (Boulding, Kalra, Staelin, & Zeithaml, 1993) (De Ruyter, Wetzels, & Bloemer, 1998) and overall satisfaction (Kim, 2013) (Cronin Jr & Taylor, 1992) (Caceres & Paparoidamis, 2007) (Muturi, Sagwe, & Namukasa, 2013). In addition, X. Zhang et al. (2020) investigated the satisfaction factors of public transport and railway consists, such as wait time, transfer convenience, service, information, passenger comfort, station environment, and inte-rior sanitation.

2.3.2 Customer Satisfaction

Satisfaction is feeling level of person which affect from the comparison between per-ceived service and expected service of each person. The customer can realize satisfac-tion with 3 levels as followings; Firstly, if the perceived service is lower than the ex-pected service, the customer will be dissatisfied. Secondly, if the perceived service is equal the expected service, the customer will be satisfied. Thirdly, if the perceived ser-vice is higher than the expected service, the customer will be satisfied very much. Grönroos (1990) said that the satisfaction of service consisted of 2 elements; 1) the ele-ment of perceived service which mean the customers will know that the service or goods have good quality as they have known and this will be satisfied to the custom-ers. 2) The element of perceived quality of service presentation. The customer will re-alize that which service presentation of service process is appropriate for them and all of these will be exactly satisfied to the customer.

2.3.3 Customer Loyalty

Loyalty denotes unity, encouragement, and strength or a feeling and expression of respect for another person. Specifically, brand loyalty refers to consistent satisfaction with or repurchase of a certain brand. Zeithaml, Berry, and Parasuraman (1996) and Bloemer, De Ruyter, and Wetzels (1999) used the customer behavior

intention criteria to summarize the factors used to meas-ure service loyalty, such as word-of-mouth, purchase intention, price sensitivity, and complaining behavior. Previous studies have found that customer loyalty is influenced by psychological or internal factors from consumers and external factors from the en-vironment. Such factors are customer expectation, perceived service quality, customer satisfaction, perceived value, customer trust, commitment, and attractiveness of competitors (Jomnonkwao, Ratanavaraha, Khampirat, Meeyai, & Watthanaklang, 2015).

The research that concerned about the perceived service quality, satisfaction, and loyalty of passengers who use service at public transportation such as bus, airline, and high-speed railway in abroad found that the perceived service was considered by SERVQUAL (De Oña, De Oña, Eboli, & Mazzulla, 2013) (Chou, Kim, Kuo, & Ou, 2011) (Wen, Lan, & Cheng, 2005). Moreover, K. Zhang, Zhou, and Zhang (2014) have studied the perceived service quality from vehicle indictor and there was a research group who studied 3 indicators: driver, vehicle, and admistrative management. The researcher has reviewed the re-search about BTS in Thailand that focus on the relationship between perceived service quality, satisfaction, and passenger loyalty by using the Marketing Mix Model (7Ps) and Thailand Customer Satisfaction Index Model (TCSI Model) to be concept of re-search Laohacharupat (2014) Changwetchay (2018) Rungthong (2011); According to previously study, there is limitation of indicator relation study about the public passenger loyalty. There was only (Ratanavaraha & Jomnonkwao, 2014) who studied the indicator of public driver. Trust the researcher de-cided to study the relation of the indicator about the perceived service quality, satis-faction, and the loyalty of urban railways passenger in Thailand and the service quali-ty was considered from the main facilities and Infrastructure.

2.3.4 Research Purpose

The current study aims to investigate the indicators of the service quality of urban electric trains in Thailand using the structural equation model to examine perceived service quality and passenger loyalty toward electric train transportation with a con-ceptual research framework (Figure 2.1). The models were examined under 10 hypotheses.

Hypothesis 1 (H1): Perceived service quality exerts a positive effect on customer satisfaction.

Hypothesis 2 (H2): Perceived service quality exerts a positive effect on customer trust.

Hypothesis 3 (H3): Perceived service quality exerts a positive effect on customer perceived value.

Hypothesis 4 (H4): Service satisfaction exerts a positive effect on customer loyalty.

Hypothesis 5 (H5): Perceived service quality exerts a positive effect on customer satisfaction.

Hypothesis 6 (H6): Perceived service value exerts a positive effect on customer loyalty.

Hypothesis 7 (H7): Trust exerts a positive effect on customer loyalty.

Hypothesis 8 (H8): Trust exerts a positive effect on customer satisfaction.

Hypothesis 9 (H9): Switching exerts a negative effect on customer loyalty.

Hypothesis 10 (H10): Commitment exerts a positive effect on customer loyalty.

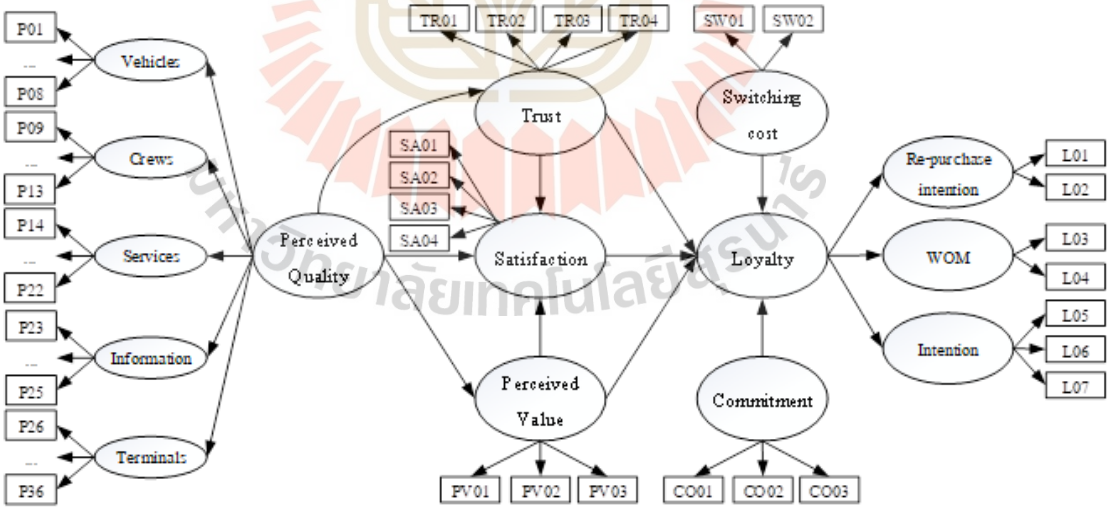

Figure 2.1 Conceptual framework

2.4 Research and Methodology

2.4.1 Sample

Bloemer et al. (1999) suggested that the appropriate sample size for developing a structural equation model should be approximately 500. In the current study, proceeding of data collection was during February to March 2020. The samples consisted of 600 users of urban electric trains in Thailand which travel 3 routes, and use quota sampling for sample choosing. The samples consisted of BTS Skytrain (n = 200; 33.33%), MRT users (n = 200; 33.33%), and Airport Rail Link (n = 200 33.33%). Face-to-face interviews were conducted to collect data from electric train users around the stations and bus stops (the samples were from the passenger who were going to use service and who already used the service) near the stations of Chalong Ratchadham Line, Cha-loem Ratchamongkhon Line, Sukhumvit Line, Silom line, and Airport Rail Link. The interview of samples took 5-10 minutes per person.

2.4.2 Variables

A total of seven major variables were analyzed, namely, satisfaction, perceived quality, loyalty, trust, perceived value, relationship, and cost of switching service pro-viders with 59 indicators to measure the expectation and perceived quality of electric train users in urban areas. Each item is rated using a 7-point Likert-type scale (7 = Strongly agree to 1 = Strongly Disagree).

2.4.3 Reliability of the Questionnaire

To verify the quality of the research tool, five experts examined content validity and considered the consistency of each question by analyzing and scoring the ques-tions against the index of item objective congruence (IOC). The IOC index was higher than 0.5, that mean the content validity of the questionnaire is within the acceptable range. Then, a pilot study was piloted with 50 respondents who were excluded from the research. Reliability was analyzed using Cronbach's alpha coefficient. The results indicated a Cronbach's alpha coefficient of 0.784–0.965, which was greater than 0.7 (Tavakol & Dennick, 2011).

2.4.4 Structural Equation Model

The study of the relationship between variables in a structured manner began during the early 1900s when Spearman developed an analytical method that can be considered a prototype of today's elemental analysis. The author can then be regarded as the first person who elucidated the relationship between latent and structural vari-ables in 1904 (Golob, 2003). Moreover, Wright (Wright, 1918) was the first to examine causal modeling and develop the analytical method-a model of path analysis that can be considered the fundamental analysis of the structural equation model (Golob, 2003) (R. B. Kline, 2010). In addition, Churproong, Khampirat Churproong, Khampirat, Matrakool, Phuangphairote, and Intra (2012) explained that the structural equation model is known by several names, such as covariance structure analysis. The SEM illustrates the relationship between latent variables and latent variables and that between latent variables and observable variables. The Structural Equation Modeling (SEM) was utilized to measure the correlation of variables in the theoretical model to illustrate the relationship between latent variables and observable variables. This model is formed through the synthesis of three essential data analysis methods, namely, fac-tor analysis, path analysis, and parameter estimation, in regression analysis. The structural equation model consists of two sub-models, namely, the measurement mod-el and structural model. SEM was analyzed using Mplus version 7.2 by the maximum likelihood method.

2.5 Results

2.5.1 Descriptive Analysis

Table 2.1 presents the analysis of the frequency and percentage of fundamental data from the 600 samples, such as passenger characteristics, travel routes, and frequency of use of service. The sample comprises 353 women (58.83%), 47 students (7.83%) be-low high school or equivalent, 104 students (17.33%) with a high school level or voca-tional certificate, 50 students (8.33%) with a higher vocational certificate, 363 people (60.50%) with bachelor's degree, and 36 people (6%) at the post-graduate levels. A to-tal of 176 individuals (29.33%), earn more than 30,000 baht per month (this study was defined to be a group of the highest earner by using income regulation that start from income of undergraduates), whereas the majority (317; 52.83%) are company employees.

Table 2.1 Participants' characteristics

	Sample Categories	Frequency	Percent
Route	BTS	200	33.33
	MRT	200	33.33
	ARL	200	33.33
Gender	Male	247	41.17
	Female	353	58.83
Education	Mattayom 3 (Grade9) and lower	47	7.83
	Mattayom 6 (Grade12)/vocational certificate	104	17.33
	Diploma / high vocational certificate	50	8.33
	Bachelor's degree	363	60.50
	Master's degree and Doctoral 's degree	36	6.00
Income	less than 10,000 THB	8	1.33
	10,000 - 14,999 THB	40	6.67
	15,000 - 19,999 THB	158	26.33
	20,000 - 24,999 THB	142	23.67
	25,000 - 29,999 THB	76	12.67
	30,000 THB and above	176	29.33
Occupation	Government / State Enterprises	57	9.50
	company employees	317	52.83
	Personal business	121	20.17
	Farmers	1	0.17
	Students	25	4.17
	Other	79	13.17
Frequency	1-3 days/week	389	64.83
	4-5 days/week	167	27.83
	Everyday	44	7.33
	Total	600	100

Analysis of fundamental statistical values of the 59 indicators consisted of basic sta-tistics, standard deviation, skewness, and kurtosis (Table 2.2 provides a detailed analy-sis). The indicators are divided into seven groups as follows.

1) Service quality indicators (36 variables) with five categories, namely, vehicles, staff, services, information, and stations. The result suggested that the indicator with the highest average was P28: The station is clean (mean = 5.97; SD = 1.10) followed by P13: The staff provides accurate and reliable information and services before traveling (mean = 5.94; SD = 1.02).

2) Loyalty indicators (7 variables) with three categories, namely, word-of-mouth, identification, and repurchase. The indicator with the highest average was L01: I will use the "electric train" service for the next trip (mean = 5.59; SD = 0.88) followed by L02: If fare levels and service quality are well maintained, then I will use the "electric train" service regularly (mean = 5.56; SD = 1.00).

3) Perceived service value indicators (3 variables). The indicator with the highest average was PV02: I accept the service I received compared to the money I paid; it is reasonable (mean = 5.39; SD = 1.03).

4) Service satisfaction indicators (4 variables). The indicator with the highest av-erage was SA02: I will use the "electric train" service on the next trip (mean = 5.59; SD = 0.88).

5) Trust indicators (4 variables). The indicators with the highest average were TR02: The "electric train" is a form of transport that I can always trust (mean = 5.53; SD = 0.99) and TR04: Overall, I am satisfied with the service provided by the "electric train" (mean = 5.53; SD = 1.14).

6) Cost of switching service providers (2 variables). The indicator with the highest average was SW01: I can waste time searching for information on "other forms of transport" that provide better service on the next trip (mean = 4.73; SD = 1.22).

7) Relationship with service providers (3 variables). The indicator with the highest average was CO03: I think traveling by "electric train" is an important form of transport for the country's development (mean = 5.77; SD = 1.16).

The maximum likelihood estimation method was used to analyze the distribution characteristics of the data. The method requires that data must have a

normal distri-bution determined by skewness and kurtosis. Table 2 points to negative skewness val-ues between −0.37 and −1.47, whereas kurtosis values ranged between −0.11 and 3.21. In summary, skewness was less than 3.0, whereas kurtosis was less than 10. This find-ing indicates that data has a normal distribution (R. B. Kline, 2010). The data are, therefore, appro-priate for further analysis of the composition.

Table 2.2 Descriptive statistics

Item	Description	Mean	SD	Sk	Ku
P01	The condition inside the car is clean and tidy.	5.92	1.07	-1.47	3.15
P02	The temperature inside the car is cool.	5.84	1.11	-1.35	2.72
P03	The seats are clean.	5.74	1.1	-0.88	0.58
P04	The seating arrangement is reasonable.	5.55	1.16	-0.72	0.41
P05	Luggage compartments are large, available, and sufficient.	5.4	1.28	-0.82	0.43
P06	There is security against criminals and crimes on board.	5.68	1.1	-1.08	1.71
P07	Seating for special people, such as elders, persons with disabilities, and pregnant women, are arranged in a good location and have a reasonable amount of space.	5.7	1.18	-1.2	1.73
P08	The convoy is in new condition, looks good, and is attractive.	5.82	1.09	-1.2	1.79
P09	The staff provides fast and agile service.	5.73	1.13	-1.15	1.88
P10	The staff provides service with good manners.	5.82	1.02	-1.04	1.63
P11	There is adequate staff to facilitate when getting on and off the electric train.	5.63	1.05	-0.96	1.44
P12	When problems occur during the trip, the staff is willing to help resolve the issue.	5.74	1.13	-1.1	1.42

Table 2.2 Descriptive statistics (Continued)

Item	Description	Mean	SD	Sk	Ku
P13	The staff provides accurate and reliable information and services before traveling.	5.94	1.02	-1.46	3.21
P14	There are adequate ticket distribution channels.	5.75	1.07	-1	1.49
P15	The fare collection system is modern and accurate.	5.76	1.04	-1	1.41
P16	The fare collection and ticket distribution systems are user friendly.	5.66	1.11	-1.01	1.42
P17	The fare is reasonable.	5.36	1.27	-0.72	0.32
P18	The density of the train during rush hours is suitable.	5.31	1.37	-0.92	0.53
P19	The density of the train during non-rush hours is suitable.	5.4	1.21	-0.87	0.7
P20	The frequency of the train is appropriate and sufficient.	5.6	1.14	-0.91	0.86
P21	Organize a promotion for passengers.	5.32	1.26	-0.66	-0.05
P22	There is a special discount for passengers with prepaid tickets.	5.32	1.25	-0.73	0.36
P23	There are announcements regarding arrival time and change in the departure time of the train.	5.68	1.06	-0.86	0.82
P24	There is a channel for complaints at the station via telephone or online.	5.47	1.36	-0.93	0.29
P25	The station has sufficient navigation signs and travel information.	5.73	0.85	-0.58	0.77
P26	The suitability of the station location allows easy access to services.	5.78	1.08	-0.92	1.23
P27	Facilities, such as passenger elevators, promote access to the station for persons with disabilities.	5.85	1.04	-1.06	1.48

Table 2.2 Descriptive statistics (Continued)

Item	Description	Mean	SD	Sk	Ku
P28	The station is clean.	5.97	1.1	-1.21	1.65
P29	There is a suitable waiting area for buying tickets.	5.61	1.1	-0.95	1.19
P30	The ticket-checking machines for accessing the platform are sufficient wide to walk through.	5.61	1.05	-0.9	1.03
P31	Convenient walkways, such as the Sky Walk, connect to essential places.	5.63	1.23	-0.95	0.68
P32	There is security against criminals and crime at the station.	5.64	1.1	-0.94	1.21
P33	There are other facilities, such as Wi-Fi, services, and shops within the station.	5.66	1.06	-0.75	0.36
P34	The station's ascent and descent are convenient and safe.	5.73	0.98	-1.13	2.72
P35	It is convenient to connect to other transportation systems.	5.75	1	-1.07	1.96
P36	The arrangement of the platform area is appropriate.	5.61	1.05	-1.05	1.62
L01	I will use the "electric train" service for the next trip.	5.59	0.88	-0.39	0.42
L02	If fare levels and service quality are well maintained, I will use the "electric train" service regularly.	5.57	1	-0.53	0.03
L03	I will mention only good things about travel on "electric trains" with others.	5.45	1.01	-0.53	0.59
L04	I will encourage friends and acquaintances to travel by the "electric train."	5.48	1.01	-0.59	0.54
L05	I rank this "electric train" as the first mode of transport for each trip.	5.17	1.14	-0.52	0.1

Table 2.2 Descriptive statistics (Continued)

Item	Description	Mean	SD	Sk	Ku
L06	I think the “electric train” is the best choice.	5.19	1.23	-0.73	0.4
L07	I will not be interested in other modes of transportation besides the “electric train.”	4.72	1.54	-0.55	-0.28
PV01	Compared to the services I received; I think it is worth the money.	5.38	1.04	-0.37	-0.12
PV02	I accept the service I received compared to the money I paid; it is reasonable.	5.4	1.04	-0.4	-0.12
PV03	When I travel by the “electric train,” I think it is more rewarding than other transportation forms.	5.29	1.12	-0.45	0
SA01	I am pleased to use the “electric train” service.	5.41	1.05	-0.46	0.11
SA02	Overall, I am satisfied with the service provided by the “electric train.”	5.53	1.03	-0.74	0.68
SA03	The quality of service I received was more than expected.	5.37	1.05	-0.63	0.51
SA04	The quality of service I received is at the service level I dreamed of.	5.27	1.13	-0.64	0.36
TR01	I believe that traveling by the “electric train” is the best form of transportation.	5.47	1.05	-0.47	0.2
TR02	The “electric train” is a form of transport that I can always trust.	5.54	1	-0.63	0.84
TR03	The “electric train” is a form of transport that knows what to do to satisfy customers.	5.49	1.06	-0.73	0.89
TR04	The “electric train” is a very reliable form of transport.	5.53	1.15	-0.74	0.48
SW01	I can waste time searching for information on “other forms of transport” that provide better service on the next trip.	4.74	1.22	-0.45	-0.11

Table 2.2 Descriptive statistics (Continued)

Item	Description	Mean	SD	Sk	Ku
SW02	I will pay more to switch to “other forms of transport” if they provide better service.	4.61	1.32	-0.41	-0.14
CO01	I am proud to use the “electric train” service.	5.26	1.12	-0.47	0.4
CO02	I am concerned about the long-term success of “BTS/MRT/Airport Rail Link.”	5.33	1.09	-0.31	-0.17
CO03	I think traveling by the “electric train” is an important form of transport for the country’s development.	5.77	1.17	-0.9	0.58

2.5.2 Structural Equation Model

2.5.2.1 Goodness-of-fit Statistics

The model was found to be relatively consistent with empirical data (chi-squared = 4523.458, df = 1671, p < 0.001, CFI = 0.901, TLI = 0.900, SRMR = 0.061, RMSEA = 0.053). Table 2.3 provides the details.

Table 2.3 Cut-off values of model fit indices

Model fit index	Cut-off value	References
χ^2/df χ^2/df	<3	P. B. Kline (2005)
SRMR	≤ 0.08	Hu and Bentler (1999); Wu, Taylor, and West (2009)
RMSEA	≤ 0.07	Steiger (2007)
CFI	≥ 0.90	Hu and Bentler (1999)
TLI	≥ 0.80	Hooper, Coughlan, and Mullen (2008)

2.5.2.2 Measurement Model

According to the conceptual framework of the research, results of the structural equation model (Figure 2.1 and Table 2.4) confirm one endogenous variable, namely, loy-alty, and six exogenous variables, namely, service quality, perceived service value, ser-vice satisfaction, trust, cost of switching, and commitment. The exogenous variables are described as follows.

Table 2.4 Results of measurement model

Item	Description	Loading	t-value	Error Variance
Second-ordered measurement model				
	Perceived quality			
PQ01	Vehicles	0.981**	154.671	0.006
PQ02	Crews	0.984**	179.870	0.006
PQ03	Services	0.985**	178.441	0.006
PQ04	Information	0.994**	106.516	0.009
PQ05	Terminals	0.998**	239.268	0.004
	Loyalty			
LY01	Word of mount	0.975**	51.663	0.019
LY02	Identification	0.653**	21.876	0.030
LY03	Re-purchase	0.894**	42.113	0.021
First-ordered measurement model				
	Vehicles (Cronbach's Alpha = 0.909, AVE=0.740, CR=0.909)			
P01	The condition inside the car is clean and tidy.	0.756**	39.997	0.019
P02	The temperature inside the car is cool.	0.770**	42.571	0.018
P03	The seats are clean.	0.752**	41.648	0.018
P04	The seating arrangement is reasonable.	0.731**	35.442	0.021
P05	Luggage compartments are large, available, and sufficient.	0.643**	25.601	0.025
P06	There is security against criminals and crimes on board.	0.720**	34.460	0.021
P07	Seating for special people such as elders, disabilities, pregnant women, etc. are arranged in a good location and have a reasonable amount.	0.702**	32.211	0.022

Table 2.4 Results of measurement model (Continued)

Item	Description	Loading	t-value	Error Variance
P08	The convoy is in new condition, looks good, and attractive.	0.782**	45.198	0.017
	Crews (Cronbach's Alpha = 0.869, AVE=0.750, CR=0.876)			
P09	The staff provides fast and agility service.	0.799**	50.100	0.016
P10	The staff provides service in good manners.	0.695**	31.049	0.022
P11	There is adequate staff to facilitate when getting on and off the electric train.	0.770**	43.418	0.018
P12	When problems occur during the trip, the staff is willing to help resolve the issue.	0.739**	38.225	0.019
P13	The staff provides accurate and reliable information and services before traveling.	0.770**	43.858	0.018
	Services (Cronbach's Alpha = 0.898, AVE=0.700, CR=0.904)			
P14	There are adequate ticket distribution channels.	0.720**	34.185	0.021
P15	The fare collection system is modern and accurate.	0.766**	41.979	0.018
P16	The fare collection and ticket distribution systems are user friendly.	0.754**	40.560	0.019
P17	The fare is reasonable.	0.634**	24.717	0.026
P18	The density of the train during rush hour is suitable.	0.641**	25.274	0.025

Table 2.4 Results of measurement model (Continued)

Item	Description	Loading	t-value	Error Variance
P16	The fare collection and ticket distribution systems are user friendly.	0.754**	40.560	0.019
P17	The fare is reasonable.	0.634**	24.717	0.026
P18	The density of the train during rush hour is suitable.	0.641**	25.274	0.025
P19	The density of the train apart from the rush hour is suitable.	0.735**	36.720	0.02
P20	The frequency of the train is appropriate and sufficient.	0.739**	38.242	0.019
P21	Promotion is agreed to reward passengers.	0.665**	27.752	0.024
P22	There is a special discount for passengers with prepaid tickets.	0.697**	31.345	0.022
	Information (Cronbach's Alpha = 0.755, AVE=0.741, CR=0.785)			
P23	There are announcements regarding arrival time and the change of departure time of the train.	0.725**	34.371	0.021
P24	There is a channel for complaints at the station via telephone or online.	0.700**	31.645	0.022
P25	The station has sufficient navigation signs and travel information.	0.780**	42.656	0.018

Table 2.4 Results of measurement model (Continued)

Item	Description	Loading	t-value	Error Variance
	Terminal (Cronbach's Alpha = 0.922, AVE=0.711, CR=0.919)			
P26	The suitability of the station location allows easy service access.	0.641**	25.654	0.025
P27	There are facilities for disabilities to access the station, such as passenger elevators.	0.655**	26.858	0.024
P28	The station is clean.	0.712**	33.866	0.021
P29	There is a suitable waiting area to buy tickets.	0.735**	38.000	0.019
P30	The ticket checking machines for accessing the platform are wide enough to walk through.	0.699**	32.215	0.022
P31	There are convenient walkways such as the Sky Walk connecting to essential places.	0.671**	28.617	0.023
P32	There is security against criminals and crime at the station.	0.742**	38.273	0.019
P33	There are other facilities such as Wi-Fi, services, shops within the station.	0.729**	36.721	0.02
P34	The station's ascent and descent are convenient and safe.	0.720**	34.942	0.021
P35	It is convenient to connect to other transportation systems.	0.756**	40.619	0.019

Table 2.4 Results of measurement model (Continued)

Item	Description	Loading	t-value	Error Variance
P36	The arrangement of the platform area is proper.	0.749**	39.656	0.019
	Word of mount (Cronbach's Alpha = 0.794, AVE=0.793, CR=0.722)			
L01	I will use the "electric train" service for the next trip.	0.769**	37.862	0.02
L02	If fare levels and service quality are well maintained, I will use the "electric train" service forever.	0.823**	44.407	0.019
	Identification (Cronbach's Alpha = 0.834, AVE=0.797, CR=0.841)			
L03	I will mention only good things about "electric train traveling" with others	0.909**	39	0.023
L04	I will encourage friends and acquaintances to travel by the "electric train".	0.777**	710	0.025
L05	I rank this "electric train" as the first mode of transport for each trip.	0.615**	31	0.03
	Re-purchase (Cronbach's Alpha = 0.778, AVE=0.786, CR=0.764)			
L06	I think the "electric train" is the best choice.	0.748**	639	0.022
L07	I will not be interested in other modes of transportation besides the "electric train".	0.828**	20.477	0.02
	Perceived value (Cronbach's Alpha = 0.880, AVE=0.846, CR=0.884)			
PV01	When comparing to the service I received, I think it is worth the money.	0.838**	54.122	0.015

Table 2.4 Results of measurement model (Continued)

Item	Description	Loading	t-value	Error Variance
PV02	I accept the service I received compared to the money I paid; it is reasonable.	0.897**	69.783	0.013
PV03	When I travel by the "electric train", I think it is more rewarding than other transportation forms.	0.804**	45.646	0.018
	Satisfaction (Cronbach's Alpha = 0.872, AVE=0.781, CR=0.863)			
SA01	I am pleased to use the "electric train" service.	0.814**	49.371	0.016
SA02	Overall, I am satisfied with the service provided by the "electric train".	0.868**	62.168	0.014
SA03	The quality of service I received was more than what I expected.	0.706**	31.229	0.023
SA04	The quality of service I received is at the service level I dreamed of.	0.676**	27.812	0.024
	Trust (Cronbach's Alpha = 0.901, AVE=0.835, CR=0.902)			
TR01	I believe that traveling by the "electric train" is the best form of transportation.	0.827**	53.717	0.015
TR02	The "electric train" is a form of transport that I can always trust.	0.848**	59.965	0.014
TR03	The "electric train" is a form of transport which recognize what to do to satisfy customers.	0.811**	49.578	0.016

Table 2.4 Results of measurement model (Continued)

Item	Description	Loading	t-value	Error Variance
TR04	The "electric train" is very reliable form of transport.	0.854**	62.168	0.014
	Switching cost (Cronbach's Alpha = 0.833, AVE=0.850, CR=0.841)			
SW01	I can waste time searching for information on "other forms of transport" that provide better service on the next trip.	0.924**	15.577	0.059
SW02	I will pay more to switch to "other forms of transport" if they provide better service.	0.775**	14.878	0.052
	Commitment (Cronbach's Alpha = 0.839, AVE=0.806, CR=0.851)			
CO01	I am proud to use the "electric train" service.	0.714**	22.049	0.032
CO02	I am concerned for the long-term success of "BTS / MRT / Airport Rail Link".	0.811**	29.157	0.028
CO03	I think traveling by the "electric train" is an important form of transport for the country's development.	0.755**	26.763	0.028

Note: **significant at 0.001

1) Loyalty. Based on the analysis of the second-order model regarding loyalty to service providers with statistical significance at the 0.001 level, the study found that the three indicators confirmed the composition of loyalty to service providers (word-of-mouth: λ = 0.975; identification: λ = 0.653; re-purchasing: λ = 0.894). Fur-thermore, based on the results of the first confirmatory component model for loyalty to service providers with statistical significance at the 0.001 level, the study found the following results.

1.1) Word-of-mouth (measured using two indicators: L01–L02). All indicators veri-fied the composition of the measurement model for loyalty to service providers with standardized factor loadings between 0.823 and 0.769. The indicator with the highest standardized factor loading is L02: I will encourage friends and acquaintances to trav-el using the “electric train” (**λ** = 0.823), whereas L01: I will mention only good things about traveling via “electric trains” with others obtained the least standardized factor loading (**λ** = 0.769).

1.2) Identification (measured using 3 indicators: L03–L05). The study found that all indicators confirmed the composition of the measurement model regarding loyalty to service providers with standardized factor loadings between 0.909 and 0.615. The highest and lowest factor loadings were found for indicator L03: I rank this “electric train” as the first choice of mode of transport for each trip (**λ** = 0.909) and L05: I will not be interested in other modes of transportation besides the “electric train” (**λ** = 0.615), respectively.

1.3) Re-purchasing (measured using two indicators: L06–L07). All indicators veri-fied the composition of the measurement model for loyalty to service providers. The standardized factor loadings ranged between 0.828 and 0.748 with the highest and lowest standardized factor loadings found for L07: If fare levels and service quality are well maintained, I will use the “electric train” service regularly (**λ** = 0.828) and L06: I will use the “electric train” service for the next trip (**λ** = 0.748), respectively.

2) Service Quality. In terms of the second-order model for loyalty to service pro-viders with statistical significance at the 0.001 level, five indicators verified the com-position of service quality, namely, vehicles (**λ** = 0.981), staff (**λ** = 0.984), service (**λ** = 0.985.), information (**λ** = 0.994), and station (**λ** = 0.998). Additionally, regarding the results of the first-order model for loyalty to service providers with statistical signifi-cance at the 0.001 level, the study found the following results:

2.1) Vehicles (measured using 8 indicators: P01–P08). All indicators confirmed the composition of the measurement model in terms of service quality with standardized factor loadings between 0.782 and 0.643. The highest and lowest standardized factor loadings were observed for P08: The convoy is in new condition, looks good, and at-tractive (**λ** = 0.782) and P05: Luggage compartments are large, available, and sufficient (**λ** = 0.643), respectively.

2.2) Staff (measured using 5 indicators: P09-P13). All indicators confirmed the composition of the measurement model regarding service quality with standardized factor loadings between 0.799 and 0.695. The indicators with the highest and lowest standardized factor loadings were P09: The staff provides fast and agile service (**λ** = 0.799) and P10: The staff provides service with good manners (**λ** = 0.695), respectively.

2.3) Service (measured using 9 indicators: P14-P22). The indicators verified the composition of the measurement model regarding service quality with standardized factor loadings between 0.766 and 0.634. The highest and lowest standardized factor loadings were found for P15: The fare collection system is modern and accurate (**λ** = 0.766) and P17: The fare is reasonable (**λ** = 0.634), respectively.

2.4) Information (measured using 3 indicators: P23–P25). Indicators under this cat-egory verified the composition of the measurement model regarding service quality with standardized factor loadings ranging from 0.780 to 0.700. The highest and lowest standardized factor loadings were found for P25: The station has sufficient navigation signs and travel information (**λ** = 0.780) and P24: There is a channel for complaints at the station via telephone or online (**λ** = 0.700), respectively.

2.5) Station (measured using 11 indicators: P26–P36). The study found that all indi-cators verified the composition of the measurement model regarding service quality with standardized factor loadings ranging from 0.756 to 0.641. The indicators with the highest and lowest standardized factor loadings were P35: It is convenient to connect to other transportation systems (**λ** = 0.756) and P26: The suitability of the station loca-tion allows easy access to services (**λ** = 0.700), respectively.

3) Service value (measured using 3 indicators: PV01–PV03). The study observed that all indicators were able to verify the composition of the measurement model re-garding service value with standardized factor loadings ranging from 0.897 to 0.804. The indicators with the highest and lowest standardized factor loadings were PV02: I accept the service I received compared to the money I paid; it is reasonable (**λ** = 0.897) and PV03: When I travel by the “electric train,” I think it is more rewarding than other transportation forms (**λ** = 0.804), respectively.

4) Service satisfaction (measured using 4 indicators: SA01–SA04). The results show that all indicators confirmed the composition of the measurement model re-garding service satisfaction with standardized factor loadings ranging from 0.868 to 0.676. The indicators with the highest and lowest standardized factor loadings were SA02: overall, I am satisfied with the service provided by the "electric train" (**λ** = 0.868) and SA04: The quality of service I received is at the service level I dreamed of (**λ** = 0.676), respectively.

5) Trust (measured using 4 indicators: TR01–TR04). The study found that all indi-cators asserted the composition of the measurement model regarding reliability with standardized factor loading ranging from 0.854 to 0.811. The indicators with the high-est and lowest standardized factor loadings were TR04: The "electric train" is a very reliable form of transport (**λ** = 0.854) and TR03: The "electric train" is a form of transport that knows what to do to satisfy customers (**λ** = 0.811), respectively.

6) Cost of switching service providers (measured using 2 indicators: SW01–SW02). All indicators confirmed the composition of the measurement model regarding the cost of switching service providers with standardized factor loadings ranging from 0.924 to 0.755. The highest and lowest standardized factor loadings were noted for SW01: I can waste time searching for information on "other forms of transport" that provide better service on the next trip (**λ** = 0.924) and SW02: I will pay more to switch to "other forms of transport" if they provide better service (**λ** = 0.755), respectively.

7) Relationship with service providers (measured using 3 indicators: CO01–CO03). All indicators pointed to composition of the measurement model regarding the relationship with service providers with standardized factor loadings between 0.811 and 0.714. The indicators with the highest and lowest standardized factor loadings are CO02: I am concerned about the long-term success of "BTS/MRT/Airport Rail Link" (**λ** = 0.811) and CO02: I am proud to use the "electric train" service (**λ** = 0.714), respec-tively.

2.5.2.3 Structural Model

SEM Analysis result could examine hypotheses in relevant to direct influence of variables affecting to loyalty of urban electric train customers. (Table 2.5). Study results found that perceived service quality influenced to satisfaction, trust, and perceived service value, with statistically significant level of 0.001 (β=0.131, β=0.700 and β=0.587) which support H1, H2, and H3, respectively. Service satisfaction positively influenced to customer loyalty (β=0.375, p<0.001) which support H4. Perceived service value influenced to satisfaction and customer loyalty (β=0.309 and β=0.326, p<0.001) which support H5 and H6. Trust influenced to loyalty and satisfaction of customer (β=0.137, p<0.05 and β=0.587, p<0.001) which support H7 and H8. Furthermore, switching costs was negatively correlated with customer loyalty (β=-0.084, p<0.001) which support H9. Finally, commitment was positively correlated with customer loyalty (β=-0.261, p<0.001) which support H10.

Table 2.5 Results of structural model

Item	Description	Estimates	t-value	Error Variance
H01	Perceived quality ⇨ Satisfaction	0.131**	3.071	0.043
H02	Perceived quality ⇨ Trust	0.700**	29.233	0.024
H03	Perceived quality ⇨ Perceived value	0.587**	19.319	0.030
H04	Satisfaction ⇨ Loyalty	0.375**	4.695	0.080
H05	Perceived value⇨ Satisfaction	0.309**	7.487	0.041
H06	Perceived value ⇨ Loyalty	0.326**	6.517	0.050
H07	Trust ⇨ Loyalty	0.137*	1.894	0.072
H08	Trust ⇨ Satisfaction	0.587**	13.044	0.045
H09	Switching cost ⇨ Loyalty	-0.084**	-2.525	0.033
H10	Commitment ⇨ Loyalty	0.261**	5.372	0.261

Note: **significant at 0.05

2.6 Discussion and Conclusion

This study is to examine 10 hypotheses in total, and to study factors affecting to passenger's loyalty toward urban electric train service in Thailand by using SEM. The findings of this research are as follows: According to SEM, there are 5 hypotheses in relevant to customer loyalty, including satisfaction (H4), service value (H6), trust (H7), switching costs (H9), and Commitment(H10) which are in accordance with research of H4 (Van Lierop & El-Geneidy, 2016), H6 (X.-m. Fu, Zhang, & Chan, 2018), H7 (Putri, Wahab, & Shihab, 2018), H9 (Wen et al., 2005), and H10 (Chen, 2012) respectively. There is hypothesis 3 which is in relevant to customer satisfaction, perceived service quality (H1), perceived service value (H5), and trust (H8) which are in accordance with research of H1 (X.-m. Fu et al., 2018; Shen, Xiao, & Wang, 2016), H5 (Shen et al., 2016), and H8 (Putri et al., 2018) in order. Moreover, there is hypothesis in relevant to perceived service quality, that are trust (H2), and perceived service quality (H3) which are in accordance with research of H2 (Irawan, 2013), and H3 (Cordera, Nogués, & González-González, 2019; De Oña, de Oña, Eboli, Forciniti, & Mazzulla, 2016; X. Fu & Juan, 2017). In addition, when we consider factors directly influencing to customer loyalty which are trust, satisfaction, perceived service value, switching costs, and commitment, it found that satisfaction is the most important factor which affects to customer loyalty, while satisfaction is directly influenced by trust, perceived service value, and perceived service quality of customer. Therefore, service providers must give priority to mentioned issues, in order to make customers satisfied and re-purchase the service.

In reference to this study, researcher has studied variables in relevant to perceived service quality of passengers, which can be measured from 36 indicators by using second order Confirmatory Factor Analysis with statistically significant level at 0.001. It found that indicators which can be the most confirmatory factors of perceived service quality are station, information, service, staff, and vehicle consecutively. Also, when we consider first order Confirmatory Factor Analysis result of perceived service quality with statistically significant level at 0.001, it found that indicator of station which customers express the most concern is convenience on connection to other types of transport systems (P35). While indicator of information which customers express the most concern is that there are proper guide posts and travel information at the station (P25). Also for indicator of service which customers express the most concern is that there is modern and accurate method of fare collecting system (P15).

This study could summarize that there are many variables influencing to satisfaction which is the main factor causing customer loyalty. In order to keep recent group of customers, as well as to increase future customers (Sun & Lin, 2010), electric train service providers should add such service provision value by prioritizing on relevant factors e.g. for station factor, electric train service providers should give priority to convenience on connecting electric train to other types of transport systems. Also, for information factor, service providers should provide guide posts and travel information service at the station to facilitate traveling at most. The findings of this research could be used by organizations in relevant to urban electric train service provision by applying to marketing development strategy and service policy, in order to be guideline for service standard and sustainable improvement of urban electric train system e.g. connection between electric train system and other types of public transportation such as bus, taxi, and motorcycle taxi at the station which facilitate customers by connecting the traveling, and ticket promotional campaign, as well as development of modern and accurate method of fare collecting system i.e. ticket vending machine or payment through mobile application which will generate more convenience for customers who have used the service. Nevertheless, this study has offered overall picture of electric train service in Thailand, but we do not separately consider service providers of each route. Therefore, for further study, there should be examination on electric train service providers of each route (electric train routes, and State Railway of Thailand) to create suitable roadmap in accordance with sustainable travel characteristic of customers in Thailand.

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CHAPTER III

A MEASUREMENT MODEL OF THE SERVICE QUALITY OF ELECTRONIC TRAINS IN BANGKOK AND ITS NEIGHBORHOODS

3.1 Abstract

The rail transport system has been implemented as a solution to traffic congestion problems in Thailand, as evident from the construction and development plans for 13 urban electronic train routes in Bangkok and metropolitan areas. The primary objective of this study is to develop a model for measuring the service quality of railway transport in urban areas. The researchers collected and analyzed data from 500 passengers on the commuter line and 500 passengers on the urban line. The analysis utilized 37 indicators and involved statistical methods, including general passenger information, basic statistics on expected service, and confirmatory factor analysis based on the service quality concept of the SERVQUAL model. The results revealed the identification of five groups: tangible, responsiveness, reliability, empathy, and assurance. According to the service quality measurement model for the commuter line, it was found that reliability (REL) had the most significant factor loading, which differs from that for the urban line, where empathy (EMP) gained the highest. Therefore, relevant agencies involved in providing railway services in urban areas should utilize the findings of this study to develop strategies suitable for the specific service systems of each type of railway service.

3.2 Introduction

The problem of traffic congestion in Bangkok Metropolitan and its surrounding areas remains to be a critical problem. This can be seen from the traffic analysis results conducted by INRIX, a company that develops driving and travel analysis systems. It analyzed traffic congestion and travel worldwide and found that in 2022, Bangkok ranked 32nd in the world for congested areas and second in Asia. Commuters in the city wasted over 67 hours on roads due to traffic congestion. The involved government

agencies with this issue have tried to solve the mentioned problem. One of the solutions is the implementation of the public transportation system, operated either by the government or private sector because it can help alleviate traffic congestion. Furthermore, this system emphasizes the movement of people rather than vehicles. If the public transportation system is not efficient enough to serve the passengers' needs, the measures to resolve traffic congestion will not be successful. Therefore, the development of transportation infrastructure and public transportation systems, including air transportation, road transportation, water transportation, and rail transportation, is a key direction in the development of Thailand's transportation system. Actually, the rail transportation system is one of the public transportation systems that the Ministry of Transport emphasizes, as evident in the 20-year transportation development strategy of Thailand, which focuses on developing transportation infrastructure, particularly rail transportation, within the Bangkok Metropolitan and suburban areas. The Mass Rapid Transit System of Thailand has conducted studies, analyses, and projects related to railway operations to develop the rail network in the Bangkok Metropolitan and suburban areas, consisting of 13 routes. It is evident that the urban rail system has received continuous support and development to cover important urban areas . In the past. residents in those areas have shifted their travel from private cars, public buses, and taxis to using the rail transportation system more frequently. Providing efficient public transportation services is a crucial factor in attracting and encouraging passengers to use the services more frequently. Anantharanthan Parasuraman, Zeithaml, and Berry (1985) suggested that passengers or service users can assess the quality of service based on the comparison of their expectations or desires with the actual service received. Perceiving quality is a significant indicator that influences user satisfaction. Therefore, service providers should study passenger satisfaction with the service to guide the development and improvement of quality and service standards, aiming to enhance the quality of life and create satisfaction among service users. Moreover, this can also be applied in marketing strategy planning or the formulation of various service policies. Hence, the objective of this study is to develop a model for measuring the quality of service in railway transportation within urban areas.

3.3 Literature Review

3.3.1 Service Quality of Train

Servicing is crucial in various industries because it involves providing assistance or operating beneficial things to others, especially in the case of public services such as buses, trains etc. These services must have a well-designed service format that meets the passengers' needs, encouraging them to return for future service or inducing an increased number of users (Suchitra Rungthong, 2011). Therefore, service providers should prioritize service quality as it serves as a measure of effectiveness in meeting customer expectations in the service business. Service users evaluate service quality based on their experiences compared to their pre-service expectations (Anantharanthan Parasuraman et al., 1985). According to the framework proposed by Ananthanarayanan Parasuraman, Zeithaml, and Berry (1988), they have developed criteria for assessing service quality known as SERVQUAL. SERVQUAL consists of five dimensions: 1) Tangibles: This dimension encompasses the physical aspects of the service, including facilities and equipment provided to represent or deliver the service; 2)Reliability: Reliability refers to the ability to provide trustworthy and accurate service, such as being punctual, efficient check-in procedures, convenient and accurate booking and ticketing procedures, among others; 3) Responsiveness: This relates to the willingness to assist passengers in solving service-related issues promptly, as well as responding quickly to customer needs and demands, as well as handling emergency situations.; 4) Assurance: Assurance is associated with the provider's ability to deliver services energetically to establish trust and confidence in service provision; and 5) Empathy: Empathy is a service dimension that emphasizes personalized attention and care towards customers, aiming to understand and create a positive impression on service recipients. Previous literature reviews have indicated that the study of service quality depends on measurement contexts reflecting various operational considerations. Service quality directly influences perceived value (Bolton & Drew, 1991), (Zeithaml, Berry, & Parasuraman, 1988), overall satisfaction (Cronin Jr & Taylor, 1992), (Caceres & Paparoidamis, 2007), (Kim, 2013), (Namukasa, 2013), as well as indirectly affects customer loyalty (Andreassen & Lindestad, 1998), (Ostrowski, O'Brien, & Gordon, 1993), (Patterson & Spreng, 1997), (Pritchard & Howard, 1997), as well as customer loyalty (Boulding, Kalra, Staelin, & Zeithaml, 1993), (De Ruyter, Wetzels, &

Bloemer, 1998), (P.-T. Chen & Hu, 2013), and positive behavioral intentions (Kim, 2013)(H.-K. Kim, 2013), etc.

3.3.2 Expectation Theory

Expectations are attitudes related to desires or anticipated needs that are expected to be fulfilled in a particular service. What is received in relation to expectations and needs, which are deeply ingrained and influenced by lifestyle and individual status, is evaluated. When individuals perceive their needs, it generates motivation to meet those specific needs (Anantharanthan Parasuraman et al., 1985). In a study conducted by Yang, Hsieh, Li, and Yang (2012), it was found that expectations directly influence perceived value and image. Additionally, studies by Park, Robertson, and Wu (2004), (C.-F. Chen, 2008), (Chiou & Chen, 2010), and Hussain, Al Nasser, and Hussain (2015) revealed that expectations directly influence the perception of service quality as well.

3.3.3 Confirmatory Factor Analysis

Confirmatory factor analysis is an analytical approach that aims to confirm the components or factors that have been developed. Analysts can determine their own research models based on relevant literature and research studies or from prior exploratory factor analysis (EFA). The analysis involves taking the original observed variables and inputting them into the software, along with the specification of latent variables to make the latent variables more clearly evident, as shown in Figure 2.1. ξ represents the exogenous variable vector; X represents the observed variable vector; λ represents factor loadings; and δ represents error variance and covariance. To assess the overall fit of the model, statistical measures are used to determine whether the model is consistent with the empirical data. In this study, six assessment indicators were used: Chi-Square (2), Standardized Root Mean Square Residual (SRMR), Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), and Tucker Lewis Index (TLI). For the assessment of the fit of individual variables (path estimation), the relationships between observed variables and latent variables, or what is referred to as factor loadings, are considered. Generally, acceptable factor loadings are those greater than or equal to 0.5 (Joseph F Hair, Black, Babin, Anderson, & Tatham, 2010),

and the importance of the factor is compared to the empirical data to determine future factor loadings.

3.4 Research and Methodology

3.4.1 Participants and Data Collection

The sample group for this study consists of 500 passengers of the Commuter Line (Airport rail link) and 500 passengers of the Urban Line (BTS Skytrain and MRT Purple Line). The sampling method used is Stratified Random Sampling based on the study area of train stations including 8 stations of the Airport rail link, 36 stations of the BTS Sukhumvit Line, 12 stations of the BTS Silom Line, 30 stations of the MRT Blue Line, and 16 stations of the MRT Purple Line. The sample groups were selected using Simple Random Sampling with face-to-face interviews, as recommended by Joshep F Hair, Black, Babin, and Anderson (2013), stating that an appropriate number of sample groups for data analysis should be at least 500 samples.

3.4.2 Variables

This study analyzes data using 37 indicators to measure the expected quality of service provided by the urban and suburban electronic trains in the Greater Bangkok area. The analysis is based on a 7-point Likert scale questionnaire, where 7 represents "Strongly Agree" and 1 represents "Strongly Disagree."

3.4.3 Reliability

The validity of the content of the questionnaire was examined by three experts. The results showed that the content validity of the questionnaire using the index of Item-objective congruence (IOC) ranged from 0.67 to 1.00, indicating that the questions are consistent with the intended measurement objectives. Subsequently, the questionnaire was tested with a sample of 30 individuals who were not part of the initial group. The reliability of the tool was assessed by analyzing the Cronbach's Alpha coefficient (Reliability). The analysis revealed that the questionnaire's internal consistency ranged from 0.797 to 0.955. The question items with values exceeding 0.70 (Tavakol & Dennick, 2011) indicate that the question items in the questionnaire are suitable for data collection.

3.4.4 Data Analysis

The statistical analysis in this study consists of passengers' general information and expectations regarding the use of railway services. Confirmatory Factor Analysis (CFA) is employed to confirm the relationships among the 37 indicators and latent variables. The aim is to reduce the number of indicators while ensuring clarity and alignment with the SERVQUAL Model's quality of service concept. The SERVQUAL Model comprises the following dimensions: tangibles (physical evidence), responsiveness, reliability, empathy, and Assurance. The analysis was conducted using Mplus software, version 7.2.

3.5 Results

3.5.1 Descriptive Analysis

Table 3.1 shows the analysis results of general data of commuter line passengers and urban line passengers, as follows; it consists of: Urban Commuter Rail Passengers: The sample group comprised 190 males (38.00%) and 310 females (62.00%). The average age was 31 years, with an average monthly income of 26,380.28 Baht. The majority of participants (54.80%) held a bachelor's degree, and the majority (46.20%) were employed in private companies. Additionally, a significant portion of the sample (96.20%) had no experience of accidents during train travel, and 84.80% did not encounter any train malfunctions during their journeys. Urban Rail Service Users: The sample group included 200 males (40.00%) and 300 females (60.00%). The average age was 36 years, with an average monthly income of 23,250.00 Baht. The majority of participants (59.20%) held a bachelor's degree, and most of them (50.50%) were employed in private companies. Similar to the previous group, a significant proportion (97.80%) had no experience of accidents during train travel, and 86.60% did not encounter any train malfunctions during their journey.

Table 3.1 General information of suburban electric train passengers and Urban Line

Category		Commuter Line		Urban Line	
		Frequency	Percent	Frequency	Percent
Gender	Male	190	38.00	200	40.00
	Female	310	62.00	300	60.00
Educational Level	Elementary	14	2.80	19	3.80
	M.3	28	5.60	30	6.00
	M.6Vocational Certificate	103	20.60	81	16.20
	Diploma/Higher Vocational Certificate	41	8.20	51	10.20
	Bachelor's Degree	274	54.80	296	59.20
	Master's Degree	38	7.60	22	4.40
	Doctoral Degree	2	0.40	2	0.40
Occupation	Governmental Officer/ State Enterprise /	30	6.00	60	12.00
	Private officer	231	46.20	253	50.50
	Business Owner	66	13.20	112	22.40
	Farmer	0	0.00	1	0.20
	Pupil /Student	111	22.20	5	1.00
	Contractor	38	7.60	50	10.00
	Other	24	4.80	20	4.00
Average Age (Year)		31 (SD=11.68)		36 (SD=10.80)	
Average income (baht/a month)		26,380.28 (SD=11.68)		23,250.00 (SD=11.68)	

Table 3.2; The results of the basic statistical analysis for the observed variables including: mean, standard deviation, Skewness, and kurtosis values are divided into five dimensions for the commuter and urban train sample groups comprising: 1) Tangibles: This dimension comprises eight variables related to physical attributes. The variable with the highest average opinion score among the commuter rail sample group was "the cleanliness of the station" (TAN3), with a mean value of

6.04 (SD = 0.989). Similarly, among the urban train sample group, the variable with the highest average opinion score was also "the cleanliness of the station" (TAN3), with a mean value of 5.9 (SD = 0.973); 2) Responsiveness dimension: This dimension included eight variables related to the responsiveness of the rail service. The variable with the highest average opinion score among the commuter rail sample group was " There are sufficient and appropriate ticketing channels." (RES1), with a mean of 5.95 (SD = 0.984). Similarly, among the urban train sample group, the variable with the highest average opinion score was "While boarding on the train, the station names are informed throughout the route. " (RES6), with a mean of 5.79 (SD = 0.962); 3) Reliabilities dimension: This dimension comprised eight variables related to the reliability of the rail service. The variable with the highest average opinion score among the commuter rail sample group was " The facilities to help go up and down the station are convenient, such as escalators, elevators, etc..), with a mean of 5.88 (SD = 1.025). Similarly, among the urban rail sample group, the variable with the highest average opinion score was also " The facilities to help go up and down the station are convenient, such as escalators, elevators, etc." (REL4), with a mean of 5.72 (SD = 0.880); 4; Empathy dimension: This dimension included six variables related to the empathy exhibited by the rail service. The variable with the highest average opinion score among the commuter rail sample group is " Whenever a problem with train operation occurs, the cause and the action taken are notified." (EMP6), with a mean of 5.83 (SD = 1.038). Similarly, among the urban rail sample group, the variable with the highest average opinion score is " Staff are willing to solve problems that arise while traveling." (EMP3), with a mean of 5.73 (SD = 0.974); 5) Assurance dimension: This dimension comprised six variables related to the assurance provided by the rail service. The variable with the highest average opinion score among the commuter rail sample group was “The security measures are available for preventing passengers from crooks and criminals on the train. " (ASU3), with a mean of 5.77 (SD = 1.054). Similarly, among the urban rail sample group, the variable with the highest average opinion score was also " The security measures are available for preventing passengers from crooks and criminals at the station." (ASU4), with a mean of 5.76 (SD = 0.852).

When considering the data distribution characteristics using the maximum likelihood estimation method, the requirement is that the data must follow

a normal distribution. This was assessed based on the skewness and kurtosis values of the commuter rail data group, where the skewness ranged from -1.072 to -0.398, and the kurtosis ranged from -0.647 to 1.217. As for the urban rail group, the skewness ranged from -0.758 to -0.053, and the kurtosis ranged from -0.669 to 1.083. The skewness values were less than 3.0 and the kurtosis values were less than 10, indicating that the data had a normal distribution (Kline, 2023). Therefore, it is appropriate to proceed with further factor analysis using this data.

Table 3.2 Mean value, standard deviation, skewness, and kurtosis of observed variables of suburban electric trains and urban trains

Variable	Details	Commuter Line				Urban Line			
		Mean	S.D.	Sk	Ku	Mean	S.D.	Sk	Ku
Tangibles									
TAN1	The train station has enough car parking.	5.54	1.118	-0.506	-0.359	5.33	0.987	-0.293	-0.258
TAN2	There are facilities for people with disabilities to access the station, such as elevators.	5.98	1.028	-0.865	0.301	5.75	0.893	-0.313	-0.24
TAN3	The cleanliness of station	6.04	0.989	-1.058	1.139	5.9	0.973	-0.537	-0.366
TAN4	The temperature while waiting for the bus at the platform was suitable.	5.65	1.038	-0.55	-0.043	5.67	0.916	-0.227	-0.403
TAN5	The condition inside the train is clean and tidy.	5.98	0.984	-1.072	1.101	5.86	0.909	-0.482	-0.024
TAN6	The temperature inside the train is comfortable cool.	5.91	0.974	-0.755	0.149	5.82	0.927	-0.384	-0.433
TAN7	The seats are clean.	5.85	1.016	-0.677	0.08	5.81	0.928	-0.486	-0.095
TAN8	Arranging the seats are suitable.	5.73	1.079	-0.576	-0.233	5.62	0.93	-0.352	0.058
TAN9	The compartments of train are new, attractive, and desirably applicable.	5.94	0.969	-0.863	0.591	5.78	0.937	-0.327	-0.141
Responsiveness									
RES1	There are sufficient and appropriate ticketing channels.	5.95	0.984	-0.83	0.426	5.62	0.913	-0.192	-0.193

Table 3.2 Mean value, standard deviation, skewness, and kurtosis of observed variables of suburban electric trains and urban trains (Continued)

Variable	Details	Commuter Line				Urban Line			
		Mean	S.D.	Sk	Ku	Mean	S.D.	Sk	Ku
RES2	Appropriate queuing areas for buying tickets are arranged.	5.79	1.032	-0.759	0.235	5.52	0.946	-0.15	-0.346
RES3	Billing clerks record accurate and reliable data.	5.85	1.018	-0.912	1.115	5.71	0.904	-0.334	-0.043
RES4	Employees serve customers quickly and energetically.	5.87	1.044	-0.854	0.537	5.76	0.898	-0.319	-0.19
RES5	The information of arrival time and changes in operating time of train is notified	5.72	0.998	-0.413	-0.614	5.59	0.942	-0.512	0.397
RES6	While boarding on the train, the station names are informed throughout the route.	5.91	1.063	-1.042	1.212	5.79	0.962	-0.523	-0.116
RES7	The seats are arranged for vulnerable people, such as elderly, disabled people, pregnant women etc. in the appropriate positions and number.	5.85	1.083	-0.86	0.591	5.74	0.94	-0.468	-0.12
RES8	The availability of store services inside the station.	5.51	1.117	-0.485	-0.056	5.62	0.956	-0.2	-0.532
Reliabilities									
REL1	The price information is given through the websites or applications on mobile phones.	5.46	1.185	-0.466	-0.503	5.28	1.003	-0.316	0.011

Table 3.2 Mean value, standard deviation, skewness, and kurtosis of observed variables of suburban electric trains and urban trains (Continued)

Variable	Details	Commuter Line				Urban Line			
		Mean	S.D.	Sk	Ku	Mean	S.D.	Sk	Ku
REL2	There are easily understandable signs for walking direction (Introducing the direction to the station)	5.83	1.03	-0.761	0.573	5.66	0.895	-0.225	-0.378
REL3	The location is suitable for easily accessing the service.	5.82	1.049	-0.673	0.362	5.7	0.937	-0.23	-0.576
REL4	The ways up and down the station are convenient, such as escalators, elevators, etc.	5.88	1.025	-0.738	0.117	5.72	0.88	-0.272	-0.366
REL5	It is convenient to connect with other f public transportation modes (buses/intercity trains/other public transportation).	5.74	1.067	-0.56	-0.25	5.52	0.903	-0.253	-0.024
REL6	The station is near the bus stop.	5.69	1.09	-0.401	-0.647	5.6	0.9	-0.142	-0.513
REL7	The station has a taxi service center or an area for calling a taxi conveniently.	5.63	1.027	-0.398	-0.117	5.61	0.943	-0.265	-0.197
REL8	There are convenient walking paths such as a sky walk connecting to important places.	5.61	1.057	-0.68	1.217	5.55	0.991	-0.319	-0.016

Table 3.2 Mean value, standard deviation, skewness, and kurtosis of observed variables of suburban electric trains and urban trains (Continued)

Variable	Details	Commuter Line				Urban Line			
		Mean	S.D.	Sk	Ku	Mean	S.D.	Sk	Ku
Empathy									
EMP1	The ticket price is reasonable.	5.66	1.189	-0.663	-0.18	5.46	1.031	-0.25	-0.368
EMP2	The ticketing staff are sufficient for ticket service	5.8	1.025	-0.685	0.152	5.71	0.874	-0.161	-0.271
EMP3	Staff are willing to solve problems that arise while traveling.	5.79	1.019	-0.698	0.298	5.73	0.974	-0.426	-0.232
EMP4	The train's crowded conditions during peak hours are acceptable.	5.65	1.119	-0.476	-0.617	5.51	1.073	-0.518	0.08
EMP5	The train's crowded conditions outside peak hours are acceptable.	5.59	1.162	-0.471	-0.563	5.47	1.039	-0.421	-0.052
EMP6	Whenever a problem with train operation occurs, the cause and the action taken are notified.	5.83	1.038	-0.787	0.264	5.61	1.026	-0.522	0.107
Assurance									
ASU1	Travel frequency is suitable and sufficient.	5.68	1.125	-0.55	-0.429	5.61	1.068	-0.758	1.083
ASU2	The problems can be claimed through various channels: in the station area, on the telephone, and through an online platform.	5.36	1.405	-0.749	-0.079	5.67	0.905	-0.093	-0.596

Table 3.2 Mean value, standard deviation, skewness, and kurtosis of observed variables of suburban electric trains and urban trains (Continued)

Variable	Details	Commuter Line				Urban Line			
		Mean	S.D.	Sk	Ku	Mean	S.D.	Sk	Ku
ASU3	The security measures are available for preventing passengers from crooks and criminals on the train.	5.77	1.054	-0.705	0.099	5.68	0.894	-0.053	-0.669
ASU4	The security measures are available for preventing passengers from crooks and criminals at the station.	5.68	1.063	-0.663	0.257	5.76	0.852	-0.135	-0.323
ASU5	There is a promotion held for returning benefits for service users.	5.38	1.243	-0.627	-0.079	5.63	0.965	-0.226	-0.45
ASU6	There is a special discount for passengers buying prepaid cards.	5.39	1.3	-0.58	-0.173	5.73	0.934	-0.436	-0.056

3.5.2 Confirmatory Factor Analysis

3.5.2.1 Goodness-of-fit statistics

When considering the results of Bartlett's Test of Sphericity, which is a statistical test that assumes the correlation matrix is an identity matrix of the quality measurement model, it was found that the suburban electric train group had a Kaiser-Meyer-Olkin (KMO) value of 0.955, and the urban electric train group had a KMO value of 0.956. Both values were close to 1, indicating that the correlation matrix of the observed variables is not a significantly non-identity matrix and that there is sufficient correlation among the variables for analysis. When examining the model fit indices, it was found that the model for the suburban electric train group had a chi-square value of 1726.017 with 475 degrees of freedom (df), $p < 0.001$, Comparative Fit Index (CFI) of 0.913, Tucker-Lewis Index (TLI) of 0.897, Standardized Root Mean Square Residual (SRMR) of 0.070, and Root Mean Square Error of Approximation (RMSEA) of 0.073. The model for the urban electric train group had a chi-square value of 1555.962 with 544 df, $p < 0.001$, CFI of 0.900, TLI of 0.890, SRMR of 0.052, and RMSEA of 0.061. The TLI and CFI values were consistent with empirical data (Lee, Hsing, & Li, 2021). Furthermore, the Standardized Root Mean Square Residual (SRMR) value ranged from 0 to 1.00, and if it is lower than 0.08, it indicates a good model fit with the empirical data. In addition, the Root Mean Square Error of Approximation (RMSEA) value ranged from 0 to 1, the model had a good fit with the empirical data (Boulding et al., 1993).

3.5.2.2 Measurement model

From the conceptual framework of the confirmatory factor analysis model of the quality measurement model for suburban and urban electric train service quality, as shown in Table 3, it can be observed that service quality indicators can significantly confirm the components of service quality according to the SERQUAL Model at a statistically significant level of 0.001 as follows:

Analysis results of the first confirmatory factor analysis:

1) For the Tangibles dimension of the suburban electric train group, consisting of 9 items, the standardized factor loadings ranged from 0.530 to 0.734. The item " The temperature inside the train is comfortably cool." (TAN6) had the highest standardized factor loading of 0.734. For the urban electric train group, consisting of 8 items, the standardized factor loadings ranged from 0.599 to 0.684. The

item "The compartments of train are new, attractive, and desirably applicable." (TAN9) had the highest standardized factor loading of 0.684.

2) In terms of Responsiveness, the suburban electric train group, consisting of 8 items, had standardized factor loadings ranging from 0.530 to 0.734. The item " The temperature inside the train is comfortably cool " (TAN6) had the highest standardized factor loading of 0.734. For the urban electric train group, consisting of 8 items, the standardized factor loadings ranged from 0.621 to 0.736. The item " Employees serve customers quickly and energetically." (RES4) had the highest standardized factor loading of 0.736.

3) In terms of Reliability, the suburban electric train group, consisting of 9 items, had standardized factor loadings ranging from 0.530 to 0.734. The item " The temperature inside the train is comfortably cool" (TAN6) had the highest standardized factor loading of 0.734. For the urban electric train group, consisting of 8 items, the standardized factor loadings ranged from 0.504 to 0.739. The item " The station is near the bus stop." (REL6) had the highest standardized factor loading of 0.739.

4) In terms of Empathy, the suburban electric train group, consisting of 9 items, had standardized factor loadings ranging from 0.530 to 0.734. The item " The temperature inside the train is comfortably cool " (TAN6) had the highest standardized factor loading of 0.734. For the urban electric train group, consisting of 6 items, the standardized factor loadings ranged from 0.643 to 0.733. The item " Whenever a problem with train operation occurs, the cause and the action taken are notified." (EMP6) had the highest standardized factor loading of 0.733.

5) In terms of Assurance, the suburban electric train group, consisting of 9 items, had standardized factor loadings ranging from 0.530 to 0.734. The item " The temperature inside the train is comfortably cool " (TAN6) had the highest standardized factor loading of 0.734. For the urban electric train group, consisting of 6 items, the standardized factor loadings ranged from 0.641 to 0.806. The item "The problems can be claimed through various channels: in the station area, on the telephone, and through an online platform." (ASU2) had the highest standardized factor loading of 0.806.

The analysis of the second confirmed component reveals that the indicators related to Tangibles (TAN), Responsiveness (RES), Reliability (REL), Empathy (EMP), and Assurance (ASU) dimensions can significantly confirm the components of service quality of the measurement model of suburban electric train service quality at a statistically significant level of 0.001. For the suburban electric train service group, the reliability indicators (REL) had the highest standardized factor loading of 0.985 (AVE=0.938 CR=0.975), and for the urban electric train group, the Empathy indicators (EMP) had the highest standardized factor loading of 0.986 (AVE=0.940 CR=0.975). All indicators of the service quality measurement model had standardized factor loadings above 0.5, which is considered acceptable (Joseph F Hair et al., 2010), but if the value is above 0.6, it is considered good (Park et al., 2004). Moreover, the Cronbach's alpha values for each factor are above 0.7, indicating good fit (Joseph F Hair et al., 2010). The convergent validity and construct reliability (CR) values were above 0.5 (Joseph F Hair, Gabriel, & Patel, 2014), suggesting that the factors of service have good indicators with confidence in their internal consistency.

Table 3.3 Results of the confirmatory factor analysis of the service quality measurement model of commuter line and urban line

Indicators	Commuter Line			Urban Line		
	Loading	t-value	Error	Loading	t-value	Error
Tangibles	Cronbach's Alpha = 0.891 AVE=0.735 CR=0.871			Cronbach's Alpha = 0.860 AVE=0.729 CR=0.846		
TAN1	0.530**	15.615	0.72		-	-
TAN2	0.579**	17.72	0.668	0.621**	20.771	0.614
TAN3	0.646**	22.765	0.583	0.609**	19.765	0.629
TAN4	0.681**	25.788	0.536	0.599**	19.399	0.641
TAN5	0.723**	25.582	0.477	0.648**	22.549	0.58
TAN6	0.734**	31.333	0.461	0.659**	23.563	0.565
TAN7	0.678**	25.207	0.541	0.632**	21.404	0.6
TAN8	0.681**	25.569	0.537	0.653**	23.281	0.573
TAN9	0.632**	20.987	0.601	0.684**	25.932	0.532

Note: **significant at 0.001

Table 3.3 Results of the confirmatory factor analysis of the service quality measurement model of commuter line and urban line (Continued)

Indicators	Commuter Line			Urban Line		
	Loading	t-value	Error	Loading	t-value	Error
Responsiveness	Cronbach's Alpha = 0.887			Cronbach's Alpha = 0.818		
	AVE=0.705 CR=0.888			AVE=0.687 CR=0.818		
RES1	0.68**	25.764	0.538	0.621**	20.772	0.614
RES2	0.735**	31.681	0.46	0.728**	30.342	0.47
RES3	0.732**	32.379	0.46	0.708**	27.635	0.799
RES4	0.773**	37.392	0.403	0.736**	31.635	0.459
RES5	0.722**	30.873	0.479	0.643**	22.412	0.587
RES6	0.673**	25.449	0.547	-	-	-
RES7	0.652**	23.481	0.575	-	-	-
RES8	0.674**	26.806	0.546	-	-	-
Reliabilities	Cronbach's Alpha = 0.884			(Cronbach's Alpha = 0.856		
	AVE=0.643 CR=0.850			AVE=0.644 CR=0.851		
REL1	0.61**	20.15	0.628	0.504**	14.083	0.746
REL2	0.615**	20.32	0.622	0.601**	19.4	0.638
REL3	0.594**	18.876	0.648	0.585**	18.374	0.657
REL4	0.582**	18.205	0.661	0.675**	25.129	0.545
REL5	0.704**	27.04	0.504	0.712**	28.755	0.493
REL6	0.716**	28.643	0.488	0.739**	31.515	0.454
REL7	0.716**	28.784	0.487	0.672**	24.636	0.548
REL8	0.609**	19.978	0.629	0.665*	24.152	0.558
Empathy	Cronbach's Alpha = 0.895			(Cronbach's Alpha = 0.854		
	AVE=0.765 CR=0.850			AVE=0.689 CR=0.844)		
EMP1	-	-	-	0.643**	22.745	0.587
EMP2	-	-	-	0.688**	27.247	0.526
EMP3	0.777**	34.19	0.397	0.661**	23.882	0.563
EMP4	0.758**	33.847	0.426	0.707**	28.785	0.5
EMP5	0.770**	35.538	0.406	0.699**	27.906	0.512

Note: **significant at 0.001

Table 3.3 Results of the confirmatory factor analysis of the service quality measurement model of commuter line and urban line (Continued)

Indicators	Commuter Line			Urban Line		
	Loading	t-value	Error	Loading	t-value	Error
EMP6	0.759**	31.928	0.429	0.733**	21.781	0.463
Assurance	(Cronbach's Alpha = 0.926			(Cronbach's Alpha = 0.874		
	AVE=0.830 CR=0.920)			AVE=0.733 CR=0.875)		
ASU1	0.772**	39.428	0.404	0.724**	30.021	0.476
ASU2	0.832**	56.006	0.308	0.806**	42.168	0.351
ASU3	-	-	-	0.641**	21.977	0.589
ASU4	0.815**	44.342	0.336	0.708**	28.212	0.463
ASU5	0.868**	68.754	0.247	0.754**	33.726	0.498
ASU6	0.891**	69.138	0.207	0.765**	35.451	0.432
Service Quality	(AVE=0.938 CR=0.975)			(AVE=0.940 CR=0.975)		
TANG	0.978**	104.61	0.956	0.962**	80.286	0.075
RESP	0.984**	112.802	0.968	0.957**	83.998	0.085
RELI	0.985**	81.569	0.971	0.949**	79.571	0.1
EMPA	0.946**	60.232	0.895	0.986**	111.312	0.028
ASSU	0.797**	41.32	0.636	0.844**	45.228	0.288

Note: **significant at 0.001

3.6 Conclusions and Discussion

This research aims to study the service quality indicators of the urban railway in the Bangkok Metropolitan Area and its surrounding suburbs. The objective is to develop a model for measuring the service quality of railway transportation within the city using the SERVQUAL Model framework, as illustrated in Figures 1 and 2. The findings indicate that the service quality of urban railways can be measured using the five dimensions of the SERVQUAL Model, comprising a total of 34 indicators. The statistical analysis showed significant correlations at a level of 0.001 for the following dimensions: reliability (REL), responsiveness (RES), tangibles (TAN), empathy (EMP), and assurance (ASU), respectively. The results reveal that the most important aspect for service users is the convenient location of railway stations, such as having stations situated near bus

terminals or offering easy access to taxi services, followed by, the prompt and courteous service provided by staff, the cleanliness and organization within the train compartments, the assistance provided by staff during travel disruptions, and special discounts for prepaid ticket purchasers that were also highly valued. Similarly, the service quality of urban railways in the city can be measured using the five dimensions of the SERVQUAL Model, comprising a total of 33 indicators. The statistical analysis showed significant correlations at a level of 0.001 for the following dimensions: empathy (EMP), tangibles (TAN), responsiveness (RES), reliability (REL), and assurance (ASU), respectively. The results highlight that the most important aspect for service users is the provision of information and updates when there are issues with train operations and services, having well-maintained and user-friendly train carriages, staff's prompt and courteous service, stations facilitating convenient intermodal connections, and establishing complaint channels through telephone and online platforms. (Figure 3.1 and 3.2).

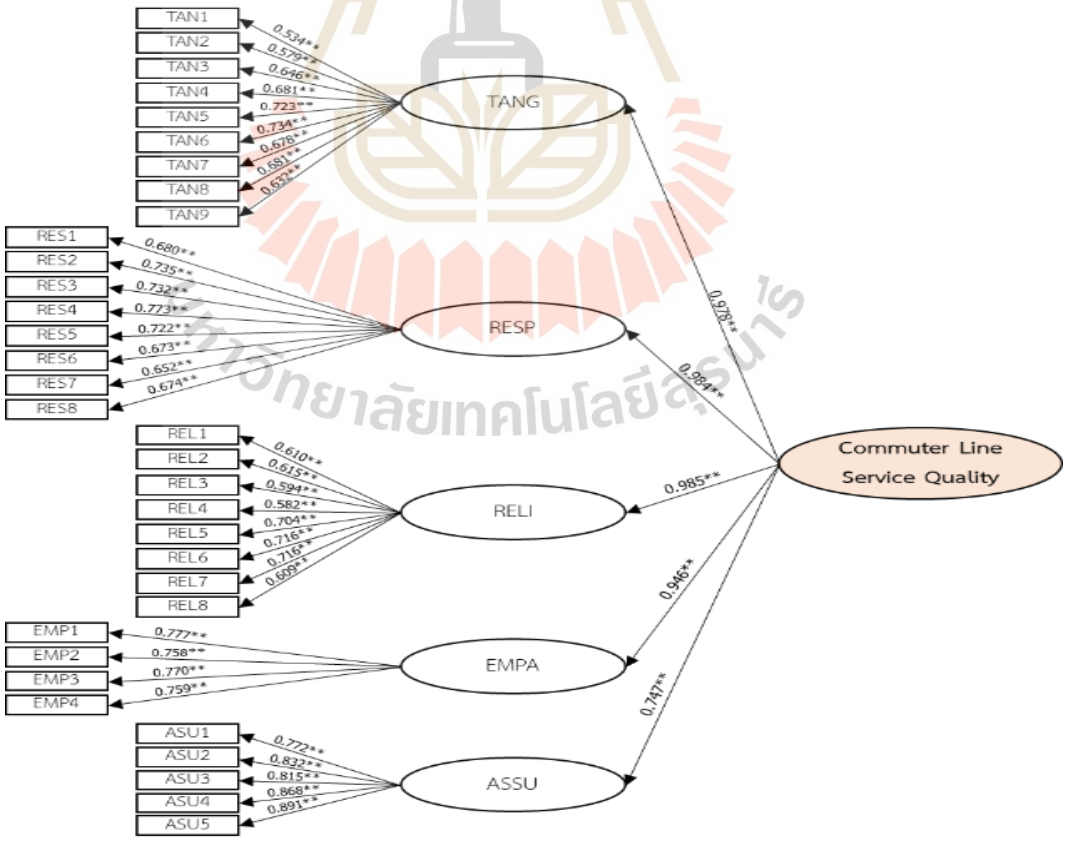

Figure 3.1 Model for service quality measurement of commuter line

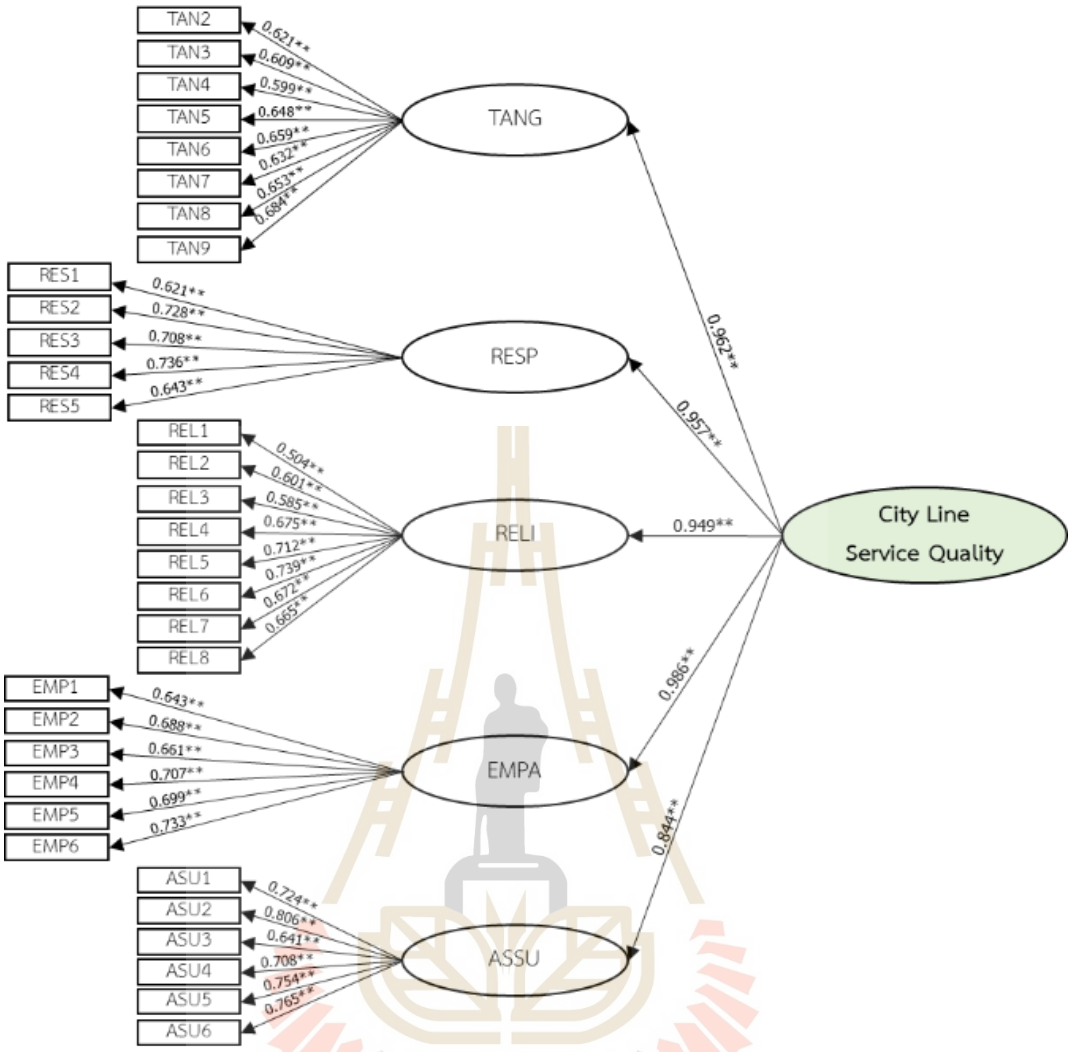

Figure 3.2 Model for service quality measurement of urban line

The expectations regarding the service quality of the aforementioned urban railway are related to and interconnected with tangibles, responsiveness, reliability, empathy, and assurance, based on the framework proposed by Anantharanthan Parasuraman et al. (1985). These findings align with the results of the study conducted by Yang et al. (2012), which revealed that expectations directly influence the perception of value and image. Similarly, the study conducted by Park et al. (2004), (C.-F. Chen, 2008), (Chiou & Chen, 2010), and (Hussain et al., 2015) found that expectations directly impact the perception of service quality. A good service format can meet the specific needs of passengers and encourage them to return for repeated usage or attract an increased number of service users. Therefore, relevant government

agencies, such as the State Railway of Thailand, and private sector organizations that invest in this field should establish guidelines and develop service models for public transportation systems that align with the expectations of service users. This is essential to attract passengers and encourage them to choose or switch from private transportation to public transportation systems.

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CHAPTER IV
TRAVEL BEHAVIOR MODEL DEVELOPMENT AND ATTITUDE TO THE LOYALTY, SATISFACTION, AND COMMITMENT OF SKY TRAIN PASSENGERS IN URBAN

4.1 Abstract

The factor analysis influencing the loyalty, satisfaction, and commitment of the passengers aims to develop a travel behavior model and attitude towards the loyalty, satisfaction, and commitment of 1,000 Skytrain passengers in urban areas who use the Commuter Line and Urban Line. The research studied observed variables, including frequency of use, perceived value, trust, perceived risk, and perceived quality, along with 16 indicators related to loyalty, satisfaction, and commitment. The analysis involved statistical data, encompassing general passenger information and basic statistics, and utilized Structural Equation Modeling of Multiple Indicators and Multiple Causes (MIMIC Model). The results indicated that passengers using both the Commuter Line and Urban Line exhibit higher levels of loyalty, satisfaction, and commitment when they perceive value, trust, and high-quality service. Therefore, ensuring that passengers perceive value, trust, and high-quality service is crucial for the sectors involved in mass rapid transit. Continuously prioritizing these factors will lead to increased passenger satisfaction and loyalty, contributing to the overall success and efficiency of the mass rapid transit system.

4.2 Introduction

The format change of travel and transportation affect to the development of city, community, and environment in the area. According to the past, the way or infrastructure development project of Thailand emphasize to mainly invest of road infrastructure, but they cannot solve traffic problem, problem of insufficient travel support system for the passengers. The government should have policy to develop infrastructure of transportation especially the rail transit such as double tracks railway,

high speed rail, and mass rapid transit authority. This system is main transport that support many passengers, energy saving, and friendly environment. As the 20 year National Strategic (2018-2037) emphasize to develop infrastructure of railway to cover most service area to answer the travel need and change travel behavior from using private car become public transportation system. Nowadays, the system of mass rapid transit authority of Thailand services covers only in Bangkok and boundary as be evident from the project of mass rapid transit authority development 13 lines that are during the construction which was built to change travel behavior from using private car become mass rapid transit authority system. A good service of mass rapid transit authority system that answer the need of passengers is necessary that the government or provider should be considered to attract more passengers to use mass rapid transit authority system service. In consequence, the management of mass rapid transit authority system service to be effective and answer the need of passengers is necessary as Anantharanthan Parasuraman, Zeithaml, and Berry (1985) said that perceive service quality of the passengers or customers can be evaluate from the comparison of need or expectation with service by perceive quality is an influenced indicator to the satisfaction of passengers. This research has purpose to study travel behavior and attitude to the loyalty, satisfaction, and commitment of urban sky train passengers.

4.3 Literature Review

4.3.1 Perceive Value

Perceive value is a decision or evaluation by customers to compare advantage or benefit from product and service (Zeithaml, Berry, & Parasuraman, 1988), value perceiving produces in all process of purchasing included to Blanket Purchasing process (Woodruff, 1997). As the research of (Park, Robertson, & Wu, 2004), (C.-F. Chen, 2008), (Chiou & Chen, 2010), (Forgas, Moliner, Sánchez, & Palau, 2010), (Hussain, Al Nasser, & Hussain, 2015) found that perceive value had positive influenced to the satisfaction, and according to the study of (Zins, 2001), (Forgas et al., 2010) found that perceive value had positive influenced to the loyalty.

4.3.2 Trust

Trust of customer is real situation when some service supporters who had participated with sharing of reliability and integrity which can be evaluated by trust of customers. Each provider will be received different trust from customers by customer decision of service perceive and agreement comparison that the provider specified. In addition, trust is a significant to relationship design that show the relation between brand and customer (Morgan & Hunt, 1994). According to the previous research of (Forgas et al., 2010), (Akamavi, Mohamed, Pellmann, & Xu, 2015) found that trust had directly positive relationship to the loyalty.

4.3.3 Perceived Risk

Perceived risk means an opportunity cognition to have damage or all negative effect of the situation that is suspected to happen to the customers if they choose those service (Jacobs & Worthley, 1999). In case of the situation is too bad over the exception of customer, this perceive will be affected to customer behavior. The perceived risk of this research means perceived security and risk of airline which is one of important factor that the passengers used to make decision to choose an airline. As previous study of (Zhang et al., 2019) found that perceived risk had negative effect to the trust, and the study of (Cho, Ali, & Manhas, 2018) had negative influenced that lead the passengers travel by low-cost airlines.

4.3.4 Perceived Service Quality

Perceived Service Quality of customer is an evaluation or agreement about the best of service. Totally, it was result from the comparison of customers between their expectation about service quality and service that they received (Ananthanarayanan Parasuraman & Berry, 1990). Mattsson (1992) divided factor that influenced to perceive service quality into 5 dimensions which were reliability, timeliness, accessible, humane: pleasant to use, and choice, cost. Gronroos (1988) is the first researcher who used customer satisfaction/ dissatisfaction or CS/D model to realize that if the customer satisfies with service quality.

4.3.5 Loyalty

Loyalty means unity, morale, and potency. Loyalty means feeling and expression of the respect to commander. Loyalty to goods price means regular satisfaction or buying old brand of goods. (Zeithaml, Berry, & Parasuraman, 1996), (Bloemer, De Ruyter, & Wetzels, 1999) had summarized the factors that use to test the loyalty to service by customer behavior intentions which consisted of word of mouth communications, purchase intention, price sensitivity, and complaining behavior.

4.3.6 Satisfaction

Satisfaction is the feeling level of person result from the comparison between success of perceived service and expected service of those people. Customers can be sensed 3 levels of the satisfaction as following; if perceived success is lower than expectation, customers will be dissatisfied (dissatisfied customer). If perceived success is equal to expectation, customers will be delighted (delighted customer) and if perceived success is higher than expectation, customers will be satisfied or very satisfied (satisfied customer) (Kotler & Armstrong, 1994).

4.3.7 Commitment

Product or service commitment means the potential of service provider has positive effect to the feeling of customers which lead to the good commitment (S.-C. Chen, 2012) as well as repurchase or support product or service again. (Bendapudi & Berry, 1997) gave advice about the factor of customer relationship creation which should consist of environment factors, keeping of relationship with business partner, customer requirement, and interaction. As the last study of S.-C. Chen (2012) found that commitment had positive influenced with the loyalty.

4.4 Research and Methodology

4.4.1 Conceptual Framework

Conceptual Framework of this study shows as picture 1; shows the concept of travel behavior model and attitude to the loyalty, satisfaction, and commitment of suburb and urban passengers by using service quality indicator and there is model examination under 15 hypotheses.

H1 : The frequency of sky train service used influences to the passengers' loyalty.

H2 : The frequency of sky train service used influences to the passengers' satisfaction.

H3 : The frequency of sky train service used influences to the passengers' commitment.

H4 : The perception of sky train service value influenced to the passengers' loyalty.

H5 : The perception of sky train service value influenced to the passengers' satisfaction.

H6 : The perception of sky train service value influenced to the passengers' commitment.

H7: The trust of sky train service influences to the passengers' loyalty.

H8 : The trust of sky train service influences to the passengers' satisfaction.

H9 : The trust of sky train service influences to the passengers' commitment.

H1 0 : The risk perception of sky train service used influences to the passengers' loyalty.

H1 1 : The risk perception of sky train service used influences to the passengers' satisfaction.

H1 2 : The risk perception of sky train service used influences to the passengers' commitment.

H1 3 : The perception of sky train service quality influences to the passengers' loyalty.

H1 4 : The perception of sky train service quality influences to the passengers' satisfaction.

H1 5 : The perception of sky train service quality influences to the passengers' commitment.

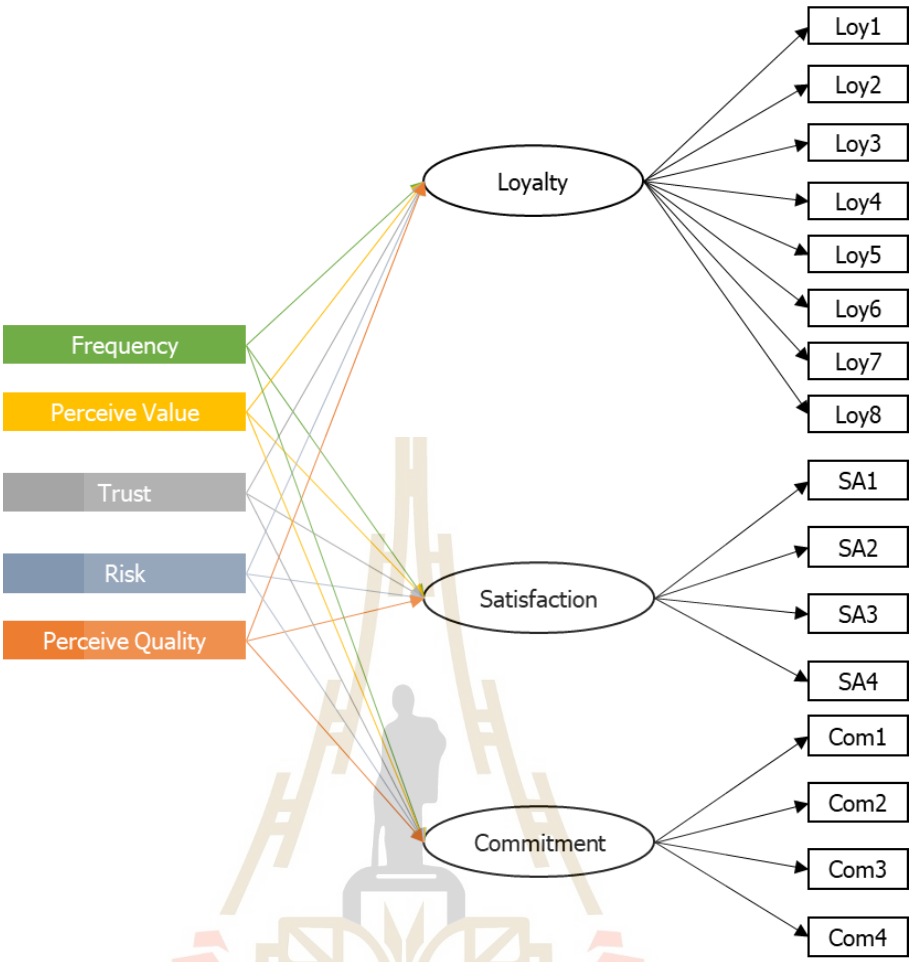

Figure 4.1 The concept of MIMIC model of the commuter line and urban line users

4.4.2 Sample

In this study, the data was collected from 500 airport rail link passengers and 500 passengers who use BTS sky train, blue line sky train, and purple line sky train by simple random sampling, Face to face Interview around the sky train station and bus stop nearby the sky train station. The Sample Size is sufficient for the analysis of Structural Equation Modeling (SEM) based on Maximum Likelihood Estimation which was 15 times of observed variables (Kline, 2023).

4.4.3 Variables

The survey consists of 16 indicators related to Loyalty, Satisfaction, Commitment, Frequency, Perceive Value, Trust, and Perceive Quality by using 7-level of passengers' aspect (7= Strongly agree to 1=Strongly Disagree).

4.4.4 Reliability

To confirm this survey reliability, the IOC is around 0.67-1.00 which appears that the questions are on target's purpose. Then data collection for pilot test from 30 samples is found that Cronbach's Alpha is equal 0.797-0.955 which is more than 0.70 (Tavakol & Dennick, 2011) indicates that the survey is fit to use for data collection.

4.4.5 Data Analysis

Data analysis by using Structural Equation Modeling base on Multiple Indicators and Multiple Causes (MIMIC Model) is data analysis as many observed variables types predict or affect to Latent Variables (Schumacker and Lomax, 2010). The Latent Variables was influenced from many external Observed Variables and affected to many internal observed variables. The easiest mimick model format is many observed variables (x-variables) predict or affect to a Latent Variable which can measure from many indicators (y-variables) (Joreskog & Sorbom, 1996).

In this study, there are 3 Latent Variables which are Loyalty, Satisfaction, and Commitment. In addition, 5 external Observe Variables are Frequency, Perceive Value, Trust, Trust, and Perceive Quality by using Mplus version 7.2 program to do data analysis.

4.5 Results

4.51 Descriptive Analysis

The sample population primarily comprises women, accounting for 310 among the total commuter line users (62%) and 300 out of the total urban line users (60%). The average age of individuals utilizing the commuter line is 31 years, whereas for those utilizing the urban line, it is 36 years. The average income of individuals utilizing commuter lines is determined to be 26,380.28 Thai baht, in comparison to urban line users who have an average income of 23,250.00 Thai baht. A notable percentage of participants, comprising 231 individuals who utilize the commuter line (46.2%) and 253 individuals who utilize the urban line (50.5%), are employed by the private sector. The Skytrain is utilized at a frequency of approximately two times per week by both categories of users. Specifically, 130 individuals, accounting for 26% of

the commuter line users, and 116 individuals, representing 23.2% of the urban line users, make use of this transportation system. Significantly, a noteworthy proportion of respondents, specifically 96.2% of commuter line users (n = 481) and 97.8% of urban line users (n = 490), indicated that they had not experienced any accidents while utilizing the sky train system. Likewise, a majority of individuals did not encounter a breakdown in their journeys on the Skytrain system. This is evidenced by 84.8% of individuals utilizing the commuter line and 86.6% of individuals utilizing the urban line reporting no instances of breakdowns. The demographic characteristics are further depicted in Table 4.1.

Table 4.1 The demographic characteristics

Var.	Items	Commuter Line		Urban Line	
		Frequency	Percent	Frequency	Percent
Gender	Male	190	38	200	40
	Female	310	62	300	60
Occupation	Government officer/government employee	30	6	60	12
	Private company's employee	231	46.2	253	50.5
	Business owner	66	13.2	112	22.4
	Farmers	0	0	1	0.2
	Students	111	22.2	5	1
	Freelance	38	7.6	50	10
	Other	24	4.8	20	4
Frequency of Service Usage (Day/Week)	1	117	23.4	113	22.6
	2	130	26	116	23.2
	3	71	14.2	88	17.6
	4	32	6.4	45	9
	5	115	23	92	18.4
	6	19	3.8	32	6.4
	7	16	3.2	15	3

Table 4.1 The demographic characteristics (Continued)

Var.	Items	Commuter Line		Urban Line	
		Frequency	Percent	Frequency	Percent
Have you experienced an accident while travelling?	No	481	96.2	490	97.8
	Yes	19	3.8	10	2
Have you ever experienced a sky train breakdown while travelling?	No	424	84.8	434	86.6
	Yes	76	15.2	66	13.2
Average age (years old)		31 (SD=11.68)		36 (SD=10.80)	
Average income (Thai baht/month)		26,380.28 (SD=11.68)		23,250.00 (SD=11.68)	

Table 4.2 Average, Standard deviation, Skewness, and Kurtosis of the indicators

Indicators	Description	Commuter Line				Urban Line			
		Mean	S.D.	Sk	Ku	Mean	S.D.	Sk	Ku
LOY1	I would recommend my friends to travel by sky train.	5.64	1.04	-0.678	0.219	5.578	0.868	-0.251	-0.253
LOY2	On my next trip, I will use the sky train service.	5.68	1.025	-0.706	0.501	5.492	0.807	-0.066	-0.481
LOY3	If the sky train can also maintain a good price level and quality of service, I will use the sky train forever.	5.59	1.126	-0.761	0.318	5.492	0.925	-0.365	0.011
LOY4	I will talk about the advantages of traveling by sky train, let others know.	5.29	1.282	-0.694	0.52	5.374	0.912	-0.522	0.891
LOY5	I would encourage friends and acquaintances to travel with the “Sky train”.	5.49	1.144	-0.574	0.02	5.412	0.89	-0.358	0.494
LOY6	On each trip, I shall select Sky train as the first option.	4.9	1.253	-0.395	-0.256	5.182	1.093	-0.357	-0.289
LOY7	Sky train is the best option.	5.02	1.32	-0.595	0.096	5.164	1.246	-0.701	0.437
LOY8	Apart from the Sky train, I am not interested in any other modes of transportation.	4.38	1.522	-0.307	-0.388	4.676	1.495	-0.453	-0.51
SAT1	Taking the Sky train makes me really happy.	5.27	1.164	-0.347	-0.347	5.412	0.908	-0.132	-0.509

Table 4.2 Average, Standard deviation, Skewness, and Kurtosis of the indicators (Continued)

Indicators	Description	Commuter Line				Urban Line			
		Mean	S.D.	Sk	Ku	Mean	S.D.	Sk	Ku
SAT2	I am satisfied with the sky train service as overall.	5.43	1.154	-0.605	0.177	5.466	0.878	-0.467	0.458
SAT3	I received exceedingly high-quality service.	5.06	1.118	-0.411	0.157	5.432	0.961	-0.493	0.381
SAT4	The service I received was the service of my dreams.	4.96	1.17	-0.457	0.139	5.282	1.099	-0.612	0.335
COM1	I am proud to use the “sky train” service.	5.21	1.208	-0.198	-0.638	5.26	1.044	-0.748	1.817
COM2	I am concerned about the sky train's long-term viability.	5.24	1.235	-0.223	-0.592	5.33	0.981	-0.24	0.245
COM3	I believe that travelling by sky train is a mode of transportation that prioritises the nation's development.	5.68	1.347	-0.832	-0.064	5.824	0.965	-0.421	-0.554
COM4	Traveling by sky train gives me a good image.	5.13	1.284	-0.259	-0.388	5.214	1.234	-0.747	1.089
FRE	Service Usage Frequency	3.04	1.743	0.475	-0.974	3.078	1.728	0.457	-0.926
PVA	Value perception	5.27	1.131	-0.299	-0.38	5.288	0.911	-0.234	-0.409
TUS	Trust	5.45	1.067	-0.68	0.363	5.528	0.829	0.006	-0.443
RIS	Risk awareness	3.25	1.455	-0.073	-1.088	2.702	1.385	0.509	-0.506
PQS	Perception of service quality	5.31	1.037	-1.022	0.939	5.842	0.683	-0.094	-0.248

An analytical evaluation was conducted on the constructs of loyalty, satisfaction, and commitment, as well as variables including frequency, perceived value, trust, risk, and perceived quality. This process involved exploring each of these 16 indicators with regards to their average, standard deviation, skewness, and kurtosis. The results of the analyses for two distinct user groups, specifically those who use the commuter line and those who use the urban line, are presented in Table 2. Within the loyalty construct, it is observed that LOY2 shows the highest mean score of 5.68 (SD = 1.025) among individuals who utilize the commuter line. Conversely, LOY1 demonstrates the highest mean score of 5.58 (SD = 0.868) among individuals who utilize the urban line. Regarding the satisfaction construct, a noteworthy observation is the elevation of SAT2's mean for the commuter line users, which reaches a maximum of 5.43 (SD = 1.154). Conversely, urban line users exhibit an mean of 5.47 (SD = 0.878). Within the commitment construct, the indicator COM3 exhibits the highest mean for both user groups: commuter line users and urban line users. Specifically, it records a maximum average of 5.68 (SD = 1.347) and 5.82 (SD = 0.911) correspondingly. In terms of perceived value, the average scores for commuter line users and urban line users are 5.27 (SD = 1.131) and 5.29 (SD = 0.911), respectively. Regarding the trust construct, the mean values for commuter and urban line passengers are 5.45 (SD = 1.067) and 5.53 (SD = 0.829), accordingly. The mean risk perception scores for the aforementioned user categories are 3.25 (SD = 1.455) and 2.70 (SD = 1.385), respectively. For commuter line users and urban line users, the mean values for service quality perception are 5.31 (SD= 1.037) and 5.84 (SD= 0.683), and the mean for service utilization frequency are 3.04 (SD= 1.743) and 3.08 (SD= 1.728), correspondingly.

Maximum Likelihood Estimation (MLE), the estimation method utilized in this study. It is essential to consider the underlying distributional properties. The range of skewness values for commuter line riders is between -1.022 and 0.475, and the range of kurtosis values is between -1.088 and 0.520. In contrast, the skewness range for urban line consumers is between -0.748 and 0.457, and the kurtosis range is between -0.926 and 1.817. Importantly, the derived skewness and kurtosis values are within normality's acceptable limits: skewness less than 3.0 and kurtosis less than 10.0 (Kline, 2023). These characteristics of the data are consistent with a normal data distribution, which makes further analysis appropriate and justifiable.

4.5.2 Multiple Indicators and Multiple Causes (MIMIC Model)

4.5.2.1 Goodness-of-fit statistics

When examining the harmonious coherence of the MIMIC model and empirical data, it is discovered that the MIMIC model and empirical data are highly coherent. The details are presented in Table 4.3.

Table 4.3 Model fit indices

Fit Index	Commuter Line	Urban Line	Cut-Off Value	References
X2/df	589.585/149	554.376/163	‹5	Jomnonkwao et al. (2022)
SRMR	0.055	0.051	≤0.08	Hu and Bentler (1999); Wu, Taylor, and West (2009)
RMSEA	0.077	0.069	≤0.07	Steiger (2007)
CFI	0.939	0.908	≥0.90	Hu and Bentler (1999)
TLI	0.919	0.887	≥0.80	Hooper, Coughlan, and Mullen (2008)

4.5.2.2 Model parameters estimated

The analysis results of the primary order confirmatory component relating to loyalty, satisfaction, and commitment variables are presented in Table 4. Both for the commuter line users and urban line users, the confirmation is exhibited as statistically significant across 16 indicators. These indicators affirm influence on loyalty at a statistically significant level of 0.001.

1) The commuter line users: The loyalty construct is represented by five indicators, each showcasing factor loadings that fall within the range of 0.706 to 0.875. Among these, LOY5 displays the highest factor loading of 0.875 (Cronbach's Alpha = 0.905 AVE=0.811 CR=0.907). Four indicators of satisfaction construct has the factor loadings between 0.644-0.909 where is SAT2 is the greatest factor loadings of this construct which is 0.909 (Cronbach's Alpha = 0.889 AVE=0.778

CR=0.992). Similarly, the satisfaction construct, bolstered by four indicators, exhibits factor loadings between 0.644 and 0.909. Of this construct, SAT2 bears the heaviest weight, with a factor loading of 0.909 (Cronbach's Alpha = 0.889 AVE=0.778 CR=0.992). The commitment construct is characterized by four indicators, with factor loadings spanning from 0.827 to 0.877. The highest loading in this group, 0.868 (Cronbach's Alpha = 0.911 AVE=0.850 CR=0.994) , is attributed to the indicator COM1.

2) The urban line users: Eight indicators fall under the loyalty construct, each with factor loadings ranging from 0.579 to 0.744. Among these, LOY5 demonstrates the highest factor loading at 0.744 (Cronbach's Alpha = 0.867 AVE=0.675 CR=0.992). The satisfaction construct, encompassing four indicators, exhibits factor loadings varying from 0.719 to 0.782. The highest loading in this construct is offered by SAT2, at 0.782 (Cronbach's Alpha = 0.823 AVE=0.739 CR=0.989). Lastly, the commitment construct, composed of three indicators, shows factor loads between 0.509 and 0.864, with COM2 holding the highest value at 0.864 (Cronbach's Alpha = 0.740 AVE=0.704 CR=0.980).

In the measurement model, indicators with a standard component weight exceeding 0.5 are deemed acceptable (Hair, Black, Babin, Anderson, & Tatham, 2010). The quality is considered good if this value surpasses 0.6 (Park et al., 2004). A Cronbach's Alpha value exceeding 0.7 caters to well-suited values (Hair et al., 2010). Components where both average variance extracted (AVE) and construct reliability (CR) values exceed 0.5 are considered to have good and consistent indicators (Hair, Gabriel, & Patel, 2014).

Table 4.4 Results of parameters estimated

Factor	Commuter Line			Urban Line		
	Loadings	t-value	Error	Loadings	t-value	Error
Loyalty	Cronbach's Alpha = 0.905			Cronbach's Alpha = 0.867		
	AVE=0.811 CR=0.907			AVE=0.675 CR=0.992		
LOY1	0.796**	42.886	0.019	0.634**	20.994	0.03
LOY2	0.817**	46.788	0.017	0.653**	22.402	0.029
LOY3	0.861**	60.259	0.014	0.684**	25.163	0.027
LOY4	0.706**	28.744	0.025	0.712**	27.665	0.026
LOY5	0.875**	66.48	0.013	0.744**	31.385	0.024
LOY6	-	-	-	0.714**	27.717	0.026
LOY7	-	-	-	0.683**	25.469	0.027
LOY8	-	-	-	0.579**	17.476	0.033
Satisfaction	Cronbach's Alpha = 0.889			Cronbach's Alpha = 0.823		
	AVE=0.778 CR=0.992			AVE=0.739 CR=0.989		
SAT1	0.864**	61.22	0.014	0.719**	28.103	0.026
SAT2	0.909**	79.982	0.011	0.782**	35.445	0.022
SAT3	0.695**	27.492	0.025	0.728**	28.957	0.025
SAT4	0.644**	22.912	0.028	0.726**	28.784	0.025
Commitment	Cronbach's Alpha = 0.911			Cronbach's Alpha = 0.740		
	AVE=0.850 CR=0.994			AVE=0.704 CR=0.980		
COM1	0.868**	50.706	0.017	0.740**	26.895	0.028
COM2	0.877**	60.393	0.015	0.864**	35.851	0.024
COM3	0.828**	47.102	0.018	0.509**	13.561	0.038
COM4	0.827**	49.414	0.017	-	-	-

Note: **significant at 0.001

4.5.2.3 MIMIC Model

The MIMIC model's results pertaining to commuter line users are delineated in Table 5 with relevant details:

1) Regarding loyalty, the study constructs such as Perceived Value (PVA), Trust (TUS), and Perceived Quality (PQS) account for 70.8% predictability for passenger loyalty. All the constructs show a statistically significant positive correlation with loyalty at a 0.01 level, where PVA scores 0.473, TUS registers 0.339, and PQS tallies 0.130. However, the construct Risk (RIS) demonstrates a statistically significant negative correlation with loyalty at a 0.1 level, scoring -0.056. Frequency (FRE) fails to predict passenger loyalty.

2) Pertaining to satisfaction, the constructs: PVA, TUS, RIS, and PQS can potentially foretell 73.8% of passenger satisfaction. The PVA, TUS, and PQS display statistically significant positive correlations with satisfaction at a 0.05 level, with respective values of 0.339, 0.424, and 0.178. However, RIS reveals a statically significant negative correlation with loyalty at the 0.05 level, recording -0.136. Again, FRE cannot predict passenger satisfaction.

3) Regarding commitment, constructs like FRE, PVA, TUS, RIS, and PQS predict approximately 62.5% of passenger's commitment. The constructs PVA, TUS, PQS, and FRE suggest statistically significant positive correlations with commitment at the level of 0.05, with values of 0.228, 0.424, 0.152, and 0.053 (only FRE with significance at 0.1). However, RIS demonstrates a statistically significant negative correlation with commitment at a 0.05 level, registering -0.223.

Table 4.5 MIMIC model analysis results of the commuter line users

Factor	Loadings	t-value	Error	p-Value	Result
Loyalty					
FRE	0.024	0.751	0.028	0.453	Rejected H
PVA	0.473**	12.795	0.037	0.000	Accepted H
TUS	0.339**	8.262	0.041	0.000	Accepted H
RIS	-0.056*	-1.885	0.03	0.059	Accepted H
PQS	0.130**	3.634	0.036	0.000	Accepted H
R^2	0.708				
Satisfaction					
FRE	0.013	0.463	0.028	0.644	Rejected H
PVA	0.339**	9.137	0.037	0.000	Accepted H
TUS	0.424**	10.69	0.04	0.000	Accepted H
RIS	-0.136**	0.03	-4.599	0.000	Accepted H
PQS	0.178**	5.059	0.035	0.000	Accepted H
R^2	0.738				
Commitment					
FRE	0.053*	1.691	0.031	0.091	Accepted H
PVA	0.228**	5.43	0.042	0.000	Accepted H
TUS	0.424**	9.563	0.042	0.000	Accepted H
RIS	-0.223**	0.033	-6.807	0.000	Accepted H
PQS	0.152**	3.839	0.04	0.000	Accepted H
R^2	0.625				

Note: **significant at 0.05 and *significant at 0.1

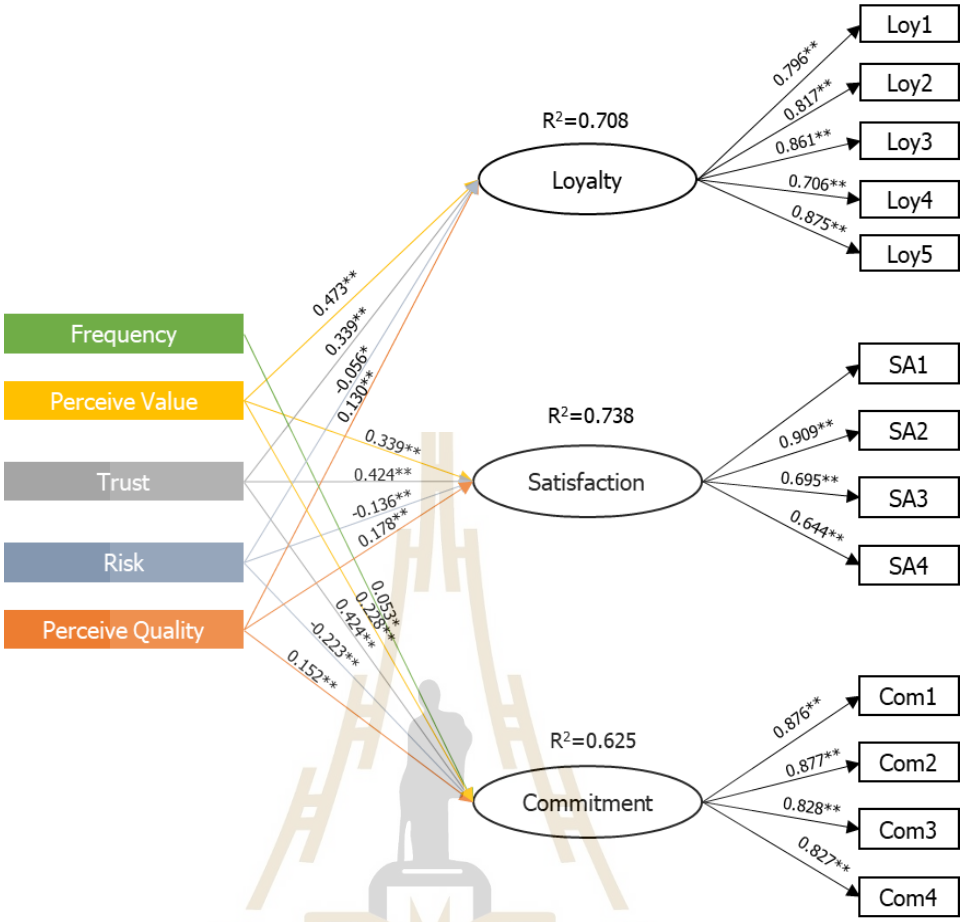

Figure 4.2 Results of MIMIC model of the commuter line users

The results of the MIMIC model analysis relating to urban line users are presented in Table 4.6.

1) With respect to loyalty, observable variables such as Perceived Value (PVA), Trust (TUS), and Perceived Quality (PQS) predict passenger loyalty at 58.6%. There is a statistically significant positive correlation between these variables and loyalty, evidenced at a 0.05 level, with PVA at 0.389, TUS at 0.352 and PQS at 0.214. However, Frequency (FRE) and Risk (RIS) fail to predict passenger loyalty.

2) As for satisfaction, PVA, TUS, and PQS are noted as observable variables predicting 64.2% of passenger satisfaction. These constructs show a positive correlation with passenger satisfaction, significant at a 0.05 level, including PVA at 0.375, TUS at 0.438, and PQS at 0.194. Once again, FRE and RIS do not determine passenger satisfaction.

3) In terms of commitment, PVA, TUS, and PQS have been found as observable variables, predicting passenger commitment at 32.3%. These constructs are positively associated with commitment, significant at a 0.05 level, highlighting PVA at 0.138, TUS at 0.435, and PQS at 0.117. Similar to previous findings, FRE and RIS do not predict passenger commitment.

Table 4.6 Analysis result of the MIMIC model of the urban line users

Factor	**Loadings**	**t-value**	**Error**	**p-Value**	**Result**
Loyalty					
FRE	0.033	0.941	0.035	0.347	Rejected H
PVA	0.389**	9.594	0.041	0.000	Accepted H
TUS	0.352**	8.432	0.042	0.000	Accepted H
RIS	0.017**	0.473	0.036	0.636	Rejected H
PQS	0.214**	5.638	0.038	0.000	Accepted H
R2	0.586				
Satisfaction					
FRE	-0.015	-0.445	0.034	0.656	Rejected H
PVA	0.375**	9.368	0.04	0.000	Accepted H
TUS	0.438**	10.845	0.04	0.000	Accepted H
RIS	0.057	1.637	0.035	0.102	Rejected H
PQS	0.194**	5.219	0.037	0.000	Accepted H
R2	0.642				
Commitment					
FRE	-0.018	-0.417	0.043	0.676	Rejected H
PVA	0.138**	2.691	0.051	0.007	Accepted H
TUS	0.435**	8.666	0.05	0.000	Accepted H
RIS	0.055	1.248	0.044	0.212	Rejected H
PQS	0.117**	2.505	0.047	0.012	Accepted H
R2	0.323				

Note: **significant at 0.05 and *significant at 0.1

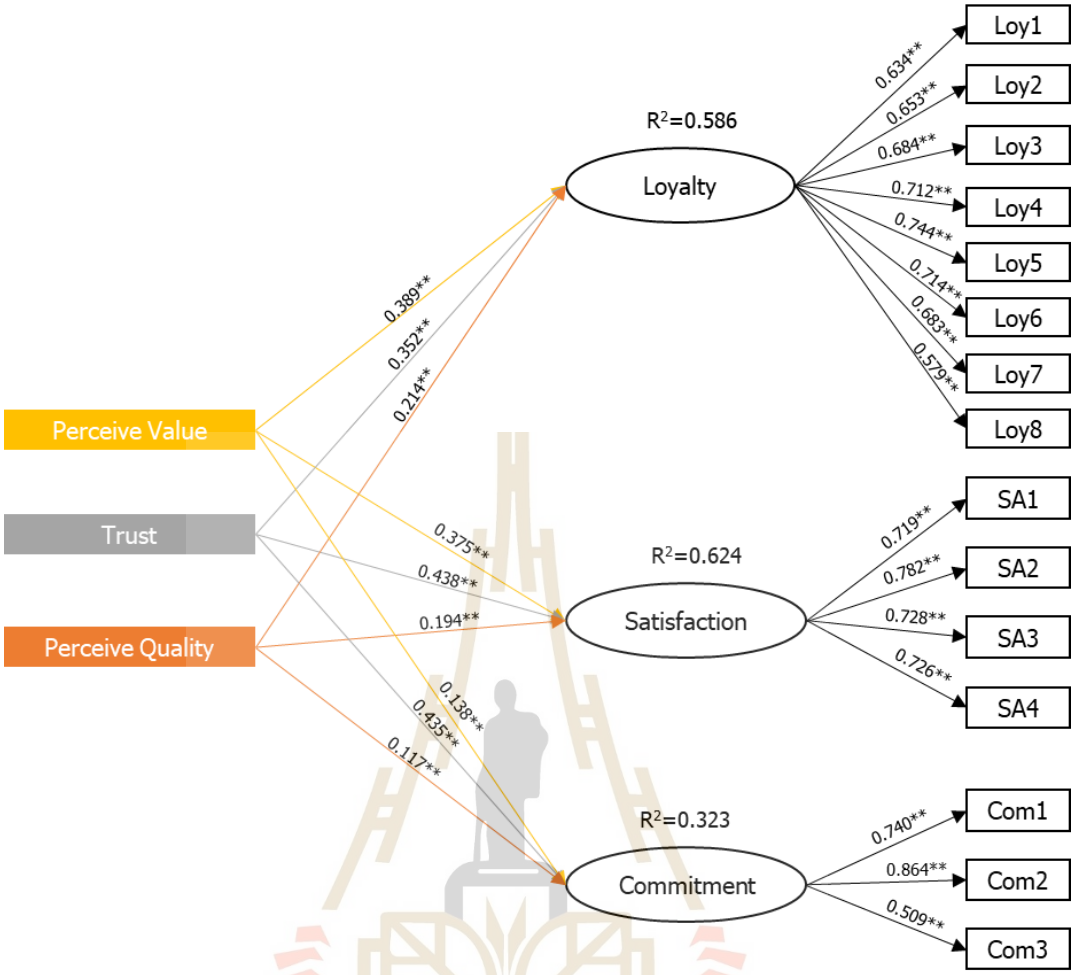

Figure 4.3 Results of MIMIC model of the urban line users

4.6 Conclusions and Discussion

The MIMIC model was developed to better understand travel behavior. The model emphasizes customer loyalty, satisfaction, and commitment while considering factors specific to both commuter and urban lines. It evaluates observable variables such as frequency of use, perceived value, trust, risk, and perceived quality – each in relation to loyalty, satisfaction, and commitment. Based on the model's analysis, the following findings were produced: 1) In the context of the commuter line, the perceived quality variable showed the most substantial positive contribution to loyalty, as indicated by a coefficient of 0.473. On the other hand, trust appeared as the primary variable positively impacting satisfaction, boasting a coefficient of 0.424. These findings suggest that perceived quality significantly influences customer loyalty, while trust has

a notable effect on satisfaction and commitment. 2) As for urban line usage, perceived value was found to be the most influential factor positively impacting loyalty, demonstrated by a coefficient of 0.389. Trust also showed a significant positive effect on satisfaction, substantiated by a coefficient of 0.432. In addition, trust was found to positively influence commitment, marked by a coefficient of 0.435. This reveals that perceived value and trust play vital roles in shaping customer loyalty, satisfaction, and commitment respectively, all of which have been statistically validated at the 0.001 level.

This investigation emphasizes the direct influence of perceived value, trust, and perceived quality on customers' loyalty. This results in repeated use of the sky train service by current customers and recommendations to prospective users. A body of literature substantiates this claim, notably Jomnonkwao, Ratanavaraha, Khampirat, Meeyai, and Watthanaklang (2015) who found that customer loyalty is propelled by perceived service quality, perceived value, and trust. Similarly, Zins (2001) and Forgas et al. (2010) posit that perceived value positively impacts loyalty, as backed up by further empirical studies by (Forgas et al., 2010) and (Akamavi et al., 2015) asserting a direct positive relationship between trust and loyalty. Moreover, the study uncovers that the recognition of value, trust, and quality of service directly impacts satisfaction levels. This somewhat exceeding patrons' initial expectations aligns with fundamental marketing precepts indicating customer satisfaction as a critical determinant in service reuse (Chou, Kim, Kuo, & Ou, 2011). Supporting this assertion are the findings of a collection of researchers (Park et al., 2004) (C.-F. Chen, 2008) (Chiou & Chen, 2010) (Hussain et al., 2015) indicating to the positive impact of perceived value on satisfaction. Lastly, the study validates the direct influence of these factors on commitment, which manifests in the form of a general concern for the sky train service's long-term success and a sense of pride among its users. This complies with definitions of commitment towards goods and services: such commitment likely stems from positive feelings produced by the interactions between the service provider and its consumers (S.-C. Chen, 2012). This relationship reinforces mutual loyalty, deterring switching behaviors towards newer offerings.

4.7 References

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CHAPTER V
CONCLUSION AND RECOMMENDATION

The development of indicators for city rail service quality in Thailand aims to achieve several objectives: firstly, to create a measurement model for assessing railway transport service quality in urban areas; secondly, to establish a conceptual framework and model for evaluating the impact of railway transport service quality on passenger loyalty; and finally, to develop a causal relationship model that links travel behavior to loyalty, satisfaction, and passenger commitment. The research methodology employed a Quantitative Research approach, using a Questionnaire as the primary data collection instrument. The data analysis process encompassed Descriptive Statistics Analysis, Factor Analysis, and Structural Equation Modeling Analysis, which are summarized as follows:

5.1 Research Conclusion

5.1.1 The Development Model Conclusion of Perceived Quality Service of Urban Railway Transportation to the Passenger Royalty

The objective of this study was to create a conceptual framework and develop a model to measure passenger loyalty for those using railway transportation in Bangkok and the surrounding areas. The researcher achieved this by identifying perceived quality service indicators across five fields, namely satisfaction (4 fields), trust (4 fields), perceived value (3 fields), cost of switching service providers (2 fields), and loyalty (3 fields). Statistical data, including passenger general information and perceived quality of city rail service usage, were collected and analyzed using Structural Equation Modeling. The analysis yielded the following results:

5.1.1.1 Demographic findings indicated that the majority of city rail passengers in Bangkok and the surrounding areas were female 58.83%, with 60.50% holding Bachelor's degrees. Additionally, 29.33% of the passengers earned a monthly income exceeding 30,000 baht, and 52.83% were employed in private companies. The most frequent service usage pattern was 1-3 days per week, accounting for 64.83% of passengers.

5.1.1.2 The structural Equation Modeling analysis of the loyalty measurement model for the passengers using city rail services revealed that perceived quality service could be measured through 36 indicators. Confirmatory factor analysis with statistical significance at the 0.001 level validated the composition of service quality, which encompassed vehicles, staff, service, news information, and stations. All composition weights were higher than 0.5. As a result, the concerned sectors of city rail services in urban areas can use these research findings to devise strategic planning for station management, news information, and service quality improvement.

Regarding the first confirmatory factor analysis model of perceived quality service, statistical significance at the 0.001 level showed that the main station indicator that passengers paid attention to was the convenience of connecting with other transportation systems (P35). The news information indicator that received the most attention from passengers was the presence of guideposts and sufficient travel information (P25). Lastly, the service indicator that passengers paid most attention to was the availability of a modern and accurate fee storage system (P15).

Perceived quality service significantly influenced passenger trust, satisfaction, and perceived value. Furthermore, passenger trust directly impacted customer satisfaction and loyalty. This finding indicates that if passengers have a higher level of trust in the service, their satisfaction and loyalty will increase as well. Therefore, the concerned sectors of city rail services in urban areas should prioritize enhancing service quality to retain current passengers and attract new ones in the future (Sun & Lin, 2010). Additionally, the cost of switching service providers directly affected passenger loyalty.

5.1.2 The Measurement Model Development Conclusion of Railway Transport Service Quality in Urban Area

The objective of this study was to develop a measurement model for railway transport service quality in urban areas. The researcher accomplished this by creating a service quality measurement model for city rail services in Bangkok and the surrounding areas, based on 5 fields of SERVQUAL Model indicators: Tangibles, Responsiveness, Reliability, Empathy, and Assurance. The model included 37 indicators and was divided into two parts: (A) Commuter Line service quality measurement model

and (B) Urban Line service quality measurement model. The study focused on passengers using the Commuter Line (airport rail link city rail) and the Urban Line (BTS city rail and MRT), and statistical data was analyzed, encompassing passenger general data, basic statistics of expectations regarding city rail service use, and Confirmatory Factor Analysis. The summarized analysis results are as follows:

5.1.2.1 Most of the Commuter Line passengers were female, accounting for 62.00% of the total. The average age of these passengers was 31 years old, and their average monthly income was 26,380.28 baht. Additionally, a significant portion, around 54.80%, had graduated with a Bachelor's Degree. Around 46.20% of them were employed in private companies. In terms of service usage frequency, the majority used the service approximately 1, 2, and 5 days per week. As for the Urban Line passengers, 60.00% of them were female. The average age of these passengers was 36 years old, and their average monthly income amounted to 23,250.00 baht. Furthermore, the majority, about 59.20%, had completed a Bachelor's Degree. Around 50.50% of them earned a living as private company employees. Regarding the service usage frequency, most of the Urban Line passengers used the service approximately 1 and 2 days per week.

5.1.2.2 The confirmatory factor analysis of the service quality measurement model for both the Commuter Line and Urban Line, based on the 5 fields of the SERVQUAL Model indicators, revealed that the service quality of the Commuter Line could be effectively measured using the following concepts with statistical significance at the 0.001 level: Reliability (REL), Responsiveness (RES), Tangibles (TAN), Empathy (EMP), and Assurance (ASU). These indicators indicated that passengers placed the highest value on the location of city rail stations, particularly their easy accessibility to pathways, such as bus stations, taxi service areas, or areas with convenient access to taxis. Additionally, passengers highly valued fast and active staff responses, a cool and clean internal train environment, and prompt resolution of any issues that might arise during travel. Providing special discounts for passengers who purchase prepay tickets was also appreciated. Regarding the Urban Line, the confirmatory factor analysis showed that its service quality could be effectively measured using the following concepts with statistical significance at the 0.001 level: Empathy (EMP), Tangibles (TAN), Responsiveness (RES), Reliability (REL), and Assurance

(ASU). Passengers on the Urban Line valued communication regarding any travel or service issues, with staff promptly informing them about the causes and ongoing solutions. Additionally, passengers highly valued trains that were in new condition, fast and active staff service, stations conveniently located near bus stations and pathways, and the availability of complaint channels, including phone and online options, around the stations. Overall, these findings highlight the essential aspects that passengers prioritize when evaluating the service quality of both the Commuter Line and Urban Line, which can be utilized to improve and enhance the overall passenger experience.

5.1.3 A Causal Relationship Model Development Conclusion of Travel Behavior to the Loyalty, Satisfaction, and Commitment of the Passengers

The objective of this study was to develop a causal relationship model of travel behavior to passenger loyalty, satisfaction, and commitment. The researcher achieved this by creating separate causal relationship models for City Line and Urban Line passengers. The observed variables used in these models included service frequency (FRE), Perceived Value (PVA), Trust (TUS), Perceived Risk (RIS), and Perceived Quality Service (PQS). These variables were used to predict loyalty (with 8 indicators), satisfaction (with 4 indicators), and commitment (with 4 indicators) among the passengers. Perceived Quality Service (PQS) was further divided into two groups: indicators of the SERVQUAL Model and Infrastructure. The statistical data used in the analysis consisted of passenger general information and basic statistics regarding their expectations of city rail service usage. The Structural Equation Modeling analysis of Multiple Indicators and Multiple Causes (MIMIC Model) was employed to assess the relationships among these variables and predict passenger loyalty, satisfaction, and commitment. The summarized analysis results are as follows:

5.1.3.1 The majority of City Line passengers were female, accounting for 62.00% of the total. The average age of these passengers was 31 years old, and their average monthly income was 26,380.28 baht. Additionally, around 54.80% of them had graduated with a Bachelor's Degree, and 46.20% were employed in private companies. In terms of service usage frequency, the majority used the service approximately 1, 2, and 5 days per week. As for the Urban Line passengers, 60.00% of them were female.

The average age of these passengers was 36 years old, and their average monthly income amounted to 23,250.00 baht. Furthermore, the majority, about 59.20%, had completed a Bachelor's Degree, and around 50.50% earned a living as private company employees. Regarding the service usage frequency, most Urban Line passengers used the service approximately 1 and 2 days per week.

5.1.3.2 The Structural Equation Modeling analysis of MIMIC Model was divided into 2 models as following: 1) The MIMIC model of travel behavior and attitude to the loyalty, satisfaction, and commitment of city line passengers by indicator of SERVQUAL Model found that the loyalty was directly influenced from perceived value (PVA), trust (TUS), perceived risk (RIS), and perceived quality service (PQS). The satisfaction was directly influenced from perceived value (PVA), trust (TUS), perceived risk (RIS), and perceived quality service (PQS). The commitment was directly influenced from service frequency (FRE), perceived value (PVA), trust (TUS), perceived risk (RIS), and perceived quality service (PQS) and 2) The MIMIC model of travel behavior and attitude towards loyalty, satisfaction, and commitment of Urban Line passengers, using indicators of the SERVQUAL Model, also found that loyalty, satisfaction, and commitment were directly influenced by perceived value (PVA), trust (TUS), and perceived quality service (PQS). The analysis demonstrates the significant impact of perceived value, trust, perceived risk, service frequency, and perceived quality service on the loyalty, satisfaction, and commitment of both City Line and Urban Line passengers.

5.2 Research and Application

This research focused on studying passengers who use city rail services in Bangkok and the surrounding areas, specifically including the passengers of the airport rail link, BTS (Bangkok Transit System), and MRT (Metropolitan Rapid Transit). The study involved two main aspects: the service quality measurement model of railway transportation in urban areas and a causal relationship model of travel behavior in relation to passenger loyalty, satisfaction, and commitment. These models were further categorized based on the two main service lines: Commuter Line and Urban Line. It was observed that most passengers on both of these lines were female, employed in private companies, with an average age of 31 and 36 years for the

Commuter Line and Urban Line, respectively. Additionally, the average income of these passengers fell within the range of 23,000 to 26,000 baht.

According to the city rail fee, it starts at around 17-47 baht per round, depending on the number of stations used during the journey. If passengers need to travel for study or work, the highest fee will be 47 baht per round, which constitutes 14% of the lowest income bracket of 15,000 baht per month. This indicates that the passengers need the location of station where easily link to another transportation, need good management when there are travel problem and the problem cause and operation need to be informed to the passengers, the staff must be willing to fix problem with fast and active service, the internal condition of the train should be new, have cool temperature, clean, be nice and tidy, and have special discount for the passengers who buy prepay ticket or have promotion for regularly passengers, including to prepare for complaint channel around the station area through phone and online channel. Therefore, when considering service quality, the concerned sectors should establish service guidelines to meet the demands and satisfaction of the passengers. This can be achieved by clearly specifying the travel timetable, ensuring punctual service, and facilitating connections to other public transportation systems, such as public buses, light rail, and taxis. Additionally, it is crucial for all staff to be committed to performing their duties and providing excellent service, along with maintaining security both on the trains during travel and inside the stations. Given the importance of passenger security, particularly for female passenger groups, the government, the State Railway of Thailand, and private partners must work together to define and develop a public transportation system that aligns with passenger demands. This approach aims to attract more passengers to use public transportation services and encourage a shift in travel behavior from private cars to increased usage of the public transportation system. By implementing these measures and prioritizing service quality and passenger security, the city rail services can create a more appealing and reliable transportation option, leading to higher passenger satisfaction and increased use of public transportation services. In addition, the passengers will have the loyalty, satisfaction, and commitment to city rail service use and they will not use another public transportation when they are perceived service value, trusted in service, and perceived quality service while they were using city rail service. The frequency service

use does not affect to this issue since the city rail may be the most appropriate travel choice for travel in Bangkok and boundary therefore, the passengers do not have any appropriate travel choice more than the city rail.

5.3 Suggestions for Future Research

For future research, the following points are suggested:

1) Apply economic and sociological concepts and theories to the study. This involves examining the expectation levels and satisfaction regarding expenses, pricing, capability of fee payment, and differences in city rail system access.

2) Analyze spatial data and compare important issues in each area to collect more samples and cover various city rail lines' service areas.

3) Explore the origin and destination of a travel to compare opinions on service quality for both short and long-haul passengers.

4) Study loyalty options for travel and vehicle ownership.

5) Comparison service quality before and after COVID-19.

APPENDIX A

PUBLICATION

Publication

Wonglakorn, N., Ratanavaraha, V., Karoonsoontawong, A., & Jomnonkwao, S. (2021). Exploring passenger loyalty and related factors for urban railways in Thailand. Sustainability, 13(10), 5517.

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Exploring Passenger Loyalty and Related Factors for Urban Railways in Thailand

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Abstract: The research investigates the relationships among indicators related to the loyalty of urban railways passenger in Thailand at three routes, which consisted of BTS Sky train, MRT, and Airport Rail Link. The research instrument was 600 questionnaires, and the purpose was to study the indicators that affected perceived service quality and passenger loyalty by using structural equation modeling. The analysis of influence information that affects passenger loyalty revealed that trust, satisfaction, appreciation, cost of service changing, and relationships have an effect on passenger loyalty, statistically significant at 0.01. The satisfied variable was an important variable that affected passenger loyalty and was directly influenced by trust, appreciation, and perceived service quality. The perceived service quality was measured using 36 indicators and grouped into five complement groups, which were station, news, services, staffs, and vehicle, respectively. The research finding was that the cooperation concern with urban railway service can apply the result to the marketing development strategy to be a sustainable method of standardized service and urban railways system improvement.

Keywords: indicators; service quality; urban railway; loyalty; structural equation modeling

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1. Introduction

Thailand has developed transport infrastructure and public transport systems, such as air, road, water, and rail transport, on varying levels. Rail transport is one of the public transportation systems prioritized by the Ministry of Transport in Thailand. The 20 Years' Thailand Transport System Development Strategy (2017–2036) [1], which focuses on developing transport infrastructure, especially rail transport that remains an incomplete network, supports this initiative. The rail transport system in Thailand can be categorized into intercity rail, which provides services for passengers and goods transportation between cities, and urban rail, which offers services for passengers in Bangkok and its vicinity.

The government has continually provided support and developed the urban electric train system to ensure that routes cover essential metropolitan areas. People living in areas with access to electric trains have increasingly changed their means of transport from personal cars, public buses, and taxis to electric trains. The reason for this change is that they can avoid traffic jams and experience convenience in traveling, as evidenced by the increasing number of passengers using the electric train system in urban areas per year. For instance, in 2019–2020, the Bangkok (Mass) Transit System Skytrain (BTS Skytrain) had 236 million passengers and the Metropolitan Rapid Transit (MRT) pointed to an average of 102 million passengers per day. The Airport Rail Link (ARL) had 16.9 million passengers in the same year. Consequently, public transport service is a crucial factor

in attracting more passengers. Parasuraman et al. [2] argued that passengers' or users' perceived service quality can be assessed by comparing their needs or expectations to the actual service received, with perceived quality as an indicator of passenger satisfaction. Therefore, service providers examine passenger satisfaction to apply improvements to quality and service standards for sustainable urban electric trains because these aspects can enhance the quality of life and satisfaction of passengers. Furthermore, regarding the Thailand Transport System Development plan, the urban electric train system is considered and mentioned to be developed, covering Bangkok and counties as well as the major cities in every region in Thailand. Thus, the findings can be applied to the formulation of marketing strategies or policies for various services in the future.

The current study aims to investigate the indicators of the service quality of urban electric trains in Thailand using the structural equation model to examine perceived service quality and passenger loyalty toward electric train transportation.

2. Literature Review and Hypothesis Development

2.1. Service Quality

Service quality is a tool used to measure efficiency in meeting customer needs in the service business. A customer or service recipient will evaluate service quality based on experience versus expectation before using the service [2]. According to the theoretical framework of Parasuraman et al. [3], the criteria for assessing service quality, namely, SERVQUAL, consists of five dimensions, namely, tangibles, reliability, responsiveness, assurance, and empathy. A review of the previous literature indicates that studies on service quality are based on measurements that reflect the operating circumstances under consideration where service quality is hypothesized to exert a direct effect on perceived value [4,5] and positive behavioral intentions [6]. However, service quality is expected to exert an indirect effect [7–10] and a direct effect on loyalty [11,12] and overall satisfaction [6,13–15]. In addition, Zhang et al. [16] investigated the satisfaction factors of public transport and railway, such as wait time, transfer convenience, service, information, passenger comfort, station environment, and interior sanitation.

2.2. Customer Satisfaction

Satisfaction is feeling that affects the comparison between the perceived service and expected service of each person. The customer can realize satisfaction with three levels as follows; firstly, if the perceived service is lower than the expected service, the customer will be dissatisfied. Secondly, if the perceived service is equal to the expected service, the customer will be satisfied. Thirdly, if the perceived service is higher than the expected service, the customer will be very much satisfied. Grönroos [17] said that the satisfaction with the service consisted of two elements: (1) The element of perceived service, which means the customers will know that the service or goods have good quality, and this will satisfy the customers. (2) The element of perceived quality of service presentation. The customer will realize which service presentation of service process is appropriate for them, and all of these will be exactly satisfying to the customer.

2.3. Customer Loyalty

Loyalty denotes unity, encouragement, and strength or a feeling and expression of respect for another person. Specifically, brand loyalty refers to consistent satisfaction with or repurchase of a certain brand. Zeithaml et al. [18] and Bloemer et al. [19] used the customer behavior intention criteria to summarize the factors used to measure service loyalty, such as word-of-mouth, purchase intention, price sensitivity, and complaining behavior. Previous studies have found that customer loyalty is influenced by psychological or internal factors from consumers and external factors from the environment. Such factors are customer expectation, perceived service quality, customer satisfaction, perceived value, customer trust, commitment, and attractiveness of competitors [20].

The research that concerned the perceived service quality, satisfaction, and loyalty of passengers who use public transportation such as buses, airlines, and high-speed railway

abroad found that the perceived service was considered by SERVQUAL [21–23]. Moreover, Zhang et al. [24] studied the perceived service quality from the vehicle indicator, and there was a research group who studied three indicators: driver, vehicle, and administrative management. The researcher has reviewed the research about BTS in Thailand that focuses on the relationship between perceived service quality, satisfaction, and passenger loyalty by using the Marketing Mix Model (7Ps) and Thailand Customer Satisfaction Index Model (TCSI Model) to be the concept of research [25–27]; According to a previous study, there are limited indicator relation studies about public passenger loyalty. There was only Ratanavaraha and Jomnonkwao [28] who studied the indicators of public drivers. Thus, the researcher decided to study the relationship of the indicator about the perceived service quality, satisfaction, and the loyalty of urban railways passenger in Thailand, and the service quality was considered from the main facilities and infrastructure.

3. Materials and Methods

3.1. Conceptual Framework

The conceptual framework (Figure 1) showed the relationship of indicators about perceived service quality, satisfaction, perceived service quality, trust, and the indicator that influenced passenger loyalty. The models were examined under 10 hypotheses.

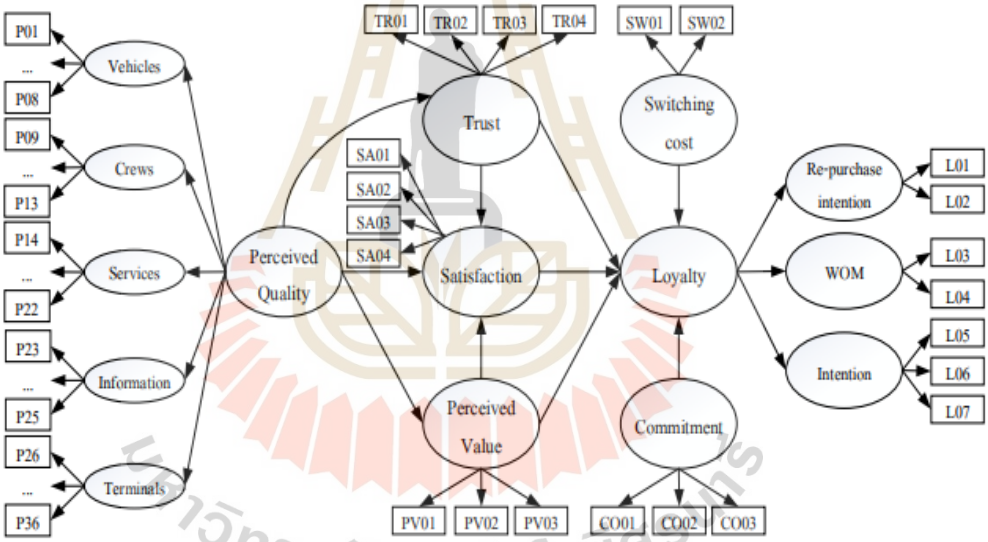

Figure 1. Conceptual Framework.

Hypotheses 1 (H1). *Perceived service quality exerts a positive effect on customer satisfaction.*

Hypotheses 2 (H2). *Perceived service quality exerts a positive effect on customer trust.*

Hypotheses 3 (H3). *Perceived service quality exerts a positive effect on customer perceived value.*

Hypotheses 4 (H4). *Service satisfaction exerts a positive effect on customer loyalty.*

Hypotheses 5 (H5). *Perceived service value exerts a positive effect on customer satisfaction.*

Hypotheses 6 (H6). *Perceived service value exerts a positive effect on customer loyalty.*

Hypotheses 7 (H7). *Trust exerts a positive effect on customer loyalty.*

Hypotheses 8 (H8). *Trust exerts a positive effect on customer satisfaction.*

Hypotheses 9 (H9). *Switching costs exerts a negative effect on customer loyalty.*

Hypotheses 10 (H10). *Commitment exerts a positive effect on customer loyalty.*

3.2. Sample

Hair and Black [19] suggested that the appropriate sample size for developing a structural equation model is approximately 500. In the current study, data collection was from February to March 2020. The samples consisted of 600 users of urban electric trains in Thailand which travel 3 routes, and quota sampling was used to choose the sample. The samples consisted of BTS Skytrain (n = 200; 33.33%), MRT users (n = 200; 33.33%), and Airport Rail Link (n = 200; 33.33%). Face-to-face interviews were conducted to collect data from electric train users around the stations and bus stops (the samples were from the passengers who were going to use service and who already used the service) near the stations of Chalong Ratchadham Line, Cha-loem Ratchamongkhon Line, Sukhumvit Line, Silom Line, and Airport Rail Link. The interview of samples took 5–10 min per person.

3.3. Variables

A total of seven major variables were analyzed, namely, satisfaction, perceived quality, loyalty, trust, perceived value, relationship, and cost of switching service providers, with 59 indicators to measure the expectation and perceived quality of electric train users in urban areas. Each item is rated using a 7-point Likert-type scale (7 = strongly agree to 1 = strongly disagree).

3.4. Reliability of the Questionnaire

To verify the quality of the research tool, five experts examined content validity and considered the consistency of each question by analyzing and scoring the questions against the index of item objective congruence (IOC). The IOC index was higher than 0.5, which means the content validity of the questionnaire is within the acceptable range. Then, a pilot study was piloted with 50 respondents who were excluded from the research. Reliability was analyzed using Cronbach's alpha coefficient. The results indicated a Cronbach's alpha coefficient of 0.784–0.965, which was greater than 0.7 [29].

3.5. Structural Equation Model

The study of the relationship between variables in a structured manner began during the early 1900s when Spearman developed an analytical method that can be considered a prototype of today's elemental analysis. The author can be regarded as the first person who elucidated the relationship between latent and structural variables in 1904 [30]. Moreover, Wright [31] was the first to examine causal modeling and develop the analytical method—a model of path analysis that can be considered the fundamental analysis of the structural equation model [30,32]. In addition, Churproong et al. [33] explained that the structural equation model is known by several names, such as covariance structure analysis. The structural equation modeling (SEM) was utilized to measure the correlation of variables in the theoretical model to illustrate the relationship between latent variables and observable variables. This model is formed through the synthesis of three essential data analysis methods, namely, factor analysis, path analysis, and parameter estimation, in regression analysis. The structural equation model consists of two sub-models, namely, the measurement model and structural model. SEM was analyzed using Mplus version 7.2 by the maximum likelihood method.

4. Results

4.1. Descriptive Analysis

Table 1 presents the analysis of the frequency and percentage of fundamental data from the 600 samples, such as passenger characteristics, travel routes, and frequency of use of service. The sample comprises 353 women (58.83%), 47 students (7.83%) below high school or equivalent, 104 students (17.33%) with a high school level or vocational certificate, 50 students (8.33%) with a higher vocational certificate, 363 people (60.50%) with bachelor's degree, and 36 people (6%) at the post-graduate levels. A total of 176 individuals (29.33%) earn more than 30,000 baht per month (this study was defined to be a group of the

highest earners by using income regulation that starts from the income of undergraduates), whereas the majority (317; 52.83%) are company employees.

Table 1. Participants' characteristics.

	Sample Categories	Frequency	Percent
Route	BTS	200	33.33
	MRT	200	33.33
	ARL	200	33.33
Gender	Male	247	41.17
	Female	353	58.83
Education	Mattayom 3 (Grade 9) and lower	47	7.83
	Mattayom 6 (Grade 12)/vocational certificate	104	17.33
	Diploma/high vocational certificate	50	8.33
	Bachelor's degree	363	60.50
	Master's degree and Doctoral degree	36	6.00
Income	Less than 10,000 (THB/Month)	8	1.33
	10,000–14,999 (THB/Month)	40	6.67
	15,000–19,999 (THB/Month)	158	26.33
	20,000–24,999 (THB/Month)	142	23.67
	25,000–29,999 (THB/Month)	76	12.67
	30,000 THB and above	176	29.33
Occupation	Government/state enterprises	57	9.50
	Company employees	317	52.83
	Personal business	121	20.17
	Farmers	1	0.17
	Students	25	4.17
	Other	79	13.17
Frequency	1–3 days/week	389	64.83
	4–5 days/week	167	27.83
	Everyday	44	7.33
	Total	600	100

Analysis of fundamental statistical values of the 59 indicators consisted of basic statistics, standard deviation, skewness, and kurtosis (Table A1 provides detailed analysis). The indicators are divided into seven groups as follows.

(1) Service quality indicators (36 variables) with five categories, namely, vehicles, staff, services, information, and stations. The result suggested that the indicator with the highest average was P28: The station is clean (mean = 5.97; SD = 1.10), followed by P13: The staff provides accurate and reliable information and services before traveling (mean = 5.94; SD = 1.02).

(2) Loyalty indicators (seven variables) with three categories, namely, word-of-mouth, identification, and repurchase. The indicator with the highest average was L01: I will use the "electric train" service for the next trip (mean = 5.59; SD = 0.88), followed by L02: If fare levels and service quality are well maintained, then I will use the "electric train" service regularly (mean = 5.56; SD = 1.00).

(3) Perceived service value indicators (three variables). The indicator with the highest average was PV02: I accept the service I received compared to the money I paid; it is reasonable (mean = 5.39; SD = 1.03).

(4) Service satisfaction indicators (four variables). The indicator with the highest average was SA02: I will use the "electric train" service on the next trip (mean = 5.59; SD = 0.88).

(5) Trust indicators (four variables). The indicators with the highest average were TR02: The "electric train" is a form of transport that I can always trust (mean = 5.53; SD = 0.99) and TR04: Overall, I am satisfied with the service provided by the "electric train" (mean = 5.53; SD = 1.14).

(6) Cost of switching service providers (two variables). The indicator with the highest average was SW01: I can waste time searching for information on "other forms of transport" that provide better service on the next trip (mean = 4.73; SD = 1.22).
(7) Relationship with service providers (three variables). The indicator with the highest average was CO03: I think traveling by "electric train" is an important form of transport for the country's development (mean = 5.77; SD = 1.16).

The maximum likelihood estimation method was used to analyze the distribution characteristics of the data. The method requires that data must have a normal distribution determined by skewness and kurtosis. Table 2 points to negative skewness values between −0.37 and −1.47, whereas kurtosis values ranged between −0.11 and 3.21. In summary, skewness was less than 3.0, whereas kurtosis was less than 10. This finding indicates that the data have a normal distribution [32]. The data are, therefore, appropriate for further analysis of the composition.

Table 2. Cut-off values of model fit indices.

Model Fit Index	Cut-Off Value	References
χ^2/df	<3	Kline [34]
SRMR	≤0.08	Wu et al. [35],Hu and Bentler [36]
RMSEA	≤0.07	Steiger [37]
CFI	≥0.90	Hu and Bentler [36]
TLI	≥0.80	Hooper et al. [38]

4.2. Structural Equation Model

4.2.1. Goodness-of-Fit Statistics

The model was found to be relatively consistent with empirical data (chi-squared = 4523.458, df = 1671, $p < 0.001$, CFI = 0.901, TLI = 0.900, SRMR = 0.061, RMSEA = 0.053). Table 2 provides the details.

4.2.2. Measurement Model

According to the conceptual framework of the research, results of the structural equation model (Figure 1 and Table 3) confirm one endogenous variable, namely, loyalty, and six exogenous variables, namely, service quality, perceived service value, service satisfaction, trust, cost of switching, and commitment. The exogenous variables are described as follows.

Table 3. Results of measurement model.

Item	Description	Loading	*t*-Value	Error Variance
	Second-Ordered Measurement Model			
	Perceived Quality			
PQ01	Vehicles	0.981 **	154.671	0.006
PQ02	Crews	0.984 **	179.870	0.006
PQ03	Services	0.985 **	178.441	0.006
PQ04	Information	0.994 **	106.516	0.009
PQ05	Terminals	0.998 **	239.268	0.004
	Loyalty			
LY01	Word of mount	0.975 **	51.663	0.019
LY02	Identification	0.653 **	21.876	0.030
LY03	Re-purchase	0.894 **	42.113	0.021
	First-ordered measurement model			
	Vehicles (Cronbach's Alpha = 0.909, AVE = 0.740, CR = 0.909)			
P01	The condition inside the car is clean and tidy.	0.756 **	39.997	0.019
P02	The temperature inside the car is cool.	0.770 **	42.571	0.018

Table 3. *Cont.*

Item	Description	Loading	*t*-Value	Error Variance
P03	The seats are clean.	0.752 **	41.648	0.018
P04	The seating arrangement is reasonable.	0.731 **	35.442	0.021
P05	Luggage compartments are large, available, and sufficient.	0.643 **	25.601	0.025
P06	There is security against criminals and crimes on board.	0.720 **	34.460	0.021
P07	Seating for special people such as elders, disabilities, pregnant women, etc., are arranged in a good location and have a reasonable amount.	0.702 **	32.211	0.022
P08	The convoy is in new condition, looks good, and is attractive.	0.782 **	45.198	0.017
	Crews (Cronbach's Alpha = 0.869, AVE = 0.750, CR = 0.876)			
P09	The staff provides fast and agility service.	0.799 **	50.100	0.016
P10	The staff provides service with good manners.	0.695 **	31.049	0.022
P11	There is adequate staff to facilitate when getting on and off the electric train.	0.770 **	43.418	0.018
P12	When problems occur during the trip, the staff is willing to help resolve the issue.	0.739 **	38.225	0.019
P13	The staff provides accurate and reliable information and services before traveling.	0.770 **	43.858	0.018
	Services (Cronbach's Alpha = 0.898, AVE = 0.700, CR = 0.904)			
P14	There are adequate ticket distribution channels.	0.720 **	34.185	0.021
P15	The fare collection system is modern and accurate.	0.766 **	41.979	0.018
P16	The fare collection and ticket distribution systems are user friendly.	0.754 **	40.560	0.019
P17	The fare is reasonable.	0.634 **	24.717	0.026
P18	The density of the train during rush hour is suitable.	0.641 **	25.274	0.025
P19	The density of the train apart from the rush hour is suitable.	0.735 **	36.720	0.02
P20	The frequency of the train is appropriate and sufficient.	0.739 **	38.242	0.019
P21	Organize a promotion for passengers.	0.665 **	27.752	0.024
P22	There is a special discount for passengers with prepaid tickets.	0.697 **	31.345	0.022
	Information (Cronbach's Alpha = 0.755, AVE = 0.741, CR = 0.785)			
P23	There are announcements regarding arrival time and the change of departure time of the train.	0.725 **	34.371	0.021
P24	There is a channel for complaints at the station via telephone or online.	0.700 **	31.645	0.022
P25	The station has sufficient navigation signs and travel information.	0.780 **	42.656	0.018
Item	Description	Loading	t-value	Error Vaiance
	Terminal (Cronbach's Alpha = 0.922, AVE = 0.711, CR = 0.919)			
P26	The suitability of the station location allows easy service access.	0.641 **	25.654	0.025
P27	There are facilities for disabilities to access the station, such as passenger elevators.	0.655 **	26.858	0.024
P28	The station is clean.	0.712 **	33.866	0.021
P29	There is a suitable waiting area to buy tickets.	0.735 **	38.000	0.019
P30	The ticket checking machines for accessing the platform are sufficiently wide enough to walk through.	0.699 **	32.215	0.022
P31	There are convenient walkways such as the Sky Walk connecting to essential places.	0.671 **	28.617	0.023
P32	There is security against criminals and crime at the station.	0.742 **	38.273	0.019
P33	There are other facilities such as Wi-Fi, services, and shops within the station.	0.729 **	36.721	0.02
P34	The station's ascent and descent are convenient and safe.	0.720 **	34.942	0.021
P35	It is convenient to connect to other transportation systems.	0.756 **	40.619	0.019
P36	The arrangement of the platform area is proper.	0.749 **	39.656	0.019

Table 3. *Cont.*

Item	Description	Loading	*t*-Value	Error Variance
	Word-of-mouth (Cronbach's Alpha = 0.794, AVE = 0.793, CR = 0.722)			
L01	I will use the "electric train" service for the next trip.	0.769 **	37.862	0.02
L02	If fare levels and service quality are well maintained, I will use the "electric train" service forever.	0.823 **	44.407	0.019
	Identification (Cronbach's Alpha = 0.834, AVE = 0.797, CR = 0.841)			
L03	I will mention only good things about "electric train traveling" with others	0.909 **	39	0.023
L04	I will encourage friends and acquaintances to travel by the "electric train".	0.777 **	710	0.025
L05	I rank this "electric train" as the first mode of transport for each trip.	0.615 **	31	0.03
	Re-purchase (Cronbach's Alpha = 0.778, AVE = 0.786, CR = 0.764)			
L06	I think the "electric train" is the best choice.	0.748 **	639	0.022
L07	I will not be interested in other modes of transportation besides the "electric train".	0.828 **	20.477	0.02
	Perceived value (Cronbach's Alpha = 0.880, AVE = 0.846, CR = 0.884)			
PV01	When comparing to the service I received, I think it is worth the money.	0.838 **	54.122	0.015
PV02	I accept the service I received compared to the money I paid; it is reasonable.	0.897 **	69.783	0.013
PV03	When I travel by the "electric train", I think it is more rewarding than other transportation forms.	0.804 **	45.646	0.018
	Satisfaction (Cronbach's Alpha = 0.872, AVE = 0.781, CR = 0.863)			
SA01	I am pleased to use the "electric train" service.	0.814 **	49.371	0.016
SA02	Overall, I am satisfied with the service provided by the "electric train".	0.868 **	62.168	0.014
SA03	The quality of service I received was more than what I expected.	0.706 **	31.229	0.023
SA04	The quality of service I received is at the service level I dreamed of.	0.676 **	27.812	0.024
	Trust (Cronbach's Alpha = 0.901, AVE = 0.835, CR = 0.902)			
TR01	I believe that traveling by the "electric train" is the best form of transportation.	0.827 **	53.717	0.015
TR02	The "electric train" is a form of transport that I can always trust.	0.848 **	59.965	0.014
TR03	The "electric train" is a form of transport that recognizes what to do to satisfy customers.	0.811 **	49.578	0.016
TR04	The "electric train" is very reliable form of transport.	0.854 **	62.168	0.014
	Switching cost (Cronbach's Alpha = 0.833, AVE = 0.850, CR = 0.841)			
SW01	I can waste time searching for information on "other forms of transport" that provide better service on the next trip.	0.924 **	15.577	0.059
SW02	I will pay more to switch to "other forms of transport" if they provide better service.	0.775 **	14.878	0.052
	Commitment (Cronbach's Alpha = 0.839, AVE = 0.806, CR = 0.851)			
CO01	I am proud to use the "electric train" service.	0.714 **	22.049	0.032
CO02	I am concerned for the long-term success of "BTS/MRT/Airport Rail Link".	0.811 **	29.157	0.028
CO03	I think traveling by the "electric train" is an important form of transport for the country's development.	0.755 **	26.763	0.028

Note: regression. ** significant at $\alpha = 0.001$.

(1) Loyalty. Based on the analysis of the second-order model regarding loyalty to service providers with statistical significance at the 0.001 level, the study found that the three indicators confirmed the composition of loyalty to service providers (word-of-mouth:

λ = 0.975; identification: λ = 0.653; re-purchasing: λ = 0.894). Furthermore, based on the results of the first confirmatory component model for loyalty to service providers with statistical significance at the 0.001 level, the study found the following results.

Word-of-mouth (measured using two indicators: L01–L02). All indicators verified the composition of the measurement model for loyalty to service providers with standardized factor loadings between 0.823 and 0.769. The indicator with the highest standardized factor loading is L02: I will encourage friends and acquaintances to travel using the "electric train" (λ = 0.823), whereas L01: I will mention only good things about traveling via "electric trains" and others obtained the least standardized factor loading (λ = 0.769).

Identification (measured using three indicators: L03–L05). The study found that all indicators confirmed the composition of the measurement model regarding loyalty to service providers with standardized factor loadings between 0.909 and 0.615. The highest and lowest factor loadings were found for indicator L03: I rank this "electric train" as the first choice of mode of transport for each trip (λ = 0.909) and L05: I will not be interested in other modes of transportation besides the "electric train" (λ = 0.615), respectively.

Re-purchasing (measured using two indicators: L06–L07). All indicators verified the composition of the measurement model for loyalty to service providers. The standardized factor loadings ranged between 0.828 and 0.748 with the highest and lowest standardized factor loadings found for L07: If fare levels and service quality are well maintained, I will use the "electric train" service regularly (λ = 0.828) and L06: I will use the "electric train" service for the next trip (λ = 0.748), respectively.

(2) Service quality. In terms of the second-order model for loyalty to service providers with statistical significance at the 0.001 level, five indicators verified the composition of service quality, namely, vehicles (λ = 0.981), staff (λ = 0.984), service (λ = 0.985), information (λ = 0.994), and station (λ = 0.998). Additionally, regarding the results of the first-order model for loyalty to service providers with statistical significance at the 0.001 level, the study found the following results:

Vehicles (measured using eight indicators: P01–P08). All indicators confirmed the composition of the measurement model in terms of service quality with standardized factor loadings between 0.782 and 0.643. The highest and lowest standardized factor loadings were observed for P08: The convoy is in new condition, looks good, and is attractive (λ = 0.782) and P05: Luggage compartments are large, available, and sufficient (λ = 0.643), respectively.

Staff (measured using five indicators: P09–P13). All indicators confirmed the composition of the measurement model regarding service quality with standardized factor loadings between 0.799 and 0.695. The indicators with the highest and lowest standardized factor loadings were P09: The staff provides fast and agile service (λ = 0.799) and P10: The staff provides service with good manners (λ = 0.695), respectively.

Service (measured using nine indicators: P14–P22). The indicators verified the composition of the measurement model regarding service quality with standardized factor loadings between 0.766 and 0.634. The highest and lowest standardized factor loadings were found for P15: The fare collection system is modern and accurate (λ = 0.766) and P17: The fare is reasonable (λ = 0.634), respectively.

Information (measured using three indicators: P23–P25). Indicators under this category verified the composition of the measurement model regarding service quality with standardized factor loadings ranging from 0.780 to 0.700. The highest and lowest standardized factor loadings were found for P25: The station has sufficient navigation signs and travel information (λ = 0.780) and P24: There is a channel for complaints at the station via telephone or online (λ = 0.700), respectively.

Station (measured using 11 indicators: P26–P36). The study found that all indicators verified the composition of the measurement model regarding service quality with standardized factor loadings ranging from 0.756 to 0.641. The indicators with the highest and lowest standardized factor loadings were P35: It is convenient to connect to other

transportation systems (λ = 0.756) and P26: The suitability of the station location allows easy access to services (λ = 0.700), respectively.

(3) Service value (measured using three indicators: PV01–PV03). The study observed that all indicators were able to verify the composition of the measurement model regarding service value with standardized factor loadings ranging from 0.897 to 0.804. The indicators with the highest and lowest standardized factor loadings were PV02: I accept the service I received compared to the money I paid; it is reasonable (λ = 0.897) and PV03: When I travel by the "electric train," I think it is more rewarding than other transportation forms (λ = 0.804), respectively.

(4) Service satisfaction (measured using four indicators: SA01–SA04). The results show that all indicators confirmed the composition of the measurement model regarding service satisfaction with standardized factor loadings ranging from 0.868 to 0.676. The indicators with the highest and lowest standardized factor loadings were SA02: Overall, I am satisfied with the service provided by the "electric train" (λ = 0.868) and SA04: The quality of service I received is at the service level I dreamed of (λ = 0.676), respectively.

(5) Trust (measured using four indicators: TR01–TR04). The study found that all indicators asserted the composition of the measurement model regarding reliability with standardized factor loading ranging from 0.854 to 0.811. The indicators with the highest and lowest standardized factor loadings were TR04: The "electric train" is a very reliable form of transport (λ = 0.854) and TR03: The "electric train" is a form of transport that knows what to do to satisfy customers (λ = 0.811), respectively.

(6) Cost of switching service providers (measured using two indicators: SW01–SW02). All indicators confirmed the composition of the measurement model regarding the cost of switching service providers with standardized factor loadings ranging from 0.924 to 0.755. The highest and lowest standardized factor loadings were noted for SW01: I can waste time searching for information on "other forms of transport" that provide better service on the next trip (λ = 0.924) and SW02: I will pay more to switch to "other forms of transport" if they provide better service (λ = 0.755), respectively.

(7) Relationship with service providers (measured using three indicators: CO01–CO03). All indicators pointed to composition of the measurement model regarding the relationship with service providers with standardized factor loadings between 0.811 and 0.714. The indicators with the highest and lowest standardized factor loadings are CO02: I am concerned about the long-term success of "BTS/MRT/Airport Rail Link" (λ = 0.811) and CO02: I am proud to use the "electric train" service (λ = 0.714), respectively.

4.2.3. Structural Model

The SEM analysis result could examine hypotheses relevant to the direct influence of variables affecting te loyalty of urban electric train customers (Table 4). Study results found that perceived service quality influenced satisfaction, trust, and perceived service value, with a statistically significant level of 0.001 (β = 0.131, β = 0.700, and β = 0.587), which supports H1, H2, and H3, respectively. Service satisfaction positively influenced customer loyalty (β = 0.375, $p < 0.001$), which supports H4. Perceived service value influenced satisfaction and customer loyalty (β = 0.309 and β = 0.326, $p < 0.001$), which supports H5 and H6. Trust influenced loyalty and the satisfaction of customer (β = 0.137, $p < 0.05$ and β = 0.587, $p < 0.001$), which supports H7 and H8. Furthermore, switching costs was negatively correlated with customer loyalty (β = −0.084, $p < 0.001$), which supports H9. Finally, commitment was positively correlated with customer loyalty (β = −0.261, $p < 0.001$), which supports H10.

Table 4. Results of structural model.

Item	Description	Estimates	*t*-Value	Error Vaiance
H01	Perceived quality ◊Satisfaction	0.131 **	3.071	0.043
H02	Perceived quality ◊Trust	0.700 **	29.233	0.024
H03	Perceived quality ◊Perceived value	0.587 **	19.319	0.030
H04	Satisfaction ◊Loyalty	0.375 **	4.695	0.080
H05	Perceived value ◊Satisfaction	0.309 **	7.487	0.041
H06	Perceived value ◊Loyalty	0.326 **	6.517	0.050
H07	Trust ◊Loyalty	0.137 *	1.894	0.072
H08	Trust ◊Satisfaction	0.587 **	13.044	0.045
H09	Switching cost ◊Loyalty	−0.084 **	−2.525	0.033
H10	Commitment ◊Loyalty	0.261 **	5.372	0.261

Note: regression. * Significant at $\alpha = 0.05$; ** significant at $\alpha = 0.001$.

5. Discussion and Conclusions

This study's aim is to examine 10 hypotheses in total and to study factors affecting passenger loyalty toward urban the electric train service in Thailand by using SEM. The findings of this research are as follows: According to SEM, there are five hypotheses relevant to customer loyalty, including satisfaction (H4), service value (H6), trust (H7), switching costs (H9), and commitment (H10), which are in accordance with the research of H4 [39], H6 [40], H7 [41], H9 [23], and H10 [42], respectively. There is Hypothesis 3, which is in relevant to customer satisfaction, perceived service quality (H1), perceived service value (H5), and trust (H8), which are in accordance with the research of H1 [40,43], H5 [43], and H8 [41], in order. Moreover, there are hypotheses relevant to perceived service quality, trust (H2), and perceived service quality (H3), which are in accordance with the research of H2 [44], and H3 [45–47]. In addition, when we consider the factors directly influencing customer loyalty, which are trust, satisfaction, perceived service value, switching costs, and commitment, we found that satisfaction is the most important factor that affects customer loyalty, while satisfaction is directly influenced by trust, perceived service value, and perceived service quality of customer. Therefore, service providers must give priority to the mentioned issues in order to make customers satisfied and re-purchase the service.

In reference to this study, the researcher has studied variables relevant to perceived service quality of passengers, which can be measured from 36 indicators by using second order confirmatory factor analysis with the statistically significant level at 0.001. It found that the indicators that can be the most confirmatory factors of perceived service quality are station, information, service, staff, and vehicle, consecutively. Additionally, when we consider the first order confirmatory factor analysis result of perceived service quality with the statistically significant level at 0.001, we find that the indicator of station about which customers express the most concern is convenience of connection to other types of transport systems (P35), while the indicator of information about which customers express the most concern is that there are proper guide posts and travel information at the station (P25). Additionally, the indicator of service about which customers express the most concern is that there is a modern and accurate fare collecting system (P15).

This study could summarize that there are many variables influencing satisfaction, which is the main factor causing customer loyalty. In order to keep the recent group of customers, as well as to increase future customers [48], electric train service providers should add such service provision value by prioritizing relevant factors, e.g., for the station factor, electric train service providers should give priority to convenience of connecting the electric train to other types of transport systems. Additionally, for the information factor, service providers should provide guide posts and travel information service at the station to facilitate traveling the most. The findings of this research could be used by organizations relevant to urban electric train service provision by applying marketing development strategy and service policy, in order to be a guideline for service standards and the sustainable improvement of the urban electric train system, e.g., connection between

the electric train system and other types of public transportation such as buses, taxis, and motorcycle taxis at the station, which facilitate customers by connecting the traveling and ticket promotional campaign, as well as the development of a modern and accurate fare collecting system, i.e., a ticket vending machine or payment through mobile application, which will generate more convenience for customers who use the service. This study has offered an overall picture of the electric train service in Thailand, but we do not separately consider service providers of each route. Therefore, for further study, there should be an examination of electric train service providers of each route (electric train routes and State Railway of Thailand) to create a suitable roadmap in accordance with the sustainable travel characteristic of customers in Thailand.

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Appendix A

Table A1. Descriptive statistics.

Item	Mean	SD	Sk	Ku
P01	5.92	1.07	−1.47	3.15
P02	5.84	1.11	−1.35	2.72
P03	5.74	1.10	−0.88	0.58
P04	5.55	1.16	−0.72	0.41
P05	5.40	1.28	−0.82	0.43
P06	5.68	1.10	−1.08	1.71
P07	5.70	1.18	−1.20	1.73
P08	5.82	1.09	−1.20	1.79
P09	5.73	1.13	−1.15	1.88
P10	5.82	1.02	−1.04	1.63
P11	5.63	1.05	−0.96	1.44
P12	5.74	1.13	−1.10	1.42
P13	5.94	1.02	−1.46	3.21
P14	5.75	1.07	−1.00	1.49
P15	5.76	1.04	−1.00	1.41
P16	5.66	1.11	−1.01	1.42
P17	5.36	1.27	−0.72	0.32
P18	5.31	1.37	−0.92	0.53
P19	5.40	1.21	−0.87	0.70
P20	5.60	1.14	−0.91	0.86
P21	5.32	1.26	−0.66	−0.05
P22	5.32	1.25	−0.73	0.36
P23	5.68	1.06	−0.86	0.82
P24	5.47	1.36	−0.93	0.29

Table A1. *Cont.*

Item	Mean	SD	Sk	Ku
P25	5.73	0.85	−0.58	0.77
P26	5.78	1.08	−0.92	1.23
P27	5.85	1.04	−1.06	1.48
P28	5.97	1.10	−1.21	1.65
P29	5.61	1.10	−0.95	1.19
P30	5.61	1.05	−0.90	1.03
P31	5.63	1.23	−0.95	0.68
P32	5.64	1.10	−0.94	1.21
P33	5.66	1.06	−0.75	0.36
P34	5.73	0.98	−1.13	2.72
P35	5.75	1.00	−1.07	1.96
P36	5.61	1.05	−1.05	1.62
L01	5.59	0.88	−0.39	0.42
L02	5.57	1.00	−0.53	0.03
L03	5.45	1.01	−0.53	0.59
L04	5.48	1.01	−0.59	0.54
L05	5.17	1.14	−0.52	0.10
L06	5.19	1.23	−0.73	0.40
L07	4.72	1.54	−0.55	−0.28
PV01	5.38	1.04	−0.37	−0.12
PV02	5.40	1.04	−0.40	−0.12
PV03	5.29	1.12	−0.45	0.00
SA01	5.41	1.05	−0.46	0.11
SA02	5.53	1.03	−0.74	0.68
SA03	5.37	1.05	−0.63	0.51
SA04	5.27	1.13	−0.64	0.36
TR01	5.47	1.05	−0.47	0.20
TR02	5.54	1.00	−0.63	0.84
TR03	5.49	1.06	−0.73	0.89
TR04	5.53	1.15	−0.74	0.48
SW01	4.74	1.22	−0.45	−0.11
SW02	4.61	1.32	−0.41	−0.14
CO01	5.26	1.12	−0.47	0.40
CO02	5.33	1.09	−0.31	−0.17
CO03	5.77	1.17	−0.90	0.58

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