Techno-Science Research Journal V13 (3) (2025) P 80-91

Content list available at ITC

Techno-Science Research Journal

Journal Homepage: http://techno-srj.itc.edu.kh/

Techno-Science Research Journal

The Negative Experiences of Low-Income Citizen Commute and Their Intentions Toward Public Bus in Phnom Penh

Khematakavid Ros*, Veng Kheang Phun, Panha Yang

Transportation and Infrastucture Engineering departement, Faculty of Civil Engineering, Institute of Technology of Cambodia, Russian Federation Blvd., P.O. Box 86, Phnom Penh, Cambodia

Received: 17 February 2025; Revised: 12 March 2025; Accepted: 29 September 2025; Available online: December 2025

Abstract: *For a low-income Cambodian citizen, commuting to and from work is one of the most dangerous parts of their job. In Phnom Penh, the capital city of Cambodia, low-income citizens commute by truck or long-tail remork. This sort of transportation would be dangerous on the road. Thousands of workers get to and from work every day in vans, but this massive transportation system is almost completely unregulated. Most of the drivers are independent contractors, and few receive any training. The number of traffic accidents is increasing every year, especially for low-income groups. This research is a study on the negative experiences of low-income citizen commute and their intentions toward public bus in Phnom Penh. To achieve the research and study objectives, a questionnaire survey was conducted on low-income citizens, such as factory workers. The effects were investigated using structural equation modeling based on data collected from 476 people in Phnom Penh, Cambodia, in August 2022. The model of structure develops with five latent variables: 'negative experience in a traffic accident', 'Service quality', 'Perceived value', 'Involvement', satisfaction, and behavioral intention'. For the result, the transport mode of the low-income citizen depends not only on their income but also on public transport availability, job location, and community location. The results of this research could be used to operate effectively and help policymakers develop and implement policies, along with recommendations to improve safety for commuters and their intentions to use public transport.*

Keywords: Low-income, Structural equation modeling, Service quality, Public Bus, Behavioral intention

1. INTRODUCTION

Public transportation is a type of shared transportation that is available to the general public. It is also referred to as public transport services, public transit, mass transit, paratransit. Public transportation plays a vital role in enhancing urban mobility, especially in developing cities where private car ownership is limited. Successful public transport systems hinge on multiple factors, such as accessibility, affordability, frequency, safety, and reliability. However, In many Southeast Asian cities, investments in public transportation have aimed to shift people from informal transport modes to formal, safer, and more efficient systems[1].

In Cambodia, particularly Phnom Penh, low-income citizens—primarily garment and factory workers—commute daily under precarious conditions, often relying on informal modes such as motorbikes, trucks, and remorks (tuk-tuks). These modes are inexpensive but poorly regulated, contributing to traffic congestion, safety hazards, and inefficiencies in the urban transport landscape.[2]

While previous studies have explored public transport issues in Southeast Asia[3], few have addressed the behavioral factors influencing low-income workers' willingness to switch from informal modes to formal public bus services. Even fewer have applied structural equation modeling (SEM) to quantify how factors like perceived service quality, driver behavior, and pedestrian infrastructure influence satisfaction and usage intention[4].

This study aims to fill that gap by examining the commuting experiences of low-income workers in Phnom Penh and identifying how their experiences and perceptions shape their willingness to adopt public bus services. Through a survey of 476 respondents and the use of SEM, this research contributes new evidence to support policy and planning interventions that promote safer and more inclusive transportation systems.

* Corresponding author: Khematakavid Ros
E-mail: ros_khematakavid@gsc.itc.edu.kh; Tel: +855-96 446-5688

1.1. Public bus in Phnom Penh

In June 2001, Phnom Penh Capital Hall, in collaboration with the Japan International Cooperation Agency (JICA), conducted a one-month public bus service trial. This demonstration was part of JICA's study to develop a comprehensive urban transport system for Phnom Penh. During the trial, 23 air-conditioned minibuses with 29 seats each were operated along two key routes: Monivong Boulevard and a ring road, covering a total distance of approximately 17 kilometre[5]. Two flat fare rates were applied: 500 KHR (around 0.13 USD at the June 2001 exchange rate) for the first 5 days and the final 8 days, and 800 KHR (around 0.21 USD) for the remaining period.

The public bus system in Phnom Penh, the capital of Cambodia, is a relatively recent development in the city's urban transportation network. It was introduced in 2014 as part of efforts to alleviate traffic congestion and provide an affordable and efficient mode of transportation for the city's residents and visitors. The bus system is managed by the Phnom Penh City Bus Authority, and it currently operates on multiple routes covering major parts of the city. The buses are air-conditioned, making them a comfortable option compared to other forms of public transport in the city, such as tuk-tuks or motorbike taxis. The fare is inexpensive, typically around 1500 Cambodian riel (about $0.37 USD) per ride, which makes it an accessible option for many locals[5].

The public bus system in Phnom Penh, faces several significant challenges that hinder its effectiveness and ridership. Since its reintroduction in 2014, the bus service has struggled with low ridership numbers and operational costs, raising concerns about its long-term viability as a public transport option. Factors influencing bus ridership include the prevalence of informal transport modes, such as Motodup and Remork, which have historically dominated the urban transport landscape and continue to be favored by many local travellers due to their convenience and affordability[3]. The competition from these informal modes complicates efforts to promote the public bus system, as they often provide more flexible and immediate service compared to the scheduled bus routes.

1.2. Low-income citizen in Phnom Penh, Cambodia

Cambodia's economy relies heavily on the garment industry, which is one of the largest employers in the country. Factory workers, particularly in the garment sector, represent a significant portion of Cambodia's low-income citizens. The minimum wage for garment workers in Cambodia has been a subject of both local and international concern, as it directly impacts the livelihood of a large number of citizens. As of 2023, the minimum wage for garment factory workers in Cambodia was set at $200 per month, following an increase from the previous wage of $194 per month[6]. Despite these adjustments, the wage remains relatively low when considering the cost of living in urban areas like Phnom Penh[7]. Factory workers often struggle to meet basic needs such as food, housing, and healthcare, which places them in the low-income bracket of Cambodian society. Moreover, the minimum wage is typically insufficient to cover the living expenses for workers who often support families[8].

1.3. Low-income citizen commuting modes in Phnom Penh

In Phnom Penh, low-income citizens predominantly rely on informal transport modes, such as motorbikes and remorks (tuk-tuks), due to their affordability and flexibility[9] highlight that informal transport has historically served as a crucial means of mobility for local travelers, particularly before the establishment of a formal public bus system in 2014. The flexibility and affordability of these modes make them particularly appealing to low-income commuters.

Low-income workers often live on the outskirts of urban areas, leading to longer commuting distances. [4]note that low-income populations typically experience longer commutes and spend a higher proportion of their income on transportation costs compared to higher-income groups. This pattern is similarly observed in Phnom Penh, where inadequate public transport options exacerbate commuting challenges for low-income citizens [4].

The urban infrastructure in Phnom Penh presents several challenges that affect mobility. highlight the need for improved infrastructure, such as dedicated bicycle lanes, sidewalks, and pedestrian crossings, to enhance safe accessibility for all commuters. The lack of such facilities contributes to congestion and traffic accidents, making the urban environment less conducive to walking and cycling.[10]

2. METHODOLOGY

2.1. Data Collection

The data survey was conducted at several factories in Phnom Penh city in total 12 locations **Fig. 1** . The first section aims to collect respondents' personal information, which includes education, working hours, monthly income, and expenses, among other things. In the second part focus on their current travel information such as travel mode, travel duration, travel expenses. This part also asked respondents to deliver their personal perception about their current travel mode. For the perception questionnaire items were based on a 5-point scale (1: very unlikely, 2: unlikely, 3: neither, 4: likely, and 5: very likely). Third part asked about their opinion on public bus and their intention toward public bus. The fourth part asked about their opinion on Sidewalk in Phnom Penh and their willingness to walk. The questionnaire was drafted in Khmer

and divied in four sections. During the survey, surveyors did not ask all respondents they saw to join the survey. They first observed if a respondent was free and then requested them to participate in the survey. The surveyor requested approximately 758 workers, but only 519 respondents voluntarily to join this survey. Some respondents rejected our requests because they were busy, having lunch, tired, not ins a good mood, did not dare to give interview, etc. On average, each respondent took around 10 to 15 min to answer the whole questionnaire.

Fig. 1. Survey Location

2.2. Analytical Methods

Structural Equation Modeling (SEM) is a multivariate statistical analysis technique that is used to analyze structural relationships. This technique is a combination of factor analysis and multiple regression analysis, and it is used to analyze the structural relationship between measured variables and latent constructs[11]. SEM allows researchers to test a series of dependence relationships simultaneously, making it a powerful tool for theory testing and development in social sciences, behavioral sciences, education, and other fields. SEM involves the use of path diagrams to visualize the relationships among variables and typically includes steps such as model specification, identification, estimation, evaluation, and modification [12].

Another key aspect of SEM is its ability to model latent variables unobserved variables that are inferred from observed variables. This capability makes SEM particularly useful for testing complex theoretical models that include constructs like intelligence, socioeconomic status, or attitudes [13].

In Structural Equation Modeling (SEM), the relative Chi-Square (χ^2/d.f.) is often used as a practical alternative to the p-value of the Chi-Square test to assess model fit. Unlike the Chi-Square test, which is highly sensitive to sample size and can indicate a significant misfit even with large samples[11], the relative Chi-Square provides a scaled measure that adjusts

for model complexity and is less influenced by sample size [13]. Specifically, a relative Chi-Square value less than 2 is generally considered indicative of a good fit, while values less than 3 are viewed as acceptable [14]. While the relative Chi-Square offers a useful alternative, it does not completely replace the p-value of the Chi-Square test, which provides a formal statistical assessment of fit.

The Root Mean Square Error of Approximation (RMSEA) measures the error of approximation per degree of freedom, where values less than 0.05 indicate close fit, values between 0.05 and 0.08 suggest reasonable fit, and values above 0.10 indicate poor fit [15]. The Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI), both comparing the fit of the target model to an independent model, with values greater than or equal to 0.95 indicating good fit [14]. Lastly, the Standardized Root Mean Square Residual (SRMR) and the Goodness-of-Fit Index (GFI) are also commonly used, with SRMR values less than or equal to 0.08 and GFI values greater than or equal to 0.90 indicating good fit [16].

2.2.1. Hypothesis

By combining the finding from previous study, we propose a conceptual structural equation modeling. We explore the casual relationship among on their current transport mode (Service quality, driver behavior, perceived value, involvement, satisfaction and Behavioral Intention on their using mode), their intension on public bus and availability of sidewalk improvement for pedestrian. The hyphothesis causal relationship are as follow **Fig. 2**

- H1: Driver attitude on their current mode has positively influence the Service Quality of the current transport mode because the performance of driver-related factors, such as convenience, safety, or reliability, directly affects how users evaluate the overall service quality. A better driver experience leads to a higher perception of the service quality offered by the transport mode.
- H2: Perceived Value positively influences Satisfaction with the current transport mode because Users who perceive low cost in their transport mode are more likely to be satisfied. When the service meets or exceeds expectations in terms of quality, cost-effectiveness, or time-saving, satisfaction naturally increases.
- H3: involvement in the current transport mode positively impacts satisfaction with the current transport mode because the more involved a user is with a transport mode (e.g., frequent use, emotional connection), the more likely they are to develop satisfaction with the service. higher involvement deepens the relationship between the user and the transport mode, enhancing overall satisfaction.
- H4: Service Quality positively affects Satisfaction with the current transport mode because High service quality (reliable, safe, comfortable) leads to higher satisfaction, as users feel the transport mode effectively meets their needs. Good service quality is a key factor in generating user satisfaction.
- H5: Higher Satisfaction with the current transport mode negatively influences the intention to use the Public Bus, meaning that users who are satisfied with their current mode are less likely to switch to using the Public Bus.
- H6: Higher Service Quality of the current transport mode negatively affects the intention to use the Public Bus, meaning that if users perceive high service quality in their current mode, they are less likely to switch to the Public Bus.
- H7: Better Sidewalk conditions positively affect the willingness to walk to the bus stop, increasing the likelihood of using the Public Bus.

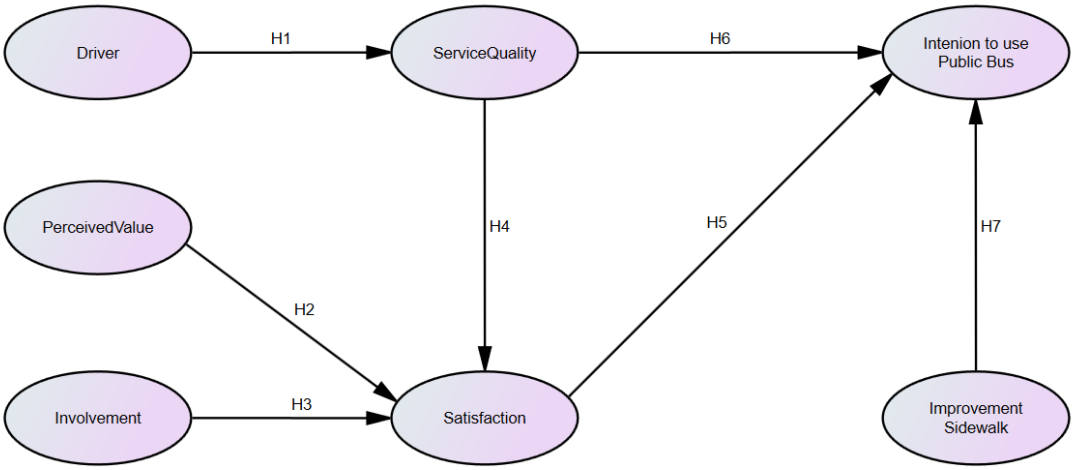

Fig. 2 Structural Equation Model illustrating the relationships among service quality, driver perception, perceived value, involvement, satisfaction, and intention to use public bus.

2.3. Participant Characteristics

A total number of 519 respondents were collected. After checking the information, only 475 samples were with adequate information for further analyses. See in Table 2.1.

Report the descriptive characteristics of respondents as low-income citizens. There are 17.26% of respondents are male and 82.74% of respondents are female. Participants were from 16 to 61 years old, with the average age of about 30 years old. Regarding the education level attainment, 39.37% finished grade 0-6 (primary school), 36.21% finished grade 7-9 (secondary school), 16.42% finished grade 10-12 (High school), only 0.63% finished Bachelor degree, but 7.37% who never going to school. Regarding income distribution, 0.21% of the population earns between $1 - $100, while 0.63% earn between $101 - $150, and 29.26% earn between $151 - $200. Moreover, 24.21% have an income ranging from $200 - $250 and 0.84% have an income exceeding $550. For accommodation, 19.37% living with their own or relative house and 80.63% renting house or room. In terms of driving licenses, 95.79% have none, 1.05% possess a car driving license, and 3.16% have a motorbike driving license. Lastly, 10.32% of the population comes from Phnom Penh, while 89.68% hail from another province. Base on section I of interview survey we have been asking for their negative experience about curent transport mode, includeing taffic accident in slight,moderate and serious injury. As result, there is 81.47% for non traffic accident, and the lowest accident is serious injury traffic accident within 3.37%. And 10.95% for moderate injury traffic accident. See in Table 2.2.

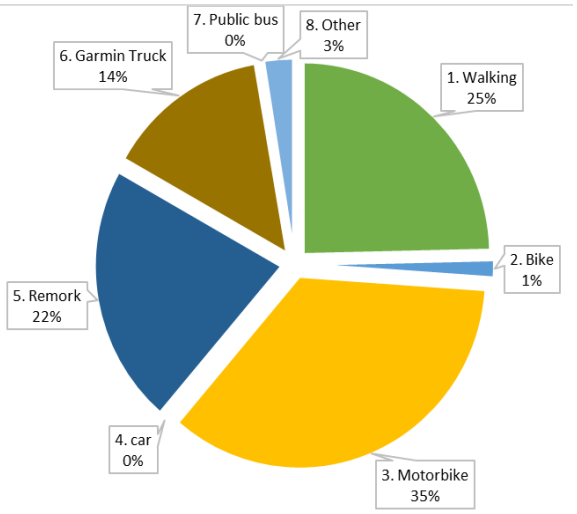

Fig. 3 Comuting mode of respondents

Table 2.1. Respondents characteristics

Variable	Percentage	Variable	Percentage
Gender		***Income***	
Male	17.26%	1$ - 100$	0.21%
Female	82.74%	101$ - 150$	0.63%
Age		151$ - 200$	29.26%

16-25	37.05%	200$ - 250$	24.21%
26-35	38.74%	251$ - 300$	16.21%
36-45	20.21%	301$ - 350$	11.58%
46-61	4.00%	351$ - 400$	10.95%
Marital Status		401$ - 450$	5.05%
Single	26.53%	451$ - 500$	0.84%
Married	70.95%	501$ - 550$	0.21%
Divorced	2.53%	Over 550$	0.84%
Education Level		***Accommodation***	
No study	7.37%	Own/relative home	19.37%
Grade 1-6	39.37%	Renting house/room	80.63%
Grade 7-9	36.21%	***Driving license***	
Grade 10-12	16.42%	None	95.79%
Bachelor degree	0.63%	Car driving license	1.05%
Came from		Motorbike driving license	3.16%
Phnom Penh	10.32%		
Another province	89.68%		

Table 2.2. Distribution of reported traffic accidents among survey respondents. highlighting the risks associated with informal transport modes.

Item	Percentage	Mean	SD
None traffic accident	81.47%	0.8147	0.3889
Slight injury traffic accident	10.95%	0.1158	0.3203
Moderate injury traffic accident	3.58%	0.0421	0.2010
Serious injury with traffic accident	3.37%	0.0337	0.1806

2.4. Measurement model

For 475 samples, there was adequate information. We selected only 172 samples that did not use their own vehicles. The descriptive statistics for various questionnaire items across different latent variables, including Service Quality, Driver, Perceived Value, Involvement, Satisfaction and Behavioral Intention, Public bus improvement, the current status of the sidewalk, and Experience with traffic accidents. Each item is characterized by its Mean and Standard Deviation. See in Table 2.3.

Service Quality is evaluated through items like "Ease for travel" (Service1), "Safe for travel" (Service2), "Comfort for travel" (Service3), and "Punctuality for travel" (Service4). The mean scores for these items range from 3.66 to 4.07, with punctuality being rated the highest, suggesting that while respondents generally find the transportation services to be punctual, there is slightly less satisfaction with ease and comfort. Drivers are assessed based on their skill and attitude, with items like "Driver has enough skill and experience" (Driver1) and "Driver's good attitude" (Driver2). These items have mean scores of 3.90 and 4.03, respectively, indicating that respondents are fairly confident in the drivers' abilities and demeanor. Perceived Value focuses on the affordability and appropriateness of the transport mode, with "Affordable travel fee" (Per_Val1) and "Travel fee is fit with the travel condition of this mode" (Per_Val2) having mean scores of 3.85 and 3.77. This reflects a moderate level of satisfaction with the cost-value relationship of the transportation services. Involvement measures how integral the transport mode is to the respondents' daily lives, with items such as "Usage of this transport mode is important for your daily living" (Involve1) and "You prefer this transport mode wherever you go" (Involve2). The mean scores here are higher, particularly for the importance of the transport mode (Involve1 at 4.01), indicating that many respondents see these services as essential. Satisfaction and Behavioral Intention items, like "Satisfied using this transport mode" (Satisfy1) and "You will use this transport mode in the future" (Satisfy2), have mean scores of 3.91 and 3.82. These scores, along with the relatively high standard deviation for COVID-19 concerns (Satisfy4 with SD = 1.02), suggest that while satisfaction is generally positive, the pandemic has introduced significant variability in respondent sentiments.

Public Buses are evaluated in terms of future usage intention and improvements, with items such as "You will use public bus in the future" (Bus1) and "You need the countermeasures about COVID19 on public bus service" (Bus3). The latter item has the highest mean score in the entire table at 4.38, reflecting strong concerns about safety measures on public buses.

Sidewalk Status is assessed with items like "You satisfy on the environment of sidewalk in Phnom Penh" (SW1) and "Good connectivity of sidewalk and well connected to bus stop" (SW4). The mean scores for these items range from 3.60 to 3.84, indicating moderate satisfaction with the current state of sidewalks, with slight concerns about safety and connectivity.

Overall, the data reveals a generally positive but nuanced view of Phnom Penh's transportation services, highlighting areas of both strength, such as punctuality and driver skill, and concern, particularly regarding COVID-19 safety and the quality of sidewalks. The standard deviations suggest that while many respondents share similar views, there is still a significant range of opinions, particularly in areas related to safety and service improvements.

.

Table 2.3 Summery statistics of potential model variables

Questionair Items, Abbreviation		Mean	SD
Latent Variable			
• ***Service Quality (Evaluation on the daily transport mode)***			
Ease for travel	Service1	3.66	0.8
Safe for travel	Service2	3.72	0.78
Comfort for travel	Service3	3.46	0.81
• ***Drivers***			
Driver has enough skill and experience	Driver1	3.9	0.59
Driver's good attitude	Driver2	4.03	0.53
• ***Perceived Value***			
Affordable travel fee	Per_Val1	3.85	0.74
Travel fee is fit with the travel condition of this mode	Per_Val2	3.77	0.81
• ***Involvement***			
You prefer this transport mode wherever you go	Involve2	2.68	1
You get enough information about this transport mode	Involve3	3.24	1
Satisfaction and Behavioral Intention			
Satisfied of using this transport mode	Satisfy1	3.91	0.68
You will introduce this transport mode to other	Satisfy3	3.2	0.88
• ***Public bus have been improved***			
You will use public bus in the future	Bus1	3.91	0.82
You will introduce about public bus to other	Bus2	3.89	0.65
• ***About the current status of sidewalk***			
You satisfy on the environment of sidewalk in Phnom Penh	SW1	3.6	0.83
You can walk easily and safe	SW2	3.37	0.97
Sidewalk in Phnom Penh covered by shape of tree	SW3	2.83	1.06

3. RESULTS

3.1. Covariance Analysis of Latent Variables

In the analysis of the Structural Equation Model (SEM), we explored the covariances among three important latent variables: Driver, Perceived Value, and Involvement. These covariance estimates shed light on how these constructs vary together, providing a richer understanding of their relationships beyond what is revealed by direct or indirect effects. See in Table 3.1.

The model shows significant relationships among Driver, Perceived Value, and Involvement. A positive perception of the driver is linked to higher user involvement (covariance = 0.139, $p < 0.001$) and an enhanced perceived value of the service (covariance = 0.104, $p < 0.001$). The strongest relationship is between Perceived Value and Involvement (covariance = 0.306, $p < 0.001$), indicating that users who see high value in the service are more emotionally engaged. These findings underscore the importance of improving driver performance and perceived value to increase user involvement and satisfaction.

Table 3.1 Table of Covariance

Latent Variable			Estimate	S.E.	P
Driver	<--->	Involvement	0.139	0.034	***
Driver	<--->	Perceived Value	0.104	0.026	***
Perceived Value	<--->	Involvement	0.306	0.063	***

3.2. Goodness-of-fit

The SEM analysis conducted on a sample size of 172 demonstrates a robust model fit, as evidenced by several important fit indices, see in Table 3.2. The chi-square statistic (χ^2) was 140.024, with a chi-square to degrees of freedom ratio (χ^2/d.f) of 1.49, which is comfortably below the threshold of 2.0, indicating that the model aligns well with the data. The Comparative Fit Index (CFI) was 0.939, close to the ideal value of 1.0, further suggesting that the model fits the data well when compared to a null model. Additionally, the Goodness-of-Fit Index (GFI) was 0.91, reinforcing the model's strong fit.

Moreover, the Root Mean Square Error of Approximation (RMSEA) was 0.054, which is below the recommended cutoff of 0.06, highlighting the model's accuracy in estimating the population parameters. Although the Standardized Root Mean Square Residual (SRMR) was 0.0807, slightly above the preferred threshold of 0.08, it remains within an acceptable range, indicating that the residuals are minimal. Taken together, these fit indices confirm that the model provides a valid and reliable representation of the underlying relationships in the dataset, supporting its overall suitability.

3.3. Causal effects

The Structural Equation Modeling (SEM) analysis conducted using SPSS AMOS explored the relationships between various factors related to the current transport mode and the intention to shift to public bus usage. The study was guided by several hypotheses, each examining different aspects of these relationships and revealing a complex interplay of variables with varying levels of significance. See in Table 3.2 and **Fig. 1**

Hypothesis 1 proposed that service quality would have a significant positive effect on driver-related factors. The analysis supported this hypothesis, demonstrating a strong positive relationship (0.694, $p < 0.001$). This result underscores the critical role of driver attributes—such as convenience, safety, and reliability—in shaping users' perceptions of service quality. Essentially, better driver performance directly enhances users' views of service quality. In contrast, Hypothesis 2 suggested a positive relationship between satisfaction and perceived value of the current transport mode. However, the analysis revealed a negative relationship (-0.346, $p = 0.082$) that was not statistically significant. This unexpected outcome suggests that perceived value might not influence satisfaction as strongly as hypothesized, indicating that other factors could be at play in this dynamic.

Building on these findings, Hypothesis 3 examined whether satisfaction with the current transport mode would positively impact involvement with it. The analysis supported this hypothesis, showing a strong positive relationship (1.145, $p < 0.01$). This result highlights that users who are more engaged with their current transport mode, whether through frequent use or emotional attachment, experience higher levels of satisfaction. Greater involvement thus enhances the overall perception of the transport service. However, Hypothesis 4 proposed that service quality would positively affect satisfaction. The analysis did not support this hypothesis, finding a negligible and statistically insignificant relationship (0.011, $p = 0.943$). This suggests that, within this sample, service quality does not directly contribute to increased satisfaction, implying that other factors might be more critical in determining user satisfaction levels.

Further exploring the implications for shifting transport modes, Hypothesis 5 posited that higher satisfaction with the current mode would negatively influence the intention to switch to public buses. The analysis revealed a negative but

non-significant relationship (-0.084, p = 0.532), indicating that satisfaction with the current mode may not be a significant deterrent against considering public bus options. This suggests that factors other than satisfaction might influence the decision to change transport modes. Similarly, Hypothesis 6 proposed that higher service quality of the current mode would negatively affect the intention to use public buses. The analysis showed a negative but statistically insignificant relationship (-0.098, p = 0.459), suggesting that perceived service quality does not significantly impact the decision to switch to public bus usage. This result points to the need for considering additional factors in influencing mode shift intentions.

Lastly, Hypothesis 7 explored whether improved sidewalk conditions would positively impact the willingness to walk to the bus stop and thus increase public bus usage. The analysis showed a positive but statistically insignificant relationship (0.056, p = 0.665), implying that sidewalk improvements alone might not significantly enhance public bus adoption. So, while the SEM analysis highlights the importance of driver-related attributes and user involvement in shaping satisfaction with current transport modes, the hypothesized relationships influencing a shift to public bus usage were largely unsupported. These findings suggest that while certain factors are crucial for enhancing the experience with the current transport mode, broader, more comprehensive strategies may be necessary to effectively promote a shift toward public transportation.

Table 3.2 Estimation results of SEMs with standardized effects

Path			Estimate
• *Causal relationship*			
Service Quality	←	Driver	0.694***
Satisfaction	←	Involvement	1.145**
Satisfaction	←	Service Quality	0.011
Satisfaction	←	Perceived Value	-0.346
Public Bus	←	Satisfaction	-0.084
Public Bus	←	Service Quality	-0.098
Public Bus	←	Sidewalk	0.056
• *Latent constructs*			
Service3	←	Service Quality	0.587***
Service2	←	Service Quality	0.785***
Service1	←	Service Quality	*0.727*
Driver2	←	Driver	*0.588*
Driver1	←	Driver	0.717***
Per_Val2	←	Perceived Value	*0.896*
Per_Val1	←	Perceived Value	0.855***
Involve3	←	Involvement	*0.527*
Involve2	←	Involvement	0.257**
Satisfy3	←	Satisfaction	0.387***
Satisfy1	←	Satisfaction	*0.969*
Bus_Improve1	←	Public Bus	*1.816*
Bus_Improve2	←	Public Bus	0.327
SW_Improve1	←	Sidewalk	*0.604*

SW_Improve2	←	Sidewalk	0.769**
SW_Improve3	←	Sidewalk	0.354***
N	=		172
χ^2	=		140.024
χ^2/d.f	=		1.49
CFI	=		0.939
GFI	=		0.91
RMSEA	=		0.054
SRMR	=		0.0807

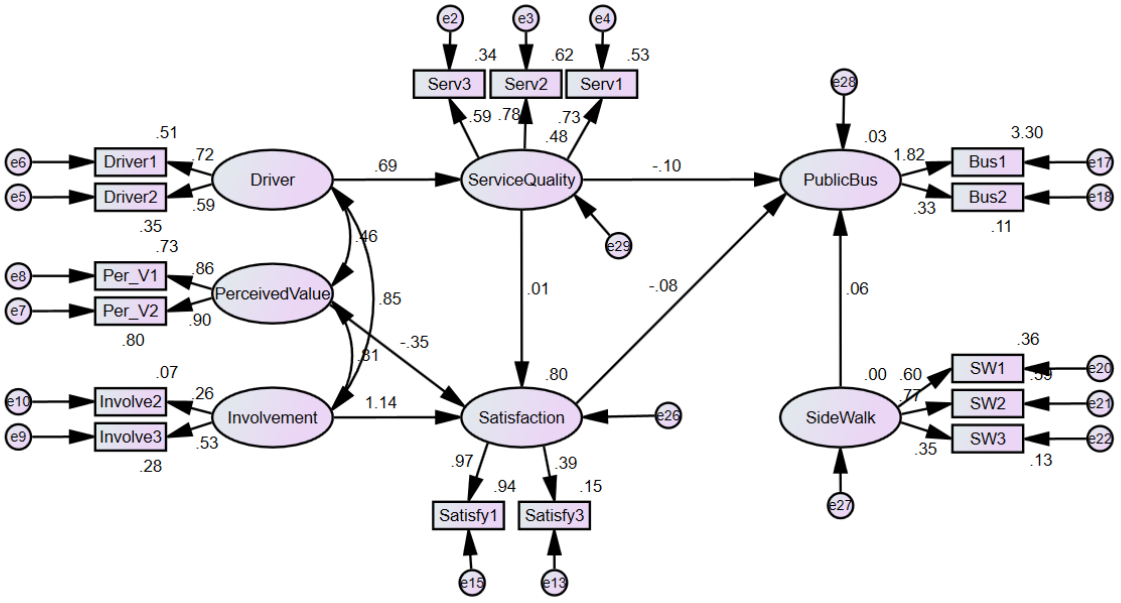

Fig. 4 Estimate result of full SEM for all respondent, with standardized effects

3.4. Direct, indirect and total effect on behavioral intention to public bus

The effects were assessed through the bootstrapping technique in SPSS AMOS, utilizing 2,000 replications to enhance accuracy. The total effect represents the combined impact, incorporating both direct and indirect effects. See in Table 3.3

The findings indicate that Satisfaction has a small but negative direct effect (-0.084) on bus usage intention, meaning lower satisfaction reduces the likelihood of using public buses. Service Quality also shows a negative direct effect (-0.098) and a minor indirect effect (-0.001), leading to a total negative effect of -0.099. This suggests that poor perceptions of service quality further discourage public bus use, both directly and indirectly. On the other hand, Sidewalk quality has a positive direct effect (0.056) on the intention to use public buses, suggesting that improved pedestrian infrastructure encourages greater public transportation usage. Since there are no indirect effects for Sidewalk, its total effect remains positive and modest. In summary, the SEM results highlight that while both Satisfaction and Service Quality negatively affect bus usage, improving sidewalk conditions can encourage more people to use public transportation. For transport planners, this underscores the importance of enhancing both service quality and pedestrian access to bus stops to increase ridership.

Table 3.3 Direct, indirect and total effect on behavioural intention to public bus

Path	Direct Effect	Indirect Effect	Total Effect
Satisfaction → Public Bus	-0.084	-	-0.084
Service Quality → Public Bus	-0.098	-0.001	-0.099
Sidewalk → Public Bus	0.056	-	0.056

4. DISCUSSION

The findings of this study reveal several key insights into the behavioral dynamics of transport mode choice among low-income commuters. First, driver-related attributes such as safety, skill, and attitude significantly shape users' perceived service quality and engagement [3].

However, in contrast to Goh et al.'s study, which identified service quality as a strong predictor of satisfaction and intention to use public transit, our analysis found no statistically significant direct effect of service quality on satisfaction or behavioral intention. This suggests that while service quality is important, it may not be sufficient alone to shift travel behavior among Phnom Penh's low-income commuters. Possible reasons include the entrenched convenience of informal modes, perceived social norms, or lack of reliable last-mile connectivity [4], [9].

Furthermore, the insignificant effect of improved sidewalks on intention to use the public bus despite a positive coefficient suggests that infrastructure improvements must be paired with other factors such as better service availability, awareness campaigns, and pricing incentives. Similar observations were reported in studies from Manila and Bangkok, where physical infrastructure alone did not result in substantial shifts in commuter behavior[10].

This study reinforces the idea that a multi-dimensional approach encompassing safety, infrastructure, affordability, and user engagement is essential for shifting commuter habits and achieving sustainable urban transport goals.

4.1. Study Limitation

Sampling Bias: The survey primarily targeted factory and garment workers in Phnom Penh, which may not represent the commuting experiences of all low-income citizens, particularly those in informal employment or residing in other urban areas.

Generalizability: The findings are specific to Phnom Penh and may not apply directly to other Cambodian cities or regions.

Model Constraints: Some hypothesized relationships were found to be insignificant, which may be due to unmeasured variables, limited sample size (n=172 for SEM), or the complexity of behavioral factors.

Cross-Sectional Design: As the data reflect a single point in time, the results do not account for changes in behavior or transport conditions over time.

5. CONCLUSION

We investigated how service quality, involvement, and satisfaction with their current transportation mode impact the intention of low-income citizens in Phnom Penh to use public buses. This study employed structural equation modeling and utilized data collected from interviews with citizens that focus on factory and garment workers at a specific location in Phnom Penh. The findings emphasize the importance of driver-related attributes such as safety, reliability, and convenience in enhancing both perceived value and user involvement. While these factors strongly influence how users engage with and perceive the current transport service, service quality alone did not significantly impact satisfaction, suggesting that user satisfaction is shaped by a broader set of factors, such as convenience and price.

Interestingly, neither satisfaction with the current transport mode nor service quality significantly influenced the intention to switch to public buses, challenging traditional assumptions that improving these factors alone would encourage users to adopt public transport. However, sidewalk quality showed a modest positive impact on public bus usage intentions, underscoring the role that pedestrian infrastructure plays in promoting sustainable transport behavior.

These results suggest that improving service quality and driver performance is essential for enhancing user perceptions, but additional strategies—particularly focusing on infrastructure improvements are crucial for promoting a shift towards public bus usage. This has important implications for urban transport planning, where a more holistic approach, integrating both service and infrastructure enhancements, is necessary to encourage public transportation adoption and create more sustainable urban mobility solutions.

5.1. Recommendation

Based on the findings of this study, several actionable strategies can be recommended to enhance public bus adoption among low-income commuters in Phnom Penh:

- Enhance Driver Performance: Develop targeted training programs to improve drivers' skills, customer service, and safety practices. Positive driver experiences were shown to significantly influence user perceptions.
- Improve Pedestrian Infrastructure: Invest in safer, shaded, and well-connected sidewalks—particularly near industrial zones and residential clusters of factory workers—to improve walkability to bus stops.

- Increase Accessibility and Coverage: Expand public bus routes to underserved areas where low-income citizens live and work. Enhance frequency and ensure better first- and last-mile connectivity.
- Promote Awareness and Public Perception: Implement outreach campaigns highlighting the benefits of public transport, including safety, cost-efficiency, and environmental impact. Use testimonials from satisfied riders to influence public attitudes.
- Incentivize Public Bus Usage: Consider fare discounts for factory workers, loyalty programs, or employer-subsidized transport passes to make public buses a more attractive option.
- Leverage Technology: Introduce real-time bus tracking and digital ticketing platforms to enhance convenience and build trust in service reliability.

5.2. Future study

Future research should focus on integrating different transportation modes with public buses, studying long-term user behavior, and evaluating specific infrastructure improvements like bus lanes. Exploring psychological factors, technological innovations (e.g., autonomous buses), and economic influences (e.g., fuel prices) on transport choices is also crucial. Additionally, comparative studies across cities can offer insights into how local contexts affect public transport usage and the effectiveness of various strategies. These areas of research can help refine public transport systems and promote more sustainable mobility solutions.

ACKNOWLEDGMENTS

First and foremost, I would like to extend my heartfelt gratitude to Dr. Veng Kheang Phun for his invaluable guidance, encouragement, and support throughout this research. His expert advice and constructive feedback have been essential in shaping the direction and quality of this paper. I am also deeply grateful to Ms. Panha Yang for her insightful feedback, which was crucial in refining the research and clarifying key arguments. Both Dr. Phun and Ms. Yang's contributions have been instrumental in the success of this study.

REFERENCES

[1] J.-P. Rodrigue, *The geography of transport systems*, Sixth edition. London New York, NY: Routledge, 2024.

[2] World Bank, *Cambodia Economic Update: Recent Economic Developments and Outlook.* World Bank Publications, 2018.

[3] M. M. Goh, K. Irvine, and M. I. Ung, "To Bus or Not to Bus: Structural Equation Modelling of Ridership Perceptions among University Students as a Planning Tool to Increase Use of Public Transit in Phnom Penh, Cambodia," *JARS*, vol. 19, no. 2, pp. 105–124, Apr. 2022, doi: 10.56261/jars.v19i2.245681.

[4] R. Ye and H. Titheridge, "The determinants of commuting satisfaction in low-income population: A case study of Xi'an, China," *Travel Behaviour and Society*, vol. 16, pp. 272–283, Jul. 2019, doi: 10.1016/j.tbs.2019.01.005.

[5] V. K. PHUN and T. YAI, "Intention of Paratransit Drivers to Operate as Feeder Service of Public Bus in Phnom Penh," Jul. 25, 2016, *Japan Transport and Tourism Research Institute*: 2. doi: 10.24639/tpsr.TPSR_19R_02.

[6] International Labour Organization, *Cambodia: Minimum wage for garment workers.* International Labour Organization Cambodia, 2023.

[7] World Bank, *Economic conditions and labor markets in Cambodia*. World Bank Cambodia, 2023.

[8] Cambodian Center for Human Rights, *Labor conditions and economic issues in Cambodia*. 2023.

[9] N. Eung and K. Choocharukul, "Modeling Frequency of Using Informal Public Transport and Public Bus: A Case Study in Phnom Penh, Cambodia," *EJ*, vol. 22, no. 3, pp. 109–122, Jun. 2018, doi: 10.4186/ej.2018.22.3.109.

[10] Y. Yen, P. Zhao, and M. T. Sohail, "The morphology and circuity of walkable, bikeable, and drivable street networks in Phnom Penh, Cambodia," *Environment and Planning B: Urban Analytics and City Science*, vol. 48, no. 1, pp. 169–185, Jan. 2021, doi: 10.1177/2399808319857726.

[11] R. B. Kline, "Principles and practice of structural equation modeling, 4th ed.," *Principles and practice of structural equation modeling, 4th ed.*, pp. xvii, 534–xvii, 534, 2016.

[12] R. H. Hoyle, "The structural equation modeling approach: Basic concepts and fundamental issues.," *Structural equation modeling: Concepts, issues, and applications.*, pp. 1–15, 1995.

[13] B. M. Byrne, *Structural Equation Modeling With AMOS: Basic Concepts, Applications, and Programming, Third Edition*, 0 ed. Routledge, 2016. doi: 10.4324/9781315757421.

[14] L. Hu and P. M. Bentler, "Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives," *Structural Equation Modeling: A Multidisciplinary Journal*, vol. 6, no. 1, pp. 1–55, Jan. 1999, doi: 10.1080/10705519909540118.

[15] R. Browne M. W. &. Cudeck, "Alternative ways of assessing model fit," in *Testing Structural Equation Models*, J. S. Bollen K. A. &. Long, Ed., Sage, 1993, pp. 136–162.

[16] D. Hooper, J. Coughlan, and M. Mullen, "Structural Equation Modeling: Guidelines for Determining Model Fit," *The Electronic Journal of Business Research Methods*, vol. 6, Nov. 2007.