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Willingness to Pay for Improvement in Service Quality of Intermediate Public Transport (IPT) Modes

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Abstract

The Rapid increase in urban population has put extraordinary pressure on transport infrastructure. Public transport frameworks in small and medium-sized cities in developing countries include of IPT modes. However, these midsized cities in developing countries face congestion problems and have severe environmental pollution. The paper focuses on the assessment of willingness to pay for improvement in service quality of IPT mode of transportation in urban India. A Stated Choice (SC) survey instrument was designed and data was collected from IPT users to collect respondent's socio-economic characteristics and their attributes for the stated hypothetical scenarios. Respondents were approached randomly and face-to-face interviews were carried out. The present study aimed at finding the willingness to pay for different attributes of an IPT mode to assess the relative importance of these attributes. The multinomial logit model was developed using the econometric software NLOGIT 4.0. The results obtained from the analysis suggest that the commuters in the city perceive safety as the most important attribute of an IPT mode followed by comfort and waiting time. The findings of the study shall be useful for policy makers and operators in urban planning and improvement of the transportation systems of mid-sized cities of developing countries and any new mode incorporating high comfort and safety shall be preferred.

Keywords: Willingness to Pay; Multinomial Logit Model; IPT; Service Quality; Stated Preference (SP).

1. Introduction

An increase in urban population and lack of commensurate growth in transportation infrastructure has created problems of severe traffic congestion and an increase in waiting and travel times in developing countries. This increase in urban population has put severe stress on urban infrastructure as there is an increased demand for travel mainly due to commuting. Most urban areas of developing countries are characterized by inadequate public transport systems both in quantitative and qualitative terms. In order to meet this inadequacy, the third mode of namely IPT has come up to fill the gap between private transport and formal public transport modes in the cities.

IPT provides transportation facilities to the locality where conventional public transport cannot operate or sometimes in parallel. Auto rickshaw and E-rickshaw are common forms of intermediate public transport systems in many developing countries that have been given different names in different countries. Auto rickshaw with their small size, better maneuverability and low operating cost has become very popular. Lately, with the introduction of electrically operated e-rickshaw, it has also become an important IPT mode. At present, both auto-rickshaw and e-

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rickshaw have a significant share in urban transportation in developing countries. It is higher in cities where there is less coverage by the public transport system. In spite of their large patronage of urban travel, their service qualities have not been up to the expectation of the users [1].

The service qualities of IPT are often regarded as unsafe, uncomfortable, and inconvenient. These limitations might discourage the use of IPT mode and thus affect the choice behaviours of the users. The knowledge of user's behaviour and their preferences are important for their travel choice decision as present and also for future improvements in service qualities of IPT modes.

2. Literature Review

Intermediate public transport supplements the public transport system by providing first and last mile connectivity to the commuters. In 1996, Shimazaki and Rahman [2] carried out an exhaustive study of IPT modes operating on similar patterns in many developing countries and have acquired different names in different places such as Tuk-Tuks in Thailand, Auto-Rickshaw in India, Three Wheeler in Sri Lanka and Keke Napeps in Nigeria. A study related to intermediate public transport was carried out for comparative assessment of service quality of IPT modes namely auto rickshaws and e-rickshaws through users perception by Ansari and Sinha [1]. Sinha et al. [3] carried out an assessment of user's satisfaction for IPT mode of transport using the Likert Scale. These studies categorically identify that there was a need for improvement in service qualities of these IPT modes. However, the improvement in service requirement increase in cost which can be assessed through the willingness to pay by the users for this enhanced service quality.

Willingness to pay is defined as the maximum amount of money that an individual is willing to pay for an additional unit of a good or service [4]. It is a tool to assess the importance of different attributes in the mode choice decision. Sadhukhan et al. [5] has designed to collect choice responses from metro users using developing random parameter logit (RPL) models and provide a basis for formulating policies for the improvement of transfer facilities. Eboli and Mazzulla [6] examined for improving the quality levels of the public transport system. It provided to tool for evaluating users willingness to pay by considering aspects like travel cost and time using multinomial and mixed logit models.

Minderhoud and Van Zuylen [7] have estimated the coefficients of utility function used for a logit model focusing on traveller's mode choice and applied in a traffic demand analysis in order to generate the future origin-destination matrix. Bachok and Ponrahono [8] have suggested for the improvement of the public transport system using modelling of willingness to pay. The utility function was described by travel time, costs, distance and various parameters results of chi-square analysis at various confidence levels. Vanany et al. [9] have described methods for improvement of modern public transportation system using the willingness to pay (WTP) and modelling by random utility model (RUM). They concluded that users prefer options that have more flexible attributes than the assumed base attributes. Hazra et al. [10] have proposed to the improvement in the planning of solid waste management (SWM) system using user's perceptions towards different attributes of SWM system in terms of willingness to pay (WTP) values.

Dell'Olio et al. [11] have recommended for improvement of service quality of the users of transport interchanges from one mode of transport to another in multimodal areas. Willingness to pay was calculated by estimating the mixed logit model based on the stated choice survey was used for travel time, quality of information availability and service provided at the interchanges for multimodal trips. Chintakayala and Maitra [12] studied the service quality of the taxi operation in Indian cities using the willingness to pay. It was applied for evaluating various alternatives and identifying a feasible option for replacing old taxies with new ones. It used stated preference data collected from users and developed a multinomial and random parameter logit model.

Phanikumar and Maitra [13] presented estimations of willingness to pay values within the factor of rural bus service in a developing country using multinomial logit model MNL and three different random parameter logit RPL models. The estimated WTP values were found to be useful for calculating the overall disutility of travel experienced by trip makers for any operating condition of rural bus service. Israel Schwarzlose et al. [14] studied the willingness to pay (WTP) for transportation attributes for improving the standard of life of the rural elderly.

Pujiati et al. [15] determined average willingness to pay for the users of public transportation to improve service quality and assessing customer satisfaction with public transportation services. Das et al. [16] used generalized cost (GC) to develop a willingness to pay (WTP) of rural users with respect to various attributes of rural feeder service. Sittha et al. [17] studied the willingness to pay for a suitable fare structure policy for a new public transport system.

Yang et al. [18] studied to estimate traveler's willingness to pay (WTP) for travel time savings by a random coefficient binary logit model. Meena et al. [19] developed a mode choice model and determined the factors which influence a trip maker's behavior of mode choice by multinomial logit and nested logit model. The study was helpful for policy makers to understand the factors affecting the choice of mode for such trips. Chen et al. [20] carried out a travel choice experiment to understand user's decision making regarding their travel time and cost using an ordered

logit model. It was found that the users insignificant numbers to be expensive alternatives with the shorter waiting time. Polydoropoulou et al. [21] have developed a model to explore user choices toward mobility as a service by using a hybrid choice model. The results indicate that users of multimodal mobility options are willing to pay more with respect to traditional mobility services. Nickkar et al. [22] determined the willingness to pay (WTP) of adult residents for autonomous vehicles by using adaptive choice-based conjoint analysis.

This paper is an attempt to explore the factors influencing the quality and level of services of IPT modes. The findings will help to understand the IPT service and help responsible authorities and policy makers to improve the quality of service and attract more users. Recently, there has been an increase in the share of IPT modes. The mode share of a different mode of transportation is enclosed in Table 1. This increase in attraction depends upon various attributes namely; travel time, travel cost, comfort, safety etc. The commuter mode choice behaviour for these IPT modes in the present study focuses on parameters like the reliability of service, punctuality, frequency and waiting time. It has been considered for modelling of mode choice decision for travel using discrete choice model [23].

The utility function developed is used for the calculation of willingness to pay of the commuters. It helps us to understand the relative importance of different attributes in terms of readiness of the service receivers for paying a certain amount for shifting from one level to another a better level. It also allows us to understand the difference in perceptions of the user about the change they feel while shifting between one pair of levels of an attributes another pair of levels of the same attributes. Therefore the present study focuses on finding the willingness to pay for different attributes of an IPT mode and the development of utility functions for those modes in urban India.

Table 1. Mode Share [30]

Mode of Journey	Percentage (Without walking)
2 wheeler	36.03%
Car	8.26%
Taxi/Ola	1.01%
Rickshaw	2.03%
Bicycle	7.67%
IPT	36.61%
Transit (Bus)	8.39%

The above literature shows that only a limited study has been carried out for IPT mode in urban India. In previous studies, WTP for public transport has been estimated by Eboli and Mazzulla (2008). However, the present study is being done for IPT modes in developing countries like India. As mention in the introduction section, no study in contemporary literature is available about WTP for modes. Therefore, a comparison with the only public transport system can be made and is given in the article. The objective of this paper is to identify the socio demographics of IPT users in Patna and to measure the willingness to pay (WTP) for improvement in service quality of IPT mode of transportation. The knowledge of willingness to pay can be suggesting improvements in the IPT services and hence maximizing the user benefits [25].

Patna, the largest and capital city of the province of Bihar has a population of about 20 lakhs (Census 2011) [26]. A large number of trips of different nature - work trips, educational trips and recreational trips are generated every day. In 2018, Patna along with its hinterland accommodating about 2.62 million people mainly depends on intermediate public transport (IPT) modes along with the other private mode of transportation [1]. About 60 percent area has residential land use and about 7.61 percent is given towards transport infrastructure [24]. The unreliable bus service and its inefficient operation coupled with narrow and congested road network have resulted in the high patronage of IPT [3].

3. Research Methodology

The estimate of WTP values is calculated by analyzing the stated preference (SP) data collected from the users. The stated choice responses are in the form of rating, ranking and choice. The assessments of the marginal disutility of variations in various attributes are carried out using this experiment. The data set includes the characteristic of trips such as trip length, trip cost and trip purpose as included in the travel diary. It also included socioeconomic characteristics such as age, profession, income, household size and responses to the selection sets were recorded during data collection. The entire work done for achieving the stated objectives can be categorized into different parts. A schematic representation of the works done along with the works flow has been represented by the flow chart given in Figure 1.

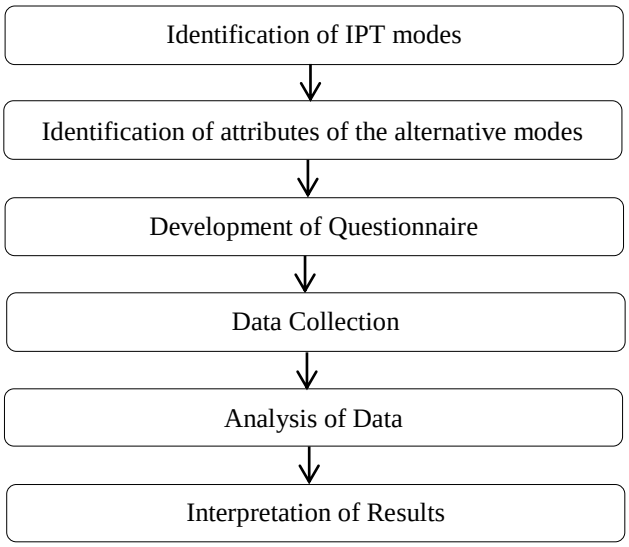

Figure 1. Research Methodology

3.1. Identification of IPT Modes

The first step involved the identification of the different IPT modes that are suitable and can be introduced in Patna. Based on the response of the pilot survey and other considerations, it was decided to consider an auto rickshaw, e-rickshaw and a proposed good quality electric van as the alternatives in the study shown in Figures 2 and 3 respectively.

3.2. Identification of Attributes

Based on the literature survey, a list of attributes was selected which were identified to have a significant role in the decision making process of commuters regarding the choice of mode while selecting IPT modes. Attributes describing service quality of IPT mode has been identified based on literature review, reconnaissance, discussion with experts and commuters. The different attributes selected for the study were travel time per unit distance, travel cost per unit distance, waiting time, comfort and safety in the model based on the work of Hensher et al. [4]. A pilot survey confirmed the relevance of these attributes in the context of Patna.

3.3. Development of Questionnaire

A questionnaire is a technique for collecting data in which a respondent provides answers to a series of questions. The questions are developing for the questionnaire should be clear, concise and direct. The data is collected taking a step by step approach to questionnaire development.

3.4. Defining Different Levels of the Attributes

The questionnaire has consisted of two parts. The first part was related to the respondent's socioeconomic characteristics related information. The second part was related to the stated choice survey wherein four different and unique scenarios were presented to the respondents. The respondents were asked to choose from among three modes about the five attributes associated with trips on those modes in each scenario. Travel time per unit distance and travel cost per unit distance were quantitative in nature whereas comfort, safety and frequency of the transit were defined qualitatively. The selections of levels of attribute were based on the existing condition, possible practical alternatives and literature review. Levels for travel cost attributes were decided based on a current fare with an increment. The average values of the attributes under consideration were determined from the pilot survey and three levels were defined. One of these levels corresponds to the average value of the attribute while the other two levels correspond to a higher and a lower value than the average. The highest safety level, highest comfort level and highest frequency level were taken as the base levels. The number of levels for each attribute will be decided by the overall complexity of the design. The different attributes and their levels have been tabulated in Table 2.

Figure 2. Auto Rickshaw

Figure 3. E-Rickshaw

Table 2. Attributes and their Levels

Attribute	Level 1	Level 2	Level 3
Travel Time per km	2	3	4
Travel Cost per km	2	2.5	3
Safety	Low	Medium	High
Comfort	Low	Medium	High
Frequency	Every 10 minutes	Every 5 minutes	Every 2 minutes

3.4.1. Forming Choice Sets

All the alternative modes taken into consideration were assumed to be comparable and several possible combinations of the different levels of the attributes were considered for each alternative. The numbers of alternatives in choice sets were 'finite', 'mutually exclusive', and 'exhaustive' as stated by Hensher et al. [4]. A full factorial design produces a large number of choice scenarios which is not practical to manage within the context of the current study with five attributes and a minimum of three levels for each attribute. Whereas, a fractional factorial design considerably reduces the size of the design by considering the main effects and higher order interaction effects based on Hensher et al. [4]. Five factors at three levels each were taken and a D-Optimal design was obtained. Choice scenarios generated from the D-Optimal design were blocked in several groups to give uniformity in similar combinations of alternatives [27].

This resulted in four surveys with four choice sets each. Four choice sets of such questionnaire are prepared with each set of questionnaire having four different, unique and relevant choice scenarios using JMP software. These sets are named A, B, C and D in the Appendix I. Hence a total number of 16 unique and relevant choice scenarios have been prepared for the survey. Each choice set contained three profiles (alternatives) with a combination of factors at different levels [28]. Electric van was represented by alternative 1 whereas Auto rickshaw and E-rickshaw were represented by alternative 2 and alternative 3 respectively. Every respondent was asked to give one survey. In other words, every respondent was asked to select one of the three alternatives in each choice set for a survey.

3.5. Data Collection and Database

A face to face interview based on a stated choice survey was conducted in all routes of Patna to collect a representative data set. 420 respondents were surveyed. The responses of 24 respondents were rejected either due to incomplete survey or irrational choices. 396 records were taken as acceptable for the present study. The data collected were tabulated in an excel sheet and coded for analysis in NLOGIT 4.0 [29]. Numerical values were used for quantitative variables like travel time per km and travel cost per km whereas coding was done for the qualitative variables.

3.6. Model Development

The collected data were recorded in an excel sheet in CSV format. A CSV file (i.e., 'comma separated values' format) has a line of variable names at the top and rows of data with values separated by commas. The data was then imported into NLOGIT 4.0, econometric and statistical software. NLOGIT 4.0 is a Windows based econometric program developed by Econometric Software, Inc. which is used worldwide by discrete choice modeler's in transport. It is a very large model estimation and analysis package that contains roughly 200 built-in estimators for a variety of models for regression, discrete choice and a wide variety of models. Using this software, the results were obtained

based on the Multinomial logit model using Maximum likelihood estimation. Using the MNL model, the expression for the probability of choosing an alternative i from a set of j alternatives is given by the Equation 1;

$$P\ (i) = \frac{e^{V_i}}{\sum e^{V_j}} \quad (1)$$

In discrete choice models, the willingness to pay for an attribute can be calculated using the Equation 2;

$$\text{WTP} = \frac{\alpha}{\beta} \quad (2)$$

Where, α = coefficient of the attribute in the utility function and β = coefficient of the fare attribute in the utility function.

4. Results and Discussion

The socio-economic characteristics of the respondents have been summarized in Table 3.

Table 3. Socio-economic characteristics of respondents

Category	Description	Number of observations	Percentage (%)
Gender	Male	311	78.54
	Female	85	21.46
Age Group	Less than 18 years	43	10.86
	18 years to 30 years	137	34.60
	30 years to 45 years	104	26.26
	45 years to 60 years	76	19.19
	More than 60 years	36	9.09
Monthly Income	Below INR 20,000	159	40.15
	INR 20,000 to INR 35,000	112	28.28
	INR 35,000 to INR 50,000	74	18.69
	INR 50,000 to INR 1,00,000	39	9.85
	More than INR 1,00,000	12	3.03
Occupation	Daily Wage Earner	23	5.81
	Salaried	89	22.47
	Self Employed	62	15.66
	Student	146	36.87
	Unemployed	57	14.39
	Other	19	4.80

The Trip characteristics of the respondents have been summarized in Figures 4 and 5.

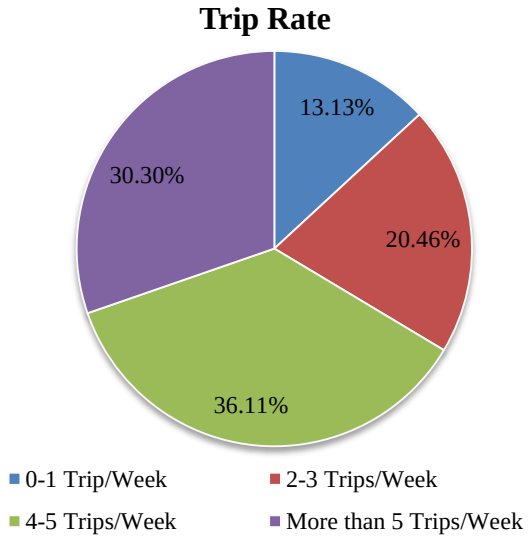

Figure 4. Trip Rate

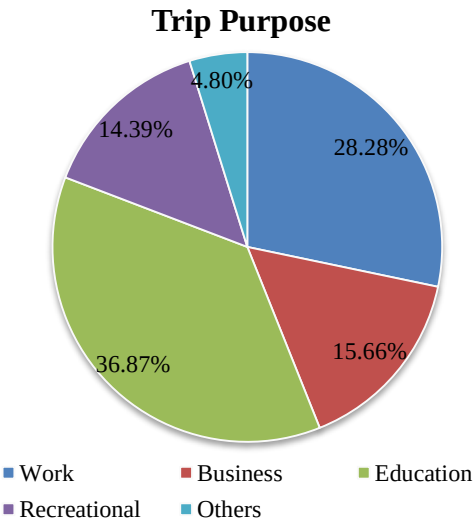

Figure 5. Trip Purpose

The output of NLOGIT 4.0 has been based on maximum likelihood estimation. The dependent variable is choice and the numbers of parameters are 10. The result obtained from MNL Model has been tabulated in Table 4. From Table 4, it can be clearly seen that the T- Statistic value for all the estimates are greater than 1.64. Also, the probability value is much less than 0.05. It can thus be stated with a confidence level of 95 per cent that all the included variables and mode-specific constants are statistically significant. The value of R^2 at 0.2590 is also found to be acceptable for stochastic studies and the model can be assumed to be a good fit [4].

Table 4. Coefficient Estimates from MNL Model

Attribute	Coefficient	T – Statistic	Probability (p value)
Travel Time	-0.3038	-5.400	.0000
Fare	-0.7003	-7.530	.0000
Frequency 1	-0.7516	-6.775	.0000
Frequency 2	-0.4359	-4.122	.0000
Comfort 1	-0.6968	-7.585	.0000
Comfort 2	-0.5289	-5.071	.0000
Safety 1	-2.4741	-18.455	.0000
Safety 2	-1.3725	-11.363	.0000
Mode Specific Constant (Electric Van)	0.5388	6.125	.0000
Mode Specific Constant (Auto Rickshaw)	-0.2021	-2.173	.0151
Adjusted R^2: 0.2590			

Since the coefficient of various attributes and at different levels one can observe that all of them are negative. It can be inferred that the respondents perceive travel time and fare as disutility with respect to base level. The coefficient for frequency level 1, frequency level 2, comfort level 1, comfort level 2, safety level 1 and safety level 2 is also negative. This means that the users perceive frequency level 1 and frequency level 2 as disutility compared to the base frequency level. Similarly, comfort level 1 and comfort level 2 are considered disutility compared to a base comfort level. Safety level 1 and safety level 2 are also perceived as disutility compared to the base level.

Commuters gave the highest priority to safety and the lowest priority to in-vehicle travel time. This is evident from the highest magnitudes of coefficient for safety level 1 and safety level 2 whereas lowest magnitude of coefficient for in-vehicle travels time. This signifies the importance of safety in the context of IPT modes. Increasing safety level can thus ensure increased patronage of intermediate public transport. The coefficient of safety level 1 is observed to be -2.4741 whereas the coefficient of safety level 2 is -1.3725. This means that in general, the utility for a travel mode increases with an increase in safety level.

The coefficient of comfort level 1 is -0.6968 while the coefficient of comfort level 2 is -0.5289. This indicates that the utility of a mode increases with comfort. Greater utility is associated with a higher comfort level.

Frequency of a mode is related to waiting time. Frequency level 1 represents lower frequency and thus higher waiting time while frequency level 2 represents higher frequency and correspondingly lowers waiting time. The coefficient of frequency level 1 is -0.7516 and the coefficient of frequency level 2 are -0.4359. Again, this implies an increase in utility of mode with an increase in frequency. In other words, it can be said that the utility of a travel mode decreases with an increase in waiting time. By comparing the coefficients of different variables, it can be concluded that commuters value frequency level 1 more than in vehicle travel time and fare.

The coefficient of fare is -0.7003 while the coefficient of in vehicle travel time is -0.3038. The higher coefficient for fare signifies that fare is a more important determinant dictating the choice of travel mode. With an increase in travel time and fare, the disutility of a mode increases.

E-rickshaw has been taken as the reference mode. The mode-specific constant for electric van comes out to be 0.5388. A positive sign indicates the higher preference for electric van compared to auto rickshaw when all other variables are kept constant. The mode specific constant for auto rickshaw is found to be -0.2021. The negative sign implies that commuters have a slightly higher preference for e-rickshaw compared to auto rickshaw. However, the small magnitude of mode-specific constant for auto rickshaw indicates that there is not a significant difference in the preference between e-rickshaw and auto rickshaw.

The observable utility V can be defined as a linear combination of variables. The different utility functions thus developed can be written as:

$$V_{Electric\ Van} = 0.5388 - 0.3038 \times Travel\ Time - 0.7003 \times Fare - 0.7516 \times Frequency\ 1 - 0.4359 \times Frequency\ 2 - 0.6968 \times Comfort\ 1 - 0.5289 \times Comfort\ 2 - 2.4741 \times Safety\ 1 - 1.3725 \times Safety\ 2$$

$$V_{Auto\ Rickshaw} = -0.2021 - 0.3038 \times Travel\ Time - 0.7003 \times Fare - 0.7516 \times Frequency\ 1 - 0.4359 \times Frequency\ 2 - 0.6968 \times Comfort\ 1 - 0.5289 \times Comfort\ 2 - 2.4741 \times Safety\ 1 - 1.3725 \times Safety\ 2$$

$$V_{E\text{-}Rickshaw} = -0.3038 \times Travel\ Time - 0.7003 \times Fare - 0.7516 \times Frequency\ 1 - 0.4359 \times Frequency\ 2 - 0.6968 \times Comfort\ 1 - 0.5289 \times Comfort\ 2 - 2.4741 \times Safety\ 1 - 1.3725 \times Safety\ 2$$

It can be seen that the mode specific constant for e-rickshaw has been kept zero. It is because of the fact that e-rickshaw was taken as the base mode in the development of the model. Willingness to pay is defined as the amount one is willing to pay for a unit amount of service. Willingness to pay between the attributes and the cost is calculated by taking ratios between the coefficients of the attributes and the coefficient of fare attribute. These values can be interpreted as WTP for a unit change in each attribute under consideration. The willingness to pay for different attributes like comfort, safety etc. has been calculated and tabulated shown in Table 5.

Willingness to pay for travel time attribute is called the value of travel time (VOTT). From Table 5, it can be seen that the value of travel time (VOTT) is INR 0.43 per km. The WTP value for frequency 1 is INR 1.07 and the WTP value for frequency 2 is INR 0.62. This means that commuters are ready to pay INR 1.07 per trip to shift from frequency level 1 to the base frequency level 3 whereas they are willing to pay only INR 0.62 per trip to shift from frequency 2 to frequency 3. This signifies the reluctance of commuters to wait for a longer duration.

Table 5. Willingness to Pay (WTP) Values

Variable	Coefficient	Willingness to Pay (in INR)
Travel Time	-0.3038	0.43 per km
Fare	-0.7003	1.00 per km
Frequency 1	-0.7516	1.07 per Trip
Frequency 2	-0.4359	0.62 per Trip
Comfort 1	-0.6968	0.99 per Trip
Comfort 2	-0.5289	0.76 per Trip
Safety 1	-2.4741	3.53 per Trip
Safety 2	-1.3725	1.96 per Trip

The WTP value for comfort 1 is INR 0.99. This means that commuters travelling in low comfort vehicles are willing to pay INR 0.99 more to shift to high comfort while they are ready to spend only INR 0.76 more to shift from medium comfort to high comfort. From the willingness to pay Table 5, it is evident that safety is given the highest importance by commuters and they are willing to pay a higher amount of money to travel more safely. The WTP values for safety 1 and safety 2 are INR 3.53 and INR 1.96 respectively. This means that commuters are willing to pay 1.8 times more to shift from safety 1 (low safety) to safety 3 (high safety) than from safety 2 (medium safety) to safety 3 (high safety). Interestingly, it can be observed that commuters give more priority to safety; comfort and waiting time than in vehicle travel time and travel cost.

5. Conclusions

The choice of travel mode by a commuter is greatly influenced by the attributes of the competing modes. All the attributes cannot be considered to be equally significant because of the commuter's inherent preference towards some of these attributes.

The study revealed that travel time, travel cost, operating frequency, safety and comfort are significant attributes influencing mode choice. The coefficient of travel time, travel cost, frequency 1, frequency 2, comfort 1, comfort 2, safety 1 and safety 2 were found to be -0.304, -0.700, -0.752, -0.436, -0.697, -0.529, -2.474 and -1.372 respectively. Safety was found to be the most significant attribute followed by comfort and operating frequency. Commuters show reluctance to travel in modes with low safety and are willing to spend extra money to enhance safety from low to high as well as from medium to high. The influence of waiting time is found to be more than in-vehicle travel time and travel cost highlighting commuters reluctance to wait. Low operating frequency of a transit mode and the consequent

higher waiting time may decrease its attractiveness. Travel cost is given more importance than in-vehicle travel time. Commuters have a disliking for low comfort and are willing to pay as high INR 0.99 to increase the comfort to a high level whereas no significant difference between medium and high comfort is observed.

Electric van has the highest mode specific constant among all the alternatives. This indicates that people of the city have a slightly greater liking for electric van and are more likely to choose this mode when the variables like travel time, cost, safety etc. are same for all the alternatives. Based on the findings of the study, IPT modes with high service quality is recommended taking into consideration the commuters willingness to pay more for enhanced safety and comfort. Among all the IPT modes, the introduction of an electric van is recommended due to the higher mode specific constant associated with it.

6. Declarations

6.1. Author Contributions

Conceptualization, S.K., and S.S.; methodology, S.K.; writing—original draft preparation, S.K.; writing—review and editing, S.S.; supervision, S.S. All authors have read and agreed to the published version of the manuscript.

6.2. Data Availability Statement

The data presented in this study are available in article.

6.3. Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

6.4. Conflicts of Interest

The authors declare no conflict of interest.

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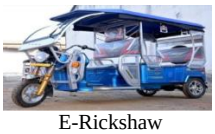
Appendix I: Stated Preference Survey (SET –A)

Please select an alternative travel option from each scenario within the given alternatives. Put a tick mark (√) against your choice (only one at a time).

Choice Scenario - 1

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	4 min	4 min	2 min
Frequency	Every 2 min	Every 10 min	Every 2 min
Riding Comfort	Standing in Congested Situation	Standing in Congested Situation	Standing in Congested Situation
Safety	Chance of Crash Negligible	Chance of Crash Negligible	Chance of Crash Medium
Travel Cost (per Km)	Rs. 2.00	Rs. 3.00	Rs. 3.00
Your Choice	○	○	○

Choice Scenario - 2

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	2 min	4 min	3 min
Frequency	Every 10 min	Every 2 min	Every 5 min
Riding Comfort	Standing in Comfortable Situation	Standing in Congested Situation	Standing in Congested Situation
Safety	Chance of Crash Medium	Chance of Crash High	Chance of Crash Negligible
Travel Cost (per Km)	Rs. 3.00	Rs. 3.00	Rs. 2.50
Your Choice	○	○	○

Choice Scenario - 3

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	2 min	3 min	4 min
Frequency	Every 2 min	Every 10 min	Every 10 min
Riding Comfort	Standing in Comfortable Situation	Get a Seat	Standing in Comfortable Situation
Safety	Chance of Crash High	Chance of Crash Medium	Chance of Crash Negligible
Travel Cost (per Km)	Rs. 2.00	Rs. 3.00	Rs. 2.00
Your Choice	○	○	○

Choice Scenario - 4

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	3 min	2 min	2 min
Frequency	Every 10 min	Every 2 min	Every 5 min
Riding Comfort	Standing in Congested Situation	Get a Seat	Standing in Comfortable Situation
Safety	Chance of Crash Negligible	Chance of Crash Negligible	Chance of Crash Medium
Travel Cost (per Km)	Rs. 3.00	Rs. 2.00	Rs. 3.00
Your Choice	○	○	○

Stated Preference Survey (SET –B)

Choice Scenario - 1

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	3 min	2 min	3 min
Frequency	Every 5 min	Every 5 min	Every 10 min
Riding Comfort	Standing in Congested Situation	Get a Seat	Standing in Comfortable Situation
Safety	Chance of Crash High	Chance of Crash Medium	Chance of Crash Negligible
Travel Cost (per Km)	Rs. 3.00	Rs. 2.00	Rs. 2.50
Your Choice	O	O	O

Choice Scenario - 2

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	4 min	4 min	4 min
Frequency	Every 10 min	Every 2 min	Every 2 min
Riding Comfort	Standing in Comfortable Situation	Get a Seat	Standing in Comfortable Situation
Safety	Chance of Crash Medium	Chance of Crash Medium	Chance of Crash Medium
Travel Cost (per Km)	Rs. 2.50	Rs. 2.50	Rs. 2.00
Your Choice	O	O	O

Choice Scenario - 3

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	3 min	3 min	2 min
Frequency	Every 5 min	Every 5 min	Every 2 min
Riding Comfort	Standing in Congested Situation	Standing in Congested Situation	Get a Seat
Safety	Chance of Crash Medium	Chance of Crash Medium	Chance of Crash Medium
Travel Cost (per Km)	Rs. 2.50	Rs. 3.00	Rs. 3.00
Your Choice	O	O	O

Choice Scenario - 4

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	3 min	2 min	2 min
Frequency	Every 5 min	Every 5 min	Every 5 min
Riding Comfort	Standing in Congested Situation	Standing in Comfortable Situation	Standing in Comfortable Situation
Safety	Chance of Crash Medium	Chance of Crash High	Chance of Crash Negligible
Travel Cost (per Km)	Rs. 2.00	Rs. 2.50	Rs. 3.00
Your Choice	O	O	O

Stated Preference Survey (SET –C)

Choice Scenario - 1

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	3 min	3 min	2 min
Frequency	Every 10 min	Every 10 min	Every 5 min
Riding Comfort	Standing in Congested Situation	Standing in Comfortable Situation	Get a Seat
Safety	Chance of Crash Medium	Chance of Crash High	Chance of Crash Medium
Travel Cost (per Km)	Rs. 2.50	Rs. 2.00	Rs. 2.50
Your Choice	○	○	○

Choice Scenario - 2

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	3 min	4 min	3 min
Frequency	Every 2 min	Every 2 min	Every 2 min
Riding Comfort	Standing in Comfortable Situation	Get a Seat	Standing in Congested Situation
Safety	Chance of Crash Negligible	Chance of Crash Medium	Chance of Crash High
Travel Cost (per Km)	Rs. 2.00	Rs. 2.50	Rs. 2.00
Your Choice	○	○	○

Choice Scenario - 3

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	4 min	3 min	2 min
Frequency	Every 10 min	Every 10 min	Every 2 min
Riding Comfort	Standing in Comfortable Situation	Standing in Comfortable Situation	Standing in Congested Situation
Safety	Chance of Crash High	Chance of Crash High	Chance of Crash High
Travel Cost (per Km)	Rs. 2.50	Rs. 3.00	Rs. 2.50
Your Choice	○	○	○

Choice Scenario - 4

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	3 min	2 min	2 min
Frequency	Every 2 min	Every 2 min	Every 10 min
Riding Comfort	Standing in Comfortable Situation	Standing in Comfortable Situation	Standing in Congested Situation
Safety	Chance of Crash Negligible	Chance of Crash Negligible	Chance of Crash High
Travel Cost (per Km)	Rs. 3.00	Rs. 2.00	Rs. 2.50
Your Choice	○	○	○

Stated Preference Survey (SET –D)

Choice Scenario - 1

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	4 min	4 min	3 min
Frequency	Every 10 min	Every 5 min	Every 5 min
Riding Comfort	Standing in Congested Situation	Get a Seat	Standing in Comfortable Situation
Safety	Chance of Crash Negligible	Chance of Crash Negligible	Chance of Crash High
Travel Cost (per Km)	Rs. 2.50	Rs. 3.00	Rs. 2.50
Your Choice	O	O	O

Choice Scenario - 2

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	4 min	2 min	2 min
Frequency	Every 2 min	Every 10 min	Every 10 min
Riding Comfort	Standing in Comfortable Situation	Standing in Congested Situation	Get a Seat
Safety	Chance of Crash High	Chance of Crash Negligible	Chance of Crash High
Travel Cost (per Km)	Rs. 3.00	Rs. 2.00	Rs. 2.00
Your Choice	O	O	O

Choice Scenario - 3

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	2 min	4 min	3 min
Frequency	Every 5 min	Every 2 min	Every 2 min
Riding Comfort	Get a Seat	Standing in Comfortable Situation	Get a Seat
Safety	Chance of Crash Medium	Chance of Crash Negligible	Chance of Crash Negligible
Travel Cost (per Km)	Rs. 2.00	Rs. 2.50	Rs. 2.50
Your Choice	O	O	O

Choice Scenario - 4

Mode / Attributes	 Electric Van	 Auto Rickshaw	 E-Rickshaw
Travel Time (per Km)	2 min	2 min	2 min
Frequency	Every 10 min	Every 5 min	Every 5 min
Riding Comfort	Get a Seat	Standing in Congested Situation	Get a Seat
Safety	Chance of Crash Negligible	Chance of Crash Negligible	Chance of Crash High
Travel Cost (per Km)	Rs. 2.50	Rs. 2.00	Rs. 3.00
Your Choice	O	O	O