

FACTORS AFFECTING ON THE DEMAND FOR THREE WHEELERS: SPECIAL REFERENCE TO THE PERCEPTION OF PASSENGERS

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Abstract - Three wheelers play a significant role in the transportation sector in Sri Lanka. The selection of this topic is highly influenced to the current situation of Sri Lanka where we can see a large number of three wheelers on the road. It is clearly highlighted a rapid growth in three-wheel population from one year to another. Statistical reports of Department of Motor Traffic Sri Lanka show More than 65% of growth from year 2014 to 2015. which compel government to restrict the importation of three wheelers. Therefore, Research is conducted to identify the factors contributing to a high demand for three wheelers. Researcher selected Colombo metropolitan area as the sample, because it is consisted with a large population, large working crowd, congested travel area and less parking facilities. Under random sampling technique, Researcher distributed a questionnaire for more than 500 passengers. After testing the reliability of the data set, a factor analysis was run to identify the most influential factors contributing the demand for three – wheelers. Finally, it was concluded that passenger behaviour, quality of service, transport sector variables, infrastructure and policy making are highly influenced on the demand for three - wheelers.

Keywords- Three Wheelers, Demand for Three Wheelers, Factors Contribution for Three Wheelers

I. INTRODUCTION

Non-arguably transport is one of the most discussed topics in current Sri Lankan context. People use transport

modes to fulfil their transport needs and also the mode of transport is depending on various factors affecting to it. (Rose and Hensher, 2013). As a developing country, Sri Lanka is not in a position to provide more effective and efficient public transport service which yield ample space for informal public transport (IPT) service providers to enter in to the market at minimum barriers as well as it increases the use of private vehicles as well.

In very early years, Sri Lanka didn't have variety of modes to fulfil their transport requirements. The man motorized

transport service is the public transport service. with the effect of privatization, different transport modes came to transport market which made a huge difference in the total context of the transport market. Although the public and private transportation services provide a rapid and reliable means of transportation, there are some gaps that still they cannot touch with their capacity such as late-night travel, early morning travel, travel up to the destination, travelling in rural areas, small cities and more. Due to these factors informal public transport or Para transit became much needed services in lifestyle of people.

Para-transit relates to public or group transportation. In relation to Sri Lankan context Three Wheelers are the most common and most popular method that can be seen as a way of providing Para-transit to the general public where it gives the user/commuter the advantage

of selecting a flexible travel option specially focused on rapidly urbanizing areas.

Three wheelers have become a much-needed transport mode in transport system and eventually it has become the most preferable mode of Para transit with compared to other modes of Para transit, in different phases such as Budget Taxi, Pick me and Fair Taxi.

Table 1.1, registrations of new three wheels in 2014 and 2015.

Month	New Registration 2014	New Registration 2015	Growth
Jan.	5944	8350	40%
Feb.	5148	7790	51%
Mar.	6292	12530	99%
Apr.	6809	10836	59%
May.	5750	10947	90%
Jun.	6126	11509	88%
Jul.	7145	12338	73%
Aug.	6450	10372	61%
Sep.	7538	12396	64%
Oct.	7250	8299	14%
Nov.	6895	13208	92%
Dec.	7691	11503	50%
Total	79038	130078	

(Source: Department of motor traffic 2014-2015)

Above is a comparison which shows how large the growth of three-wheel population in two recent years.

High demand for Travelling, increasing population, increasing the number of work places, Increasing the number of trip rate and less parking space and many other factors have undoubtedly been increased the demand for three-wheelers. (Kumarage, Bandara and Munasinghe, 2010)

Research Question

A research should be incorporated with a present-day context. Majority of policy makers as well as the general

public view that, Three - wheelers are affecting to high traffic congestion in the country. Based on that practical issue, the research question has been derived as,

What are the factors affecting high Demand for three-wheelers in Sri Lanka? (Special reference to the perception of passengers)

Hence, the research objectives have been determined as,

- 1) Identifying the most influential factors affecting to high demand for three – wheelers.
- 2) Recommending possible suggestions those can be undertaken by the policy makers to reduce the negative impacts which will be related with three – wheeler demand.

Significance of the research

No one will ever think a Motorized engine covered with an aluminum body, runs on 3 small wheels will have so much of impact on economy as well as the transport system. In Sri Lanka, transport is the most discussed topic at the current context. Less development of infrastructure facilities and Enhancing the number of private vehicles on the road has become a paradox situation in the country. and traffic congestion has become one of the most significant transportation problem. According to the view of policy makers, three wheelers are very tightly engaged with this issue. because it has a remarkable growth. three – wheelers lead to have many road accidents due to sudden turns and also traffic congestion. Many traffic offences are commonly committed by three – wheeler drivers. This transport mode is highly famous for illegal activities such as illegal drugs transportation. Social issues are created due to that. Therefore, general public view three – wheeler as a risk. But still people are demanding the service of three – wheelers. Therefore, research is conducted with the expectation of finding the most influential factors affecting on high demand for three – wheelers as it will be very supportive for policy makers to undertake solutions to mitigate the impact of this issue.

Literature review

Once the name “Para transit” has introduced to the world, varies types of Para transit methods have also been introduced. From few years back, number of terminology

has been introduced for what is called 'Informal Transport modes' such as intermediate, unincorporated, para-transit, unregulated, low cost and informal high occupancy modes. All these mentioned terminologies have been interchangeably used to identify vehicles and operational systems which fill the gaps between the mass-public transports systems, whether road, rail, non-motorized transport. (Robert, 2007)

If people do not need to move from one place to another or if they do not need to move something from one place to another place the need of transportation will be zero. Therefore It is normally argued that, transportation has a derived demand which arises due to another incident or factor.

System of a country, which as per the Manuel Jose D. Camagay "mobility is a paramount element to the rapid growing areas and areas which are already congested. And he further states that non-regularization of private short distance transportation modes creates a certain amount of pollution as well."

As per the Amal S. Kumarage (2009) "Para-transit is urban passenger transportation services usually available to certain groups of users or to the general public, but adoptable in its routing and scheduling to individual user's desires in varying degrees"

Also, he stated that informal transport modes as "transport services or modes which are unregulated and often illegal, acting in free market competition with other informal services as well as with the formal ones, usually emerging in areas of low income populations, in cities in developing countries, or areas left not served by traditional services".

Also mentioned that Informal transport modes describe "community based informal transport systems as travel services arranged among individuals who agree to prices prior to the trip, routes, and schedules case by case basis by word of mouth and without government oversight"

The ideas given by articles provide a clear-cut picture about informal transport modes. It is mostly unregulated, and the rules and regulation can change according to the facts as well. Most of the time the economy of the users can be categorized as middle or upper middle-income earners.

It states that three-wheelers are the most common type of vehicles in Sri Lanka except motorcycles. Motorcycles use

for private transportation while three wheelers are mostly used for providing Para-transit. By end-2016, there were 1,062,447 registered three-wheelers. Of course, we have more than thrice that number of motorcycles on roads (3,391,726 at end-2016), but the figure is significant compared to the numbers of cars (675,982), dual-purpose vehicles (366,831), motor Lorries (319,001) and buses (101,655). Growth in the number of three-wheelers is greater than in any other category. It has increased 261% since 2008. The number of cars has grown 177%, motorcycles 192%, dual-purpose vehicles 187%, lorries 121% and buses 126%, all far lower. Without doubt, Sri Lankan society has chosen the three-wheeler as its proffered mode of transport. This is a fact." (Wattegama, 2017)

Auto rickshaws are three-wheeled vehicles used extensively in many Asian countries as taxis of people and goods. Although the vehicle design is well-suited to the environment in which it operates, it is a crude, inefficient design. Due to poor vehicle maintenance and the use of inefficient 2 or 4 stroke engines with very little pollution control, auto rickshaws present a huge pollution problem in major Indian cities. (Mulhall, 2009)

To achieve research objectives GIS technical maps, movement pattern maps, sections, field observations, questionnaires can be used. (Weerasiri & Mendis, 2016)

As per the article written by Amal S. Kumarage (2009) the researcher has identified four reasons behind the emerging of Para transit modes which can be derived as follows.

- "First, Intermediate Public Transport modes have emerged spontaneously to fill perceived gaps in the conventional transport provisions in the urban areas. Growth in urban population and inadequate transport supply has become one of the major contributing factors for the rise in IPT markets."
- "Increased per capita income has greatly influenced the rapid increase of transport demand within the urban areas."
- Third, overcrowding, insufficient maintenance, poor management, and inadequate investment in existing transport infrastructures have stimulated the growing transport demand"

— “last, the lack of appropriate planning for metropolitan transport systems for the most cities in developing countries due to the requirement huge capital investment”

The first reason describes about the fact that inability of public transport modes which created gaps in the transport sector that had been gleefully accepted by the Para transit service providers. As an example, if public transporters are not able to provide a timely service to people they are looking for other ways of transport in order to fulfil their needs. So Para transit gets an unchallengeable opportunity to increase their service.

The second factor describes that, increase of income which increases the demand for transport as well. In that case also Para transit service providers get much better opportunity in the transport industry.

The third describes as poor quality in public transport service sector. So that people will move from public transport services to any other modes of transport services to get a better value for their money as well as the time and the best option for them is the Para transit services providers. Most visible example for that is the CTB bus services in rural areas, generally operate inadequately, providing Para transit service providers a better chance at any time.

Final factor describes management issues which create problems in the transport sector. Most suitable example for that is the congestion due to the inappropriate planning. Actually, public see that, due to Three wheelers, traffic congestion is increased, but from the point of view of Three-wheel passengers, they are using three-wheelers as a solution for traffic congestion, because the three-wheel drivers are very efficient on reaching the destination on time.

All these factors have considered in general manner. When it is connected to Sri Lankan context, we can get a proper image about the Para transit services which are mostly in line with the above-mentioned characteristics and so on. Three-wheeler can be identified as the most common and related way of Para transit method with reference to above mentioned characteristics.

Rose and Hensher, (2013) states in the research, that the demand for taxi services within a city depends on

the elasticity or preferences of individuals who use taxi services. People always make comparison between public, private transport and the Para transit with reference to the opportunity cost that they have to spend giving up one mode over other. He further elaborates on waiting time, crowding effect, and purpose of travelling, socioeconomic and other factors, illustrates on playing a vital role in selecting a taxi service.

Indians perspective towards three wheels

India is a country with large population and automatically makes high demand for transportation. In urban areas it is really high. Singh (2005) has introduced a series of policies which can be used as a path to resolve the demand issues of the transport sector in urban areas. Such as, paying attention more on bus and other related public transportation services, enhancing transport coordination, Restraining the use of polluting vehicles and fuel, demand and supply side management measures, encouraging of using more “green” modes and strengthening the urban authorities. These policies have suggested with the aim of reducing the congestion

Padam and Singh, (2004) stated about the transport issues of India as well as some solutions. In the absence of an efficient and adequate public transport, a large number of private and Para-transit modes have entered to the transport market in order to cater to the emerging demands of transportation, especially in Indian city centres and city limits. This prevailing regeneration of vehicles results in acute congestion, inordinate delays, critical accidents, high energy consumption particularly the non-renewable energies of fossil fuels, and intense growth of the population of the cities.

II. METHODOLOGY

Primary Survey

The research is conducted to find out the factors contributing high usage of three wheelers with special reference to the perception of passengers. First, the scope of the research was minimized by mentioning “with reference to the perception of passengers” for enhancing the simplicity of data collection. Colombo Metropolitan area was selected as the sample by the researcher due to time limitation and the cost. Through a literature review,

many factors identified by other researches as the demand for three-wheelers have been included in questionnaire and also, he has included some new factors as well with reference to the current situation of the country as well.

Sampling and Sampling Method

Researcher selected Colombo metropolitan area as the sample, because it is consisted with Large number of three-wheeler population (around 500,000 three – wheelers form 800,000) and large number of trips. under random sampling technique Researcher distributed his questionnaire for more than 500 passengers in the selected area with the intention of getting more than 300 replies back.

Data Collection

Researches has decided to collect Primary data though a survey questionnaire. Survey questionnaire was prepared according to the identified variables. A well-structured Questionnaire based on 5-point Likert scale was distributed randomly among users of Three-Wheeler transportation in Colombo metropolitan area to gather data.

III. MODEL DEVELOPMENT

Validity and Reliability

Before processing any kind of analytical method, the first thing that has to be done by any researcher is the reliability test. By a reliability test the researcher gets a clear idea about whether the data set is reliable or not. If data set is not reliable it is not much worthwhile to carry out the research. Also, reliable test provides much deeper idea about each variable and its influence towards the topic as well. From that, the researcher is able to get an idea about what are the variables which are highly influenced on the topic and the average variables influence on the topic. Cronbach's Alpha is the symbol that is used to measure the statistical reliability of collected primary data by using questionnaire. The higher the value of Cronbach's Alpha coefficient is considered as questionnaire is more reliable to collect primary data associated to the survey. Furthermore, Cronbach's Alpha coefficient require 0.7 or higher value to be reliable. Cronbach's Alpha coefficient

has been carried out in this study to check the reliability of the pilot survey and main survey. Following is equation used to calculate the Cronbach's Alpha coefficient.

$$\alpha = \frac{m_w(\sum_{s\lambda s}^{1/2} - 1)}{\sum_{s\lambda s}^{1/2}(m_w - 1)}$$

Data Analytical Method

Data gathered from the Questionnaire (both hard copies and Google forms) will be analysed in several steps with reference to the purpose of this research to be fulfilled successfully. Data analysing will be elaborated deeply in chapter 4 with the result that the researcher has obtained.

Software has been used to analyse the gathered data which is called as SPSS 16.0 (Statistical Packages for Social Sciences). For the data collected by distributing questionnaire among the passengers who use Three-Wheeler transportation, a descriptive analysis will be conducted which will be used to identify the relationship of the explanatory variables and the response variable.

After the collection of data as the next step, the researcher conducted a cross tabulation test as well which is also known as the Cross tab and Pearson's Chi-Square test which will be used to identify the relationship between categorical variables. After that the researcher is going to carry out a hypothesis testing for the considered factors which can be identified as independent variables as well and which are mentioned above to find out the connection between each explanatory variable and the response variable.

Factor Analysis

This is a statistical tool which is used to find factors among observed variables. Normally factor analysis is carried out to reduce the number of variables into grouping factors when the number of variables is high. Variables with similar characteristics are grouped under one factor. Through a factor analysis the researcher can make his factors in to small groups through the analysis. Then it is easy for any observer to get a clear idea about the variables as well. Multi-dimensional variables have been analysed in this factor analysis.

There are two types of factor analysis available, which are exploratory factor analysis and confirmatory factor analysis. This study uses the exploratory factor analysis method to the analyse data.

SPSS16.0 is the tool which is used to do the following test that comes under factor analysis and each of these analyses have different advantages on the research as well. Descriptive statistics, Bartlett's & Kaiser-Meyer-Olkin (KMO) test, Communalities, Total Variance, and Rotated Component Matrix are computed and analysed using software. The Bartlett's test compares the observed correlation matrix to the identity matrix. It checks whether there is a particular redundancy between the variables that can be summarized with a small number of factors. If the variables are perfectly correlated, only one factor is sufficient.

To make the data set accepted KMO value should be greater than 0.5 but the value of Bartlett's test should be greater than 0.7 in order be the test significant. KMO value is higher meaning higher correlation between pairs of variable. KMO measure the sampling adequacy of the research. KMO index can be computed as follow.

$$KMO = \frac{\sum_i \sum_{j=i} r_{ij}^2}{\sum_i \sum_{j=i} r_{ij}^2 + \sum_i \sum_{j=i} a_{ij}^2}$$

Communalities are the proportion of variance accounted for the common factors of a variable. Communalities scores range from 0 to 1. Value of 1 means that common factors will explain all variables and a value of 0 means that common factors will not explain all variables.

Initial solution table explained the total variance. Eigenvalue is the total variance described by each factor. Eigenvalues that is less than one does not have enough total variance explained to represent a unique factor. KMO and Bartlett's test analytical tools used to the factor analysis and fulfil the ultimate objective of the research. Tables, charts and figures generated through the SPSS output will be used to interpret the results with more validity as well as it can be used to demonstrate the results as well.

IV. OVERALL SUMMARY OF THE FACTORS

Dependent variable

Increasing the demand for Three Wheel Transportation

Independent Variable

1. Convenience
2. cost of transportation
3. vehicle prices
4. Online payment methods
5. Safety & Security
6. Availability of meters
7. Population
8. Income of the users
9. Time taken to reach destination
10. way of booking a three wheel
11. Low quality of service in public transport service
12. Limited private vehicle parking space in city area
13. availability of public and private transport services
14. Ticket price discounts & promotions
15. Availability in non-peak hours
16. Environmental impact
17. Weather condition
18. Tourism development
19. reputation of service provider/company
20. Congestion
21. Government policies
22. driver appearance
23. Do you identify three wheels as an alternative method of transportation

V. DATA ANALYSIS

Reliability

Reliability analysis allows the researcher to study the properties of measurements and scales and the items that compose scales. Reliability analysis calculates number of commonly used measures of scale reliability and also provides information about the relationships between individual items in the scale. Cronbach Alpha value is used to test under reliability analysis. If the value of Cronbach's alpha is higher than 0.6 or 0.7, it is in an acceptable level.

Table 1.2. Reliability for Full Data Set

Cronbach's Alpha	Cronbach's Based on Standardized Items	N of Items
.904	.906	23

Source: Research data

According to the table the value of Cronbach's Alpha is 0.904. That illustrates higher Cronbach's Alpha value which is greater than 0.6. Therefore, the reliability of variables is at acceptable level since data set can be accept

Table 1.3. Kaiser-Meyer-Olkin (KMO) and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.818
Bartlett's Test of Sphericity	Approx. Chi-Square 3817.851
	df 253
	Sig. .000

Source: Research data

The relationship of each variable as well as the strengthen among the variables is measured using Kaiser-Meyer-Olkin (KMO) and Bartlett's test. This is normally

Table 1.4. Communalities

	Initial	Extraction
Convenience	1.000	.798
cost of transportation	1.000	.714
vehicle prices	1.000	.761
Online payment methods	1.000	.670
Safety & Security	1.000	.678
Availability of meters	1.000	.615
Population	1.000	.763
Income of the users	1.000	.730
Time taken to reach destination	1.000	.695
way of booking a three wheel	1.000	.556
Low quality of service in public transport service	1.000	.672
Limited private vehicle parking space in city area	1.000	.595
availability of public and private transport services	1.000	.784
Ticket price discounts & promotions	1.000	.768
Availability in non-peak hours	1.000	.774
Environmental impact	1.000	.617
Weather condition	1.000	.557
Tourism development	1.000	.498
reputation of service provider /company	1.000	.629
Congestion	1.000	.873
Government policies	1.000	.627
driver appearance	1.000	.846
Do you identify three wheels as an alternative method of transportation	1.000	.494

Extraction Method: Principal Component Analysis.

identified as KMO test. KMO test statistics measure sample adequacy. In this test KMO test statistic value is 0.818, which is greater than 0.6 Since KMO test statistic is greater than 0.6, it can be concluded that sample is adequate. With reference to the given test statistic value and as it is more than 0.6

The hypothesis is given below,

H_0 : Correlation matrix is an identity matrix.

H_1 : Correlation matrix is not an identity matrix.

According to the table P-value of the Bartlett's test is 0.000, null hypothesis is rejected. It can be concluded that, correlation matrix is not an identity among variables used in factor analysis matrix which further supports the strength of the relationship.

VI. COMMUNALITIES

The table of communalities is the table which demonstrates how much of the variance in the variables has been accounted for by the take out from factors

Communalities table represents the amount of variance in each variable that can be explained by the retain factors after exaction. 79.8% of the variability in the model is explained by the convenience factor. The rest of the factors are interpreted the same way as factor one which is convenience.

The above table shows the eigenvalues associated with each linear component (factor) before extraction, after extraction and after rotation. As this factor analysis is doing for the Likert scale question in the questionnaire the software has identified 23 components (factors) before the extraction within the data set. The particular linear component is used to explain the eigenvalues associated with each factor which represents the variance.

Table 1.5. Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.957	34.597	34.597	7.957	34.597	34.597	3.531	15.350	15.350
2	2.187	9.509	44.106	2.187	9.509	44.106	3.408	14.819	30.169
3	1.963	8.534	52.640	1.963	8.534	52.640	3.011	13.092	43.261
4	1.384	6.016	58.656	1.384	6.016	58.656	2.272	9.878	53.139
5	1.203	5.232	63.889	1.203	5.232	63.889	1.924	8.366	61.504
6	1.018	4.424	68.313	1.018	4.424	68.313	1.566	6.809	68.313
7	.930	4.045	72.358						
8	.764	3.320	75.678						
9	.703	3.058	78.736						
10	.689	2.998	81.733						
11	.593	2.577	84.310						
12	.552	2.399	86.709						
13	.462	2.010	88.719						
14	.450	1.957	90.676						
15	.401	1.744	92.420						
16	.348	1.512	93.932						
17	.317	1.377	95.309						
18	.251	1.091	96.399						
19	.230	1.000	97.399						
20	.214	.931	98.330						
21	.180	.782	99.112						
22	.143	.621	99.733						
23	.062	.267	100.000						

SPSS output also shows the eigenvalue in terms of the percentage variance explained. The extraction sums of squared loading show the factors which met the criterions. SPSS extracts all the factors with eigenvalue greater than one. According to the table 1.5, there are six factors with eigenvalue greater than one. The “% of variance” column of the extraction sums of squared loadings part shows the amount of total variability that can be accounted by each of these factors. Factor 1 explains a variance of (15.350%). This table reveals that the first six factors explained relatively large amount of variance while other subsequent factors explain only small amount of variance. Factor 2, 3, 4, 5 and Factor 6 explain 14.819%, 13.092%, 9.878%, 8.366% and 6.809% of total variance respectively. Altogether these three factors explain the 68.313% of total variance.

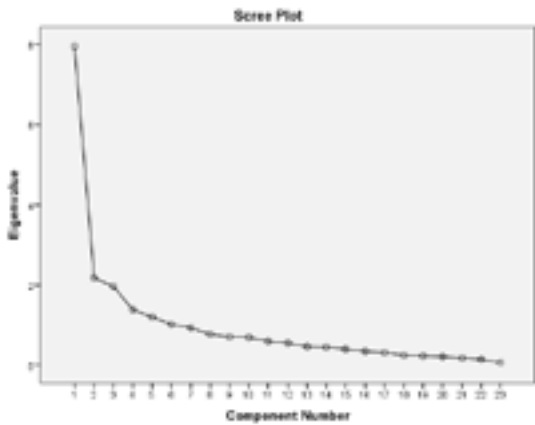


Figure 1.1. scree plot

According to figure 1.1, there is a sharp turn (elbow) after the 6th Eigen value. Therefore, it can be concluded that 6 factors are sufficient to account the total variation. It is further confirmed by the Extraction Sums of Squared Loadings. For further analysis, only six factors have retained.

Table 1.6 shows that how, all questions can be divided in to small groups as per the characteristics they belong. And the results of the factor grouping in factor one is similar in magnitude. This is always in line with other 5 factors as well. Identifying the factor loadings for each component is difficult. Thus, factors are rotated to obtain meaningful factors. Factor rotation has been done according to the varimax method. For further analysis, varimax rotation is taken into consideration.

With reference to the rotated component matrix the researcher uses it to mitigate the number of factors which are used to analyze the dependent variables. Factor rotation can be used to make interpretation simpler, but it doesn't make significance changes to the data set. In the case of interpretation factor rotation provide a path to identify each variable that comes under one factor. Without factor rotation matrix we cannot use component score coefficient matrix that use to illustrate each factor with all the available data.

Varimax Rotation method is used in this study. According to the rotated factor loadings, 23 variables can be categorized for extracted six factors as shown in the table 1.7.

As above mentioned with reference to the highest value of each variable the researcher is able to identify factor of the variable which it belongs to.

Now researcher has to group these variables as per the factors already been identified and he has to name each factor separately as per the characteristics of the variables

Factor 01 : Defined as Passenger Behavior

Factor 01 = f {Availability of meters, Population, Income of the users, Time taken to reach destination, way of booking a three-wheel, Low quality of service in public transport service.}

Factor 02 : Defined as quality of service and payments

Factor 02 = f {Convenience, cost of transportation, vehicle prices, Online payment methods, Safety & Security.}

Factor 03 : Defined as transport sector variables

Factor 03 = f {availability of public and private transport services, Ticket price discounts & promotions, Availability in non-peak hours, Environmental impact}

Factor 04 : Defined as infrastructure and policy making

Factor 04 = f {Congestion, Government policies, driver appearance}

Factor 05 : Defined as indirect factors

Table 1.6. Component Matrixa

	Component					
	1	2	3	4	5	6
Convenience	.664	.302	-.466	-.074	-.042	.207
cost of transportation	.630	.061	-.476	.006	-.037	.292
vehicle prices	.553	.328	-.539	.065	-.104	.205
Online payment methods	.419	.136	-.492	.104	.150	-.449
Safety & Security	.691	.035	-.427	.067	-.096	-.064
Availability of meters	.653	-.285	.067	-.308	.139	-.012
Population	.688	-.200	.141	-.372	.304	-.019
Income of the users	.637	-.123	.124	-.290	.388	.243
Time taken to reach destination	.660	-.350	.124	-.100	.332	.038
way of booking a three wheel	.724	.001	.078	.075	.132	.045
Low quality of service in public transport service	.734	-.111	.140	.259	.180	.027
Limited private vehicle parking space in city area	.571	-.213	.074	.448	-.015	.129
availability of public and privet transport services	.638	-.382	.260	.180	-.219	-.287
Ticket price discounts & promotions	.700	-.461	-.012	-.015	-.144	-.213
Availability in non-peak hours	.663	-.254	-.013	.013	-.502	-.130
Environmental impact	.685	-.040	-.047	-.247	-.288	.031
Weather condition	.516	.179	.434	.160	-.207	.041
Tourism development	.453	.224	.318	-.039	-.363	.092
reputation of service provider/company	.274	.366	.489	-.129	-.188	.358
Congestion	.557	.662	.240	-.071	.104	-.226
Government policies	.312	.281	.144	.567	.285	-.166
driver appearance	.509	.689	.196	-.087	.116	-.228
Do you identify three wheel as an alternative method of transportation	.111	-.164	.057	.535	.130	.384

Extraction Method: Principal Component Analysis

PROCEEDINGS

Factor 05 = f {Weather condition, Tourism development, reputation of service provider / company.}

Factor 06 : Defined as Methods and space

Factor 06 = f {Limited private vehicle parking space in city area, do you identify three wheels as an alternative method of transportation.}

Table 1.7. Rotated Component Matrix

	Component					
	1	2	3	4	5	6
Convenience	.221	.836	.082	.175	.124	.019
cost of transportation	.259	.778	.123	-.023	.044	.156
vehicle prices	.039	.849	.047	.155	.069	.088
Online payment methods	.079	.464	.230	.442	-.443	-.065
Safety & Security	.207	.671	.374	.180	-.082	.072
Availability of meters	.684	.182	.323	.030	.071	-.056
Population	.816	.136	.219	.138	.084	-.068
Income of the users	.803	.204	.005	.067	.170	.100
Time taken to reach destination	.751	.096	.272	.062	-.020	.208
way of booking a three wheel	.470	.297	.282	.275	.164	.254
Low quality of service in public transport service	.469	.206	.354	.280	.100	.442
Limited private vehicle parking space in city area	.218	.199	.406	.075	.087	.574
availability of public and private transport services	.299	-.033	.794	.131	.076	.199
Ticket price discounts & promotions	.448	.190	.722	-.012	-.065	.075
Availability in non-peak hours	.153	.314	.782	-.037	.196	.001
Environmental impact	.343	.429	.458	.025	.293	-.139
Weather condition	.130	.031	.345	.310	.525	.218
Tourism development	.064	.143	.315	.180	.585	-.001
reputation of service provider/company	.119	.016	-.052	.137	.769	.037
Congestion	.197	.218	.040	.794	.380	-.108
Government policies	-.005	.027	.052	.606	-.033	.505
driver appearance	.165	.232	-.010	.789	.350	-.138
Do you identify three wheel as an alternative method of transportation	.014	.041	-.027	-.120	.039	.689

Extraction Method: Principal Component Analysis

Table 1.8. Component Score Coefficient Matrix

	Component					
	1	2	3	4	5	6
Convenience	-.014	.323	-.126	-.063	.055	-.011
cost of transportation	.007	.314	-.111	-.169	.038	.089
vehicle prices	-.107	.353	-.096	-.060	.040	.050
Online payment methods	-.058	.085	.114	.306	-.393	-.115
Safety & Security	-.071	.204	.094	.017	-.107	-.019
Availability of meters	.256	-.037	.002	-.052	-.027	-.123
Population	.352	-.077	-.087	.012	-.047	-.131
Income of the users	.381	-.004	-.253	-.077	.046	.029
Time taken to reach destination	.305	-.085	-.066	-.018	-.094	.072
way of booking a three wheel	.102	.010	-.024	.057	.010	.111
Low quality of service in public transport service	.087	-.042	.009	.080	-.039	.238
Limited private vehicle parking space in city area	-.054	.010	.085	-.038	.015	.354
availability of public and privet transport services	-.067	-.162	.383	.064	-.051	.014
Ticket price discounts & promotions	.031	-.052	.296	-.034	-.113	-.069
Availability in non-peak hours	-.170	.044	.387	-.105	.086	-.109
Environmental impact	-.001	.107	.140	-.116	.146	-.180
Weather condition	-.093	-.071	.117	.066	.251	.097
Tourism development	-.118	.013	.125	-.032	.327	-.048
reputation of service provider/company	.007	.008	-.117	-.094	.474	.033
Congestion	.003	-.042	-.043	.380	.067	-.135
Government policies	-.077	-.090	-.022	.358	-.148	.330
driver appearance	.002	-.027	-.061	.384	.054	-.149
Do you identify three wheel as an alternative method of transportation	-.024	.044	-.126	-.132	.065	.520

Extraction Method: Principal Component Analysis

Factor1(passenger behavior) = 0.256Availability of meters+ 0.352Population+0.381Income of the users+0.305Time taken to reach destination+0.102way of booking a three wheel+0.087 Low quality of service in public transport service.

Factor2 (quality of service and payments) = 0.323 Convenience + 0.314 cost of transportation + 0.353 vehicle prices + 0.085 online payment methods + 0.204 Safety & Security.

Factor3 (transport sector variables) = 0.383availability of public and private transport services+0.296Ticket price discounts & promotions+ 0.387Availability in non-peak hours+ 0.140Environmental impact

Factor4 (infrastructure and policy making) = 0.380Congestion+0.358Government policies+ 0.384driver appearance

Factor5 (indirect factors) = 0.251Weather condition+ 0.327Tourism development+ 0.474reputation of service provider / company

Factor 6 (methods and space) = 0.354Limited private vehicle parking space in city area+ 0.520do you identify three wheels as an alternative method of transportation

VII. HYPOTHESIS TESTING

In this instance researcher has used the Chi-Square test to carry out the hypothesis testing. If there exists a statistically significant correlation between two variables, it is indicated by the P-Value or the (2-Tailed). Statistical software SPSS was used to test P-values for the research variables and the results obtained are presented below. By using hypothesis testing the researcher can develop two hypotheses as null hypothesis and alternative hypothesis which the researcher uses to interpret independent and dependent variables that he has taken in to consideration.

Hypothesis test for factor 01 (passenger behavior)

H_0 : identifying three-wheeler as an alternative method of transportation is independent from factor1 (passenger behavior)

H_1 : identifying three-wheeler as an alternative method of transportation is dependent from factor1 (passenger behavior)

Table 1.9. Chi-Square Test for passenger behavior

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1156.000a	592	.000
Likelihood Ratio	560.974	592	.816
Linear-by-Linear Association	.056	1	.813
N of Valid Cases	289		

Source: Research data

According to the above result, it is understood that 2-tailed or significant value is 0.000, and H_0 ($0.05 > 0.000$) is rejected, H_1 is accepted. Therefore, it can be stated that identifying three wheels as an alternative method of transportation is depend on the passenger behavior.

Hypothesis test for factor 02 (quality of service and money)

H_0 : identifying three wheels as an alternative method of transportation is independent from factor 02 (quality of service and money)

H_1 : identifying three wheels as an alternative method of transportation is dependent from factor 02 (quality of service and money)

Table 1.10. Chi-Square Test for transport sector variables Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1156.000a	592	.000
Likelihood Ratio	560.974	592	.816
Linear-by-Linear Association	.483	1	.487
N of Valid Cases	289		

Source: Research data

As per the above result, it is understood that 2-tailed or significant value is 0.000, and since H_0 ($0.05 > 0.000$) is rejected, H_1 is accepted. Therefore, it can be stated that identifying three wheels as an alternative method of transportation is depend on the quality of service and money.

Hypothesis test for factor 03 (transport sector variables)

H_0 : identifying three-wheeler as an alternative method of transportation is independent from factor 03 (transport sector variables)

H_1 : identifying three-wheeler as an alternative method of transportation is dependent from factor 03 (transport sector variables)

Table 1.11. Chi-Square Test for indirect factors

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1156.000a	592	.000
Likelihood Ratio	560.974	592	.816
Linear-by-Linear Association	.217	1	.641
N of Valid Cases	289		

Source: Research data

As per the above result, it is understood that 2-tailed or significant value is 0.000, and since H_0 ($0.05 > 0.000$) is rejected, H_1 is accepted. Therefore, it can be stated that identifying three-wheeler as an alternative method of transportation is depend on the transport sector variables.

Hypothesis test for factor 04 (infrastructure and policy making)

H_0 : identifying three-wheeler as an alternative method of transportation is independent from factor 04 (infrastructure and policy making)

H_1 : identifying three-wheeler as an alternative method of transportation is dependent from factor 04 (infrastructure and policy making)

Table 1.12. Chi-Square Test for infrastructure and policy making.

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1156.000a	592	.000
Likelihood Ratio	560.974	592	.816
Linear-by-Linear Association	4.137	1	.042
N of Valid Cases	289		

Source: Research data

As per the above result, it is understood that 2-tailed or significant value is 0.000, and since H_0 ($0.05 > 0.000$) is rejected, H_1 is accepted. Therefore, it can be stated that identifying three-wheeler as an alternative method of transportation is depend on the infrastructure and policy making.

Hypothesis test for factor 05 (indirect factors)

H_0 : identifying three-wheeler as an alternative method of transportation is independent from factor 05 (indirect factors)

H_1 : identifying three-wheeler as an alternative method of transportation is dependent from factor 05 (indirect factors)

Table 1.13. Chi-Square Test for indirect factors

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1156.000a	592	.000
Likelihood Ratio	560.974	592	.816
Linear-by-Linear Association	.428	1	.513
N of Valid Cases	289		

Source: Research data

As per the above result, it is understood that 2-tailed or significant value is 0.000, and since H_0 ($0.05 > 0.000$) is rejected, H_1 is accepted. Therefore, it can be stated that

identifying three-wheeler as an alternative method of transportation is depend on the indirect factors.

Hypothesis test for factor 06 (methods and space)

H₀: identifying three-wheeler as an alternative method of transportation is independent from factor 06 (methods and space)

H₁: identifying three-wheeler as an alternative method of transportation is dependent from factor 06 (methods and space)

Table 1.14. Chi-Square Test for methods and space Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1156.000a	592	.000
Likelihood Ratio	560.974	592	.816
Linear-by-Linear Association	136.820	1	.000
N of Valid Cases	289		

Source: Research data

As per the above result, it is understood that 2-tailed or significant value is 0.000, and since H₀ (0.05>0.000) is rejected, H₁ is accepted. Therefore, it can be stated that identifying three wheelers as an alternative method of transportation is depend on the methods and space.

VIII. RELIABILITY ANALYSIS FOR IDENTIFIED FACTORS

Table 1.15. Reliability analysis for factor 1

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.862	.864	6

Source: Research data

Table 1.15 shows the Cronbach's Alpha value as 0.862. That illustrates higher Cronbach's Alpha value. Therefore, the reliability of the variables is at a high level. since data set can be accepted. This means the variables included in the factor 1(passenger behavior) is reliable with the data set. So factor 1 can be considered as a reliable factor.

Table 1.16. Reliability analysis for factor 2

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.848	.849	5

Source: Research data

The Cronbach's Alpha in table 1.16 is 0.848. That illustrates higher Cronbach's Alpha value. Therefore, the reliability of the variables is at a high level since data set can be accepted. This means the variables which included in the factor 2(quality of service and money) is reliable with the data set. So, factor 2 can be considered as a reliable factor.

Table 1.17. Reliability analysis for factor 3

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.833	.836	4

Source: Research data

Table 1.17 shows Cronbach's Alpha value as 0.833. That illustrates higher Cronbach's Alpha value. Therefore, the reliability of the variables is at a high level. hence, data set can be accepted. This means the variables which included in factor 3(transport sector variables) is reliable with the data set. So, factor 3 can be considered as a reliable factor.

Table 1.18. Reliability analysis for factor 4

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.731	.753	3

Source: Research data

Table 1.18 shows Cronbach's Alpha value as 0.731. That illustrates higher Cronbach's Alpha value. Therefore, the reliability of the variables is at a high level since data set can be accepted. This means the variables which included in the factor 4 (infrastructure and policy making) is reliable with the data set. So, factor 4 can be considered as a reliable factor.

Table 1.19. Reliability analysis for factor 5

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.590	.592	3

Source: Research data

Table 1.19 shows the Cronbach's Alpha value as 0.590. That illustrates lower Cronbach's Alpha value. Therefore, the reliability of the variables is very less. Hence, the data set cannot be accepted.

Table 1.20. Reliability analysis for factor 6

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.357	.383	2

Source: Research data

According to the table 1.20, the value of Cronbach's Alpha is 0.357. That illustrates very less Cronbach's Alpha value. Therefore, the reliability of the variable is very less

Finally, according to the analysis, following 4 factors can be identified as the most influential factors of the demand for three - wheelers

1. Passenger behavior (The desire to reach destination early)
2. Quality of the service and ease of payment
3. Transport sector variables, such as frequency and ease of booking
4. Infrastructure of policy making (Traffic congestion and weaknesses in bus transportation)

IX. LIMITATIONS OF RESEARCH

There are certain limitations to this study. This study was carried out for a sample population who uses Three Wheelers in Sri Lanka and in Colombo district and only consider the ideas of passengers as well to collect the data. This study is limited to the Sri Lankan geographical context and the questionnaires were distributed to the sample of such randomly selected commuters.

X. CONCLUSION

According to the analysis of demographic factors, it is identified that, majority of the population below the age of 60 are using three-wheelers. Many of them are at the age between 20-35. Majority of the middle-income earners are using three-wheelers as a mode of transport. They are indicating that it saves their time as the drivers are easily reaching to the destination. Further they state that, though it little bit costly with compared to buses, mainly for short distances (Less than 5 Km) the best way is to go by a three-wheeler if they do not have a private vehicle to go. They do not say that three-wheeler fare is not affordable for short distances. Actually, these people are highly dissatisfied to go by bus for short distances.

Apart from these demographic factors, based on the factor analysis researcher identified, four main factors which are highly influencing on the demand for three - wheelers

Factor 1 – Passenger behaviour

With compared to bus transportation, consumers see the time taken to reach the destination is very low and efficient by three-wheelers and fare is considered by them as affordable.

Factor 2 – Quality of service and payment

With compared to public sector transport services it is evidenced that it will be more convenient for passengers to travel short distance by a three-wheeler. Communality table also proved that 79.8% of the variability in the model was explained by the convenience factor.

Factor 3 – Transport sector variables

This factor indicates the frequency for a passenger for booking a three-wheeler. Especially with the online booking systems and due to the availability in non-peak hours, people are selecting this as a mode.

Factor 4 – Infrastructure and policy making

weaknesses in current public transport infrastructure facilities and not having a sustainable policy of improving them, lead for the passengers to use an affordable and a convenient a mode of transport.

XI. RECOMMENDATIONS

Three – wheelers from one side is a burden and also a solution, as it is acting as an affordable solution for middle income earners. But the great issue is three - wheelers lead to have road accidents and traffic congestion. Therefore, the researcher takes the output generated from the research to recommend some suggestions to mitigate these issues.

The public transportation in Sri Lanka is at a very ground level. Very crowded and time consuming, so it is obvious for increasing the demand for three – wheelers as majority of people are middle income earners. So, the policy makers must put their eye on the weaknesses of the public transportation of our country. While upgrading the quality of public transport, government should gradually reduce the importation of three – wheelers.

People are demanding three – wheelers due to the convenience factor and these are seemed to be like ambulances in emergency cases. the best example is in a situation like a snake bite. As an unregulated transport mode, this might be a main cause for road accidents. Therefore, it is important to bring regulations such as supervision of three – wheelers by a state body, introduction of code of ethics and training the drivers to enhance the quality of them. These actions will lead to reduce some social issues arising due to three wheelers such as illegal drugs transportation.

More suggestions can be recommended as, developing reasonable guidelines for locating three – wheeler parks as many of them are located near road intersections, negatively affect for the traffic flow.

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