

**PRIORITY INTERVENTION AREAS FOR THE
IMPROVEMENT OF PUBLIC TRANSPORT IN THE
CONTEXT OF TOURISM: INSIGHTS FROM
ALAPPUZHA**

PROJECT REPORT

Submitted by

HAFEES MOHAMMED A

ROLL NO. : TKM20CETE05

to

the A P J Abdul Kalam Technological University

in partial fulfillment of the requirements for the award of the Degree

of

Master of Technology

in

Transportation Engineering



DEPARTMENT OF CIVIL ENGINEERING

T.K.M. College of Engineering, Kollam

July 2022

DECLARATION

I undersigned hereby declare that the project report “Priority Intervention Areas For The Improvement Of Public Transport In The Context Of Tourism: Insights From Alappuzha”, submitted for partial fulfillment of the requirements for the award of degree of Master of Technology of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Dr. Munavar Fairouz C. This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

Kollam
06-07-2022

HAFEES MOHAMMED A

DEPARTMENT OF CIVIL ENGINEERING
T.K.M. COLLEGE OF ENGINEERING, KOLLAM



CERTIFICATE

Certified that this report entitled '**PRIORITY INTERVENTION AREAS FOR THE IMPROVEMENT OF PUBLIC TRANSPORT IN THE CONTEXT OF TOURISM: INSIGHTS FROM ALAPPUZHA**' is the report of project presented by **HAFEES MOHAMMED A, Roll No.:TKM20CETE05** during **2021-2022** in partial fulfillment of the requirements for the award of the Degree of Master of Technology in Transportation Engineering of the A P J Abdul Kalam Technological University.

Guide

Project coordinator

Head of the Department

Dr. Munavar Fairouz C

Assistant Professor

Dept. of Civil Engg.

Dr. Kavitha Madhu

Associate Professor

Dept. of Civil Engg.

Dr. Sajeeb R

Professor

Dept. of Civil Engg.

ACKNOWLEDGEMENT

I take this opportunity to express my deep sense of gratitude and sincere thanks to all who helped me to complete the project successfully.

I am deeply indebted to my guide, **Dr. Munavar Fairooz C**, Assistant Professor, Department of Civil Engineering for his excellent guidance, positive criticism and valuable comments.

I am greatly thankful to my project coordinators, **Dr. Kavitha Madhu**, Associate Professor, **Prof. Meenu Tomson**, Assistant Professor and **Prof. Jijin A**, Assistant Professor, Department of Civil Engineering for their constant supervision as well as for providing necessary information regarding the seminar.

I am greatly thankful to **Dr. Sajeeb R**, Professor and Head of the Department of Civil Engineering for his kind support.

Finally, I thank my parents and friends who directly and indirectly contributed to the successful completion of my project.

HAFEES MOHAMMED A

ABSTRACT

One of the key elements of tourism activities is transportation. Transportation plays a large role in the growth of tourism, and the interaction between the two is crucial. Tourism is one of the world's fastest expanding economic industries, and has experienced substantial expansion over the years. In order to assure connectivity to tourist sites and to suggest changes to public transportation, the major goal of this project is to identify key intervention areas. In a nation like India, the development of the public transportation system with regard to tourism has not been studied in great detail. The project's goal is to identify factors that could have an impact on tourists' use of public transportation and increase efficiency by offering alternatives. A questionnaire survey has been used to gather tourist perceptions of various attributes, and an improved importance performance analysis using fuzzy c-means clustering will be performed. This will undoubtedly suggest a strategy for enhancing a location's tourist appeal using public transportation. These attributes' primary intervention areas has been noted, along with potential alternatives. Economic analysis has also been performed to determine the cost and benefit of the suggested system. The tourism industry places a lot of emphasis on transportation, which also serves as a major engine for socioeconomic development. It not only makes it easier for tourists, but also will help business travelers, those visiting friends and family, and people engaging in educational and health tourism to get around. Through this research, the potential for integrating the development of tourism and public transportation is being explored. We can increase the overall tourism appeal of the locations by enhancing the connectivity using public transportation for the various destinations.

Keywords: *Public transport planning, Tourism*

TABLE OF CONTENTS

ACKNOWLEDGEMENT	i
ABSTRACT	ii
LIST OF FIGURES	v
LIST OF TABLES	vi
1. INTRODUCTION	1
1.1 Problem Statement	2
1.2 Gaps Identified	3
1.3 Objectives	3
1.4 Methodology	4
1.5 Scope	4
2. LITERATURE REVIEW	5
2.1 Significant Factors	5
2.2 Satisfaction of Tourists	6
2.3 Public Transport and Tourism	8
2.4 Connectivity with Destinations	10
2.5 Case Study	12
2.6 Methodological Aspect	13
3. METHODOLOGY	16
3.1 Economic Analysis	20
3.2 Pilot Survey	20
4. DATA COLLECTION FOR STUDY	21
5. ANALYSIS FOR STUDY	24

5.1 Partial Correlation Analysis	24
5.2 Cluster Analysis	25
5.3 Factor Structure of The Respondents	25
5.4 Management Scheme	29
5.5 Priority Areas Identified	32
5.6 Economic Analysis	33
5.7 Scenario Analysis	37
5.8 Recommendations	38
6. RESULTS	39
7. CONCLUSION	40
8. FUTURE SCOPE OF WORK	41
REFERENCES	42
APPENDIX	45

LIST OF FIGURES

2.1	Destinations of tourists from the airport	9
2.2	(a) The number of empirical papers using computable general equilibrium (CGE) models to analyze the relationships among tourism, transportation, and the economy; and (b) The number of empirical papers using CGE models to analyze the transportation-tourism relationship.	10
3.1	Quadrant system of IPA	16
3.2	Methodology for identifying priority areas of intervention	18
4.1	Age distribution of tourists	21
4.2	Gender distribution of tourists	22
4.3	Educational qualification of tourists	22
4.4	Occupation of tourists	22
4.5	Income distribution of tourists	23
4.6	No. of cars in household of tourists	23
5.1	Clusters of factored structure	25
5.2	Factored structure	28
5.3	Clusters of management scheme	29
5.4	Management scheme	31

LIST OF TABLES

2.1	Purpose of trip	11
5.1	Derived importance value by partial correlation	24
5.2	Membership degree of factored structure	27
5.3	Membership degree of management scheme	30
5.4	Generation of Alternate Improvement scenario	34
5.5	Cost Analysis	35
5.6	Benefit-Cost ratio analysis	36

1. INTRODUCTION

Tourism is the industry which is being more promising for many countries throughout the world in the past years and in the coming future. People has been all around the globe as tourists due to the improvement of transportation system. One of the key elements of tourism activities is transportation. Transportation plays a large role in the growth of tourism, and the interaction between the two is crucial. It overrides physical, social, and economic growth. It meets the physical limitations of distance and the requirement for human mobility through space. It serves as a bridge between the starting point and ending point of travel. Numerous modes of transportation enable the movement of people on a national and international scale. At a fair price, millions of tourists are transported safely, quickly, and comfortably to their destinations. In actuality, transportation and the infrastructure that goes along with it have greatly aided human mobility. Through the production of jobs, businesses, infrastructure, and revenue, tourism is essential to the socioeconomic and cultural development of a country. Transport is one of the fundamental infrastructure elements that must be developed in concert with tourism. The tourism industry places a lot of emphasis on transportation, which also serves as a major engine for socioeconomic development. Transport is one of the essential components of tourism activities.

The United Nations World Tourism Organization (UNWTO) reported a 4.4 percent increase in travellers in 2015, totalling 1,184 million. The second-largest sector in India in terms of employment potential is tourism, according to the Planning Commission. The majority of semi-skilled individuals are employed in tourism-related support activities. A country's ability to maintain economic growth and development is greatly influenced by its transportation infrastructure.

The relationship between transport and tourism development is very important because it contributes significantly in the development of tourism. The study of development of public transportation system with respect to tourism has not been done extensively in a country like India. Mostly public transport services are being studied with quantitative attributes like price, speed etc. But in tourism context, it mainly depends on the qualitative attributes like comfort, leisure experience etc. So, it can also be studied and improved. Due to covid 19 crisis, tourism sector is the most affected sector. By improving the transport facilities by understanding the requirements of people using, we can improve the tourism attraction of the destination.

Here comes the need for the development of structure for public transport facilities that are more comfortable to the tourists coming to the destination. For this purpose, we analyse the user perception of tourists towards the various attributes in the public transport facility. Also, an economic analysis will be explained to select the best-case scenario for the improvement of the system. All the above project will be done at an area of Alappuzha. People prefer to visit more and more destinations in a shorter amount of time due to the fast-paced nature of life. The tourism industry is changing into a new viewpoint with the development of new effective transportation modes including aircraft, quick trains like the Shatabdi, Rajdhani and Duranto, as well as good roads like the Expressway from Delhi to Agra. Regarding travel and tourism, each and every form of transportation has its own unique qualities.

The tourism improvement techniques through public transport can only made by the policy changes by the government. By this way, we can change the people using private vehicles to public transport system and thereby we can make income for the government sector. This will flourish the overall economy of the state or nation. The connection between the tourist-generating and destination places is made possible by transportation. The speed of a tourist flow is determined by a transport system's capacity. In addition to expanding the transit system's capacity, incentives include the provision of comfort, safe, moderately fast speeds, ticket savings, and light refreshments. It improves the tourism industry in certain places. Travellers' transportation-related experiences, whether positive or negative, can sometimes linger in their minds for the rest of their lives. Therefore, it is evident that the expansion of the tourist transportation system is crucial.

1.1 Problem Statement

One of the key elements of tourism activities is transportation. Because transportation plays a large role in the growth of tourism, the interaction between the two is crucial. The tourism industry places a lot of emphasis on transportation, which also serves as a major engine for socioeconomic development. One of the world's fastest expanding economic industries, tourism has experienced substantial expansion over the years. In order to assure connectivity to tourist sites and to suggest changes to public transportation, the major goal of this project is to identify key intervention areas. In a nation like India, the development of the public transportation system with regard to

tourism has not been studied in great detail. The project's goal is to identify the key factors that could have an impact on tourists' use of public transportation and to increase efficiency by offering alternatives. Tourists' impressions of various aspects will be gathered using a questionnaire survey, and their responses will be analyzed for importance and performance using clustering algorithms. The key intervention areas of these attributes will be identified and will be suggested with alternatives. The tourism industry places a lot of emphasis on transportation, which also serves as a major engine for socioeconomic development.

1.2 Gaps Identified

- The study of development of public transportation system with respect to tourism has not been done extensively in a country like India. So the development of a plan with accordance with the tourism possibilities can improve the tourism sector and economy.
- Mostly public transport services are being studied with quantitative attributes like price, speed etc. in tourism context, it mainly depends on the qualitative attributes like comfort, leisure experience etc. so it can also be studied and improved.

1.3 Objectives

The objectives of the proposed study are as follows:

- Identifying key intervention areas for the improvement of Public Transport to ensure better connectivity to tourist destinations.
- To suggest recommendations for improvements of Public Transport with reference to Alappuzha.
- To do an economical analysis based on the improvements needed according to the key intervention areas identified.

1.4 Methodology

The methodology planned in order to achieve the mentioned objectives is described below:

- **Study of literature-** thorough background study has been done in the field of public transport and tourism for the identification of attributes and preparation of questionnaire.
- **Data collection-** A pilot survey is conducted at Alappuzha at various tourist destinations for the initial collection of data. The perception of tourist towards various attributes have been collected. 30 responses have been taken as an initial pilot survey.

Importance and satisfaction of various attributes are being collected. Origin and destination data are being collected. The mode of travel details is collected. Also, the socio-economic characteristics are also being collected

- **Analysis of data-** Analysis of data is being done by a modified form of Importance Performance analysis.

1.5 Scope

- The study is limited to the perception of tourists in Alappuzha.
- The study includes analysis of user perception data in terms of perceived importance and satisfaction.
- Recommendations made would be based on the identified interaction areas.
- Economic analysis is done based on the similar condition transport system at Alappuzha.

2. LITERATURE REVIEW

2.1 Significant Factors

According to Antoniou et al. (2013), service production—which includes route frequencies and service reliability—is the most important aspect for tourists to consider when determining whether to use public transportation. Instead, residents place a greater emphasis on qualitative factors like comfort, safety, and knowledge. Furthermore, transfer quality, which includes characteristics linked to transfer coordination, is a consistent criterion that ranks well in both tourists' and locals' preferences. It also describes how the local government can make necessary adjustments to their policy plans and outline activities to better address the needs and expectations of locals and visitors. Most of the time, transportation and tourism are treated as separate industries, especially by local public and private organizations. While transportation planners frequently overlook or underestimate the impact of tourist mobility on overall mobility of the tourist area, tourism planners typically concentrate their efforts on marketing the destination and managing tourism, demand, and supply. Without transportation, tourism would not exist. Therefore, it is crucial for scholars looking at either one or both of these industries to approach the subject of visitors' movement from a wider angle.

According to Gronau et al. (2007), the fundamental prerequisites for effective public transportation during leisure time are summed up in. At a particular vacation spot or recreational facility, it is crucial to identify the target groups. The development of a public transportation system should only be explored in situations where visitors have a certain propensity for using it; in other cases, the response potential is unlikely to be adequate. The quality of public transportation throughout the facility's full catchment region is the second area of concern. It must be made sure that a potential buyer may easily get to the starting point.

The status of the rival should also be taken into account because the degree to which a public transportation over fulfils a demand-side response is also determined by the link between the requirements for using a private vehicle and the standard of public transportation. It only makes sense to assess whether the availability of public

transportation at the given location is adequate if these fundamental demand side factors and those pertaining to the competitive environment are favourable. When attempting to construct a public transportation system over for leisure and tourism purposes, this is all too frequently the only factor that is taken into consideration. After a new service has been launched, another success factor—intense, innovative, and ongoing market communication—adds the finishing touches.

2.2 Satisfaction Of Tourists

Le-Khlan et al. (2015) assert that transportation is a crucial component of tourism systems. Tourism cannot exist without transportation, hence sustainable tourism and sustainable mobility are closely related. A key factor in the development of sustainable tourism is public transportation. The use of public transportation by tourists at the places, however, is not well documented. The comprehension of the elements influencing tourists' perceptions of public transportation is improved by this paper. Comfort, services, accessibility, and others were designated as the four service aspects. Tourists gave Munich's public transportation a positive review, and their opinions are often unaffected by other considerations. The systems' punctuality, dependability, network connection, and frequency of service received the highest marks from passengers. The lowest rating was given to the ticket price, which was considered "expensive" and "complex." Improvements to the waiting areas at bus stops and train stations were also suggested by visitors. Additional focus is also needed on the vehicle's cleanliness, the staff's demeanor, and the availability of seats and space.

Despite having numerous positive economic and social effects, tourism also has drawbacks, particularly with regard to the environment. 4.4 percent of all CO₂ emissions from tourism are caused by transportation, which accounts for 75 percent of that total. Transport is unquestionably an essential part of the tourism system and affects how tourists are received at their destination. There is proof, for instance, that a visitor's happiness with the location may be influenced by their experience using public transportation. A key factor in the development of sustainable tourism is public transportation. However, having a top-notch and efficient system is crucial to encouraging the usage of public transportation. Demand-driven transportation services require a thorough understanding of consumer behavior. This essay investigates how

tourists use public transportation in the German city of Munich. It aims to comprehend how travelers view public transportation and what influences their satisfaction. In both transportation research and practice, measuring customer satisfaction with public transportation services has long been a key topic. Nine aspects of the service were evaluated. According to the author, there is no connection between contentment and how frequently people utilize urban transit. The use of public transportation was highest in urban areas, then in towns with populations more than 50,000. Little transportation was used in smaller towns and suburbs. In addition, satisfaction levels tended to be highest in small towns and lowest in cities.

According to Yuksek et al. (2016), the goal of the study is to compare the effectiveness of local transportation to traveler satisfaction. When the issue was examined from this angle, it was determined that just one (staff) of the five local transportation factors had no appreciable impact on traveler satisfaction with the location. According to the model created by the local transportation factors having significant influence on destination satisfaction, the local transportation destination satisfaction accounts for a total of 22.90% of the variance.

When the impact of local transportation factors on satisfaction at the destination was examined separately, it was found that while infrastructure had an explanatory power of 14.30 percent, the explanatory powers of the other factors were 4.40 percent for ease of use, 3.50 percent for timing, and 2.00 percent for physical condition. According to the study's findings, local transportation significantly affects how happy travelers are with their destinations. The satisfaction of destination visitors who depend on local transportation must therefore be given more consideration by destination management organizations or decision-makers. It is crucial to keep in mind that the infrastructure and accessibility of local transportation have a big impact on how happy travellers are with their destinations overall. Researchers who are interested in this topic might carry out studies in several locations to see if they can produce similar outcomes.

2.3 Public Transport And Tourism

Public transportation is frequently suggested as one of the foundations to address environmental challenges, thus it should be an evident and in-depth topic in tourism studies. The authors claim that "Tourism, Public Transport, and Sustainable Mobility" is relevant because their research interests, which they have developed over the course of their academic careers, have converged. The book discusses issues that are highly relevant in today's world but whose analysis is scarce in tourism literature. Its relevance stems from the fact that it has a set of topics that may be used as a starting point for discussion on how public transportation and tourism are related. The book's Introduction states that its goal is "to explore the crucial role that transportation plays in tourism with respect to movement, as well as its contribution to the visitor experience and its significance for destination and tourism sustainability."

(1) There is a pressing need to address environmental issues in many facets of modern life, maybe even more so when considering the connection between travel and tourism. Routines related to travel and tourism in the Global North (which are gradually imitated in the Global South) significantly contribute to CO₂ emissions as well as other effects brought on by the use of fossil fuels and the growth of tourist flows themselves. Therefore, even though it is not usually covered in-depth in other textbooks and publications that deal with tourist and transportation issues, the book makes a clear statement by positioning sustainability as an all-encompassing topic.

(2) A topic that is urgently needed in transportation studies that look at the experiences of users (in this case, tourists) of various modes of transportation rather than just the operation of transportation systems.

Xue et al. (2014) suggested approaches to distinguish commuters using public transportation from visitors. For both corporate and public stakeholders, it is crucial to comprehend how tourists travel because doing so could help them develop new economic prospects or enhance their current services.



Fig 2.1: Destinations of tourists from the airport (Xue et al. 2014)

Understanding how tourists use public transportation (PT) at the destination is crucial for sustainable mobility, destination satisfaction, public transport management, and destination management, according to Le Khlan et al. (2014). The review identifies key problems and concerns, such as how public transport is applied to tourism in various situations. Additionally, it outlines possible topics for further research and suggests policies and tactics for a public transport modal shift in the tourism industry. The analysis reveals that the amount of public transport use by visitors varies between rural and urban destinations. Although the situation is more encouraging in urban locations, public transport is frequently not preferred by tourists in distant locations. Given tourist motives and habits, as well as the availability of visitor-oriented public transport services, including the requirement for effective communication and social marketing techniques, the potential of public transport as an alternative mode of travel overall remains unknown. This report gave a summary of public transport and tourism research done since 2000. Significant inferences could be made. The amount of public transport use by tourists varies across rural and urban places. While the situation in urban regions is more hopeful than it is in remote areas, there is no evidence to suggest that city visitors are more conscious of their environmental consequences or that they have any particular preferences for public transport. Given tourist motives and habits, as well as the availability of visitor-oriented public transport services, including the requirement for effective communication and social marketing techniques, the potential of public transport as an alternative mode of travel overall remains unknown.

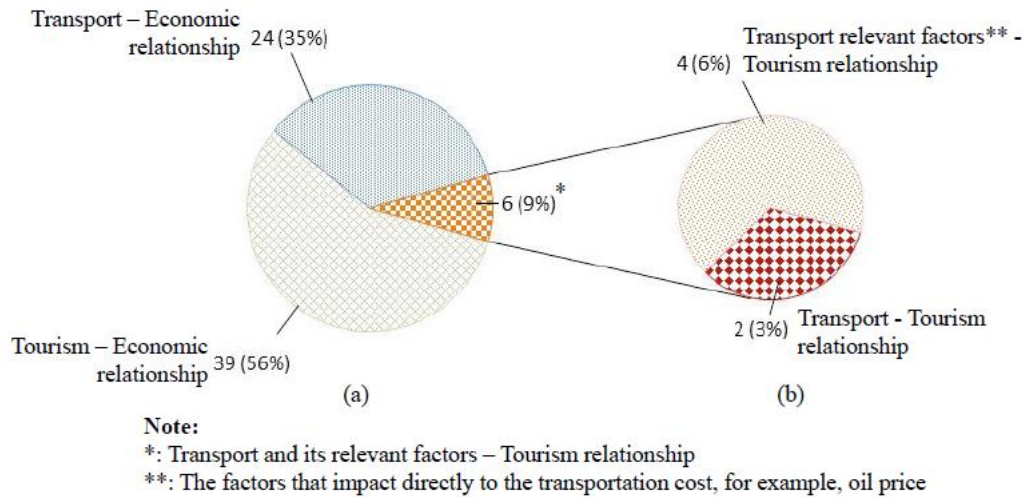


Fig 2.2: (a) The number of empirical papers using computable general equilibrium (CGE) models to analyze the relationships among tourism, transportation, and the economy; and (b) The number of empirical papers using CGE models to analyze the transportation-tourism relationship (Le-Klähn et al. , 2015).

2.4 Connectivity With Destinations

According to Yang et al. (2019), both modes of transportation have a considerable impact on improving connections between cities in terms of visitor flows, with indirect connectivity impacts that are as significant but of a lesser degree. We discovered that among various connection metrics by train type, conventional trains promote intercity tourist flows more than bullet and high-speed trains, and originating and/or ending trains are significantly more influential than enroute trains in boosting tourist flows. Based on origin to-destination, the effects of transportation connectivity and air-rail competitiveness differ. Although the impact of air travel connectivity grows as a city pair's separation increases, high-speed trains and bullet train impacts only matter for city pairs with short and medium separations. Finally, the findings demonstrate that the air-rail intermodal rivalry effect typically intensifies with distance.

Lumsdon et al. (2006) identified a number of key factors that could motivate certain user groups to consider and then implement a modal shift in the Greater Manchester area day visit market. The preliminary results support prior research in the subject that indicates the need for a more thorough investigation of the motivational elements of the day visitor market. This is done specifically in regard to the intrinsic worth of the trip itself, as well as in various contexts to create a reliable model that can be used more widely. In order to support more sustainable transport development that appeals to a vibrant, tourism-focused market, this will serve to enlighten those responsible for the development of mobility management and the improvement of public transport quality. This is important because domestic travel demand is rising across the board in many industrialized economies.

Table 2.1: Purpose of trip (Lumsdon L et al. 2006)

<i>Purpose</i>	<i>Frequency</i>	<i>Percent</i>
Touring the NW region	411	32.6
Recreational activities	268	21.3
Visiting friends/ relatives	158	12.5
Shopping	152	12.1
Visiting attractions	137	10.9
Attending cultural/ sporting events	66	5.2
Work-related journeys	23	1.8
Educational visits	16	1.3
Other	21	1.8
No response	9	0.7
Total	1261	100.1

The three study goals—user profile, use motivations, and modal shift—have all been investigated. The Wayfarer ticket appeals to people over 35, and especially to older age groups looking to take day trips by public transportation, according to an examination of the poll results.

According to Gutiérrez et al. (2016), the empirical data the model produced allowed for the identification of the profile of visitors who were most likely to use public transportation when visiting Costa Daurada's neighboring districts. The socioeconomic

and demographic characteristics of the visitors, such as their age, education level, social class, or country of origin, have an impact on how they use public transportation at their destination, as has been reported for prior studies. The social class and the nation of origin were the factors that affected our situation the most. The literature has emphasized the relevant factors of their stay, such as the amount spent, the party structure, the duration of their stay, their familiarity with the location, or the type of lodging.

French visitors demonstrated a higher likelihood of choosing a private car when PT and that mode of transportation were compared. However, study became out that travelers who had to drive the furthest to go to the Costa Daurada were more likely to increase their usage of PT than a private vehicle. Another important aspect that affected selections about the best mode of transportation was accommodations. Compared to visitors staying in four- and five-star hotels, those staying in one-, two-, and three-star accommodations were more likely to travel by automobile. It was concluded that the primary factor in determining whether a tourist utilized PT during their stay was the availability of a private car, with other factors having a less significant impact.

2.5 Case Study

According to Nwachukwu et al. (2019), tourists in the Nigerian metropolis of Lagos use and view public transportation services. It sought to identify variables that affected how satisfied they were with public transportation services. At selected tourist destinations in Lagos, information was gathered through a study of visitors using a self-rating questionnaire with an intercept survey. Descriptive statistics, principal component analysis, and discriminant function analysis were used to analyze the data. The findings show that visitors were dissatisfied with the city of Lagos's public transportation system. The results of principal component analysis revealed five underlying factors that affect tourists' satisfaction with public transportation services: accessibility, journey comfort, travel security, travel information, and customer services.

By using discriminant function analysis, the eight main service quality characteristics that affect tourists' overall satisfaction with public transportation were found. They are: on-board personal security; ease of learning about routes, destinations, and stops;

frequent service; clean interiors of vehicles; security while waiting at bus and ferry stops; reasonably priced transportation; and staff members who are willing to assist customers. Public transportation service providers in Lagos should ensure that passengers are comfortable while waiting at bus stops and ferry docks by keeping these locations aesthetically pleasing, well-lit, clean, and easily accessible. Again, to improve the comfort of boarding and lighting riders, shelters and benches should be given in public transportation stops and stations in the city of Lagos. The way payments are made needs to be a consideration in the city's public transportation providers' long-term planning. Even while respondents in Lagos were generally satisfied with the assistance they received from public transport employees, there is still a need for public transport providers to train their staff on how to deal with passengers, especially visitors to the city, to encourage their use of the services.

2.6 Methodological Aspects

According to Cheranchery and Maitra (2019), it was important to create a GC and demand model in order to evaluate the effect of improvement on ridership as well as to assess the likely benefit to users arising from the development of premium bus service. For the purpose of creating a digital database for model estimate, the responses gathered from choice riders were coded. While the qualitative attributes like security setup, traffic data, and comfort were dummy coded, the quantitative attributes like access and egress time, waiting time, in-vehicle travel time, fare, and span of operation were entered in cardinal linear form. The findings show that all parameter estimates are significant at least at a 90% level of confidence and that the signs of the coefficient estimates are reasonable.

According to model estimation, the GC model is selected and based on various combinations of the improvement levels acquired for quantitative and qualitative criteria, several scenarios for the enhancement of premium service were created. Additionally, the best scenario will be chosen from that group and put forth.

The majority of these strategies, according to **Cheranchery and Maitra (2017)**, are suitable for one-dimensional analysis (e.g., analysing importance or satisfaction, but not both). In order to uncover the crucial success variables, Wu et al. suggested an importance-performance analysis (IPA) that combined IPA with Kano's model. IPA is a well-known method that has had little use in the transportation industry but has been

widely employed in aviation and tourism. The shortcomings of IPA, particularly the assumptions, prompted the creation of a revised version of three factor theory. The satisfaction elements (factor structure) of the respondents were determined using the three-factor theory utilizing both openly stated importance and implicitly derived importance. Three elements—basic, performance, and excitement—have an impact on customer happiness, according to this hypothesis. Basic criteria are the very minimum demands that, when not met, result in consumer dissatisfaction but not satisfaction. When excitement elements are met, consumer satisfaction rises, while unmet excitement factors do not cause discontent. When performance is high, performance factors lead to satisfaction; when performance is low, discontent. Axis placement in an IPA evaluation matrix has been a source of ongoing discussion even though the method is widely acknowledged and utilized in numerous research domains.

For IPA, the paper suggested a fuzzy C-means clustering approach that essentially eliminated the axis placement ambiguity. In contrast to conventional IPA, the fuzzy C-means clustering approach was used to determine the factor structure of captive riders. The degree to which an attribute fits into each of the four clusters—basic, important performance, exciting, and insignificant performance—is known as the membership degree of the attribute. Every characteristic, thus, had four degrees of membership, and the attributes were assigned to a specific cluster based on the membership degree with the highest value. The fuzzy C-means clustering approach was used to identify the management plans for various non-AC bus features. The management strategy used the following inputs to identify four clusters: concentrate here, keep up the excellent job, possibly overkill, or least priority. Derived importance and the performance ratio of qualities with respect to captive riders were treated as inputs. Results display the degrees to which each attribute belongs to each of the four schemes. The factor structure of captive riders was contrasted with management plans for various non-AC bus features in order to determine the most important areas of intervention for non-AC buses.

According to the criterion that underperforming basic factors (concentrate here and least priority) should obtain the greatest priority, followed by underperforming performance and excitement factors, factors that needed improvement were prioritized. Consequently, a logical hierarchy for assigning priority to qualities is as follows:

1. Basic factors under concentrate here;
2. Basic factors under least priority;
3. Performance factors under concentrate here; and
4. Excitement factors under concentrate here.

3. METHODOLOGY

3.1 General

Importance–Performance Analysis (IPA) is a simple and useful technique for identifying those attributes of a product or service that are most in need of improvement. The objective is to identify which attributes or its combination gives more impact toward customer satisfaction and leads to the repetitive customer behavior. IPA technique is a graph between the importance and performance or satisfaction of the customers using the service. In the graph, x- axis represents the performance and the y- axis represents the importance. These performance and importance values will be the stated values collected from the customers using the service. IPA technique divides the attributes having different coordinates into quadrant system. Each attribute will be assigned to a separate quadrant and the respective quadrant will be having an assigned property.

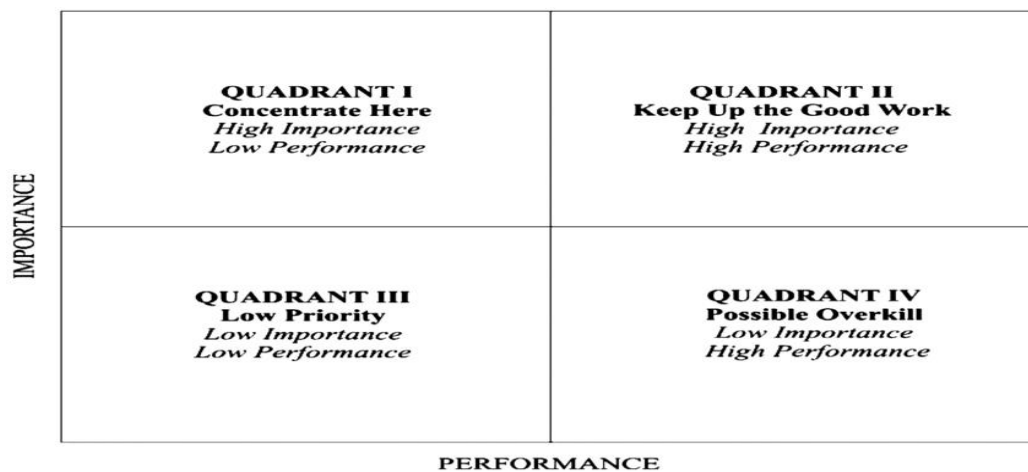


Fig 3.1: Quadrant system of IPA

In IPA, the attributes are being divided into four quadrants having different properties as shown above. The attributes coming in the 1st quadrant will be having high importance and low performance and hence it should be concentrated. The attributes coming in the 2nd quadrant will be having high importance and high performance also. So, it have to be kept like that. The attributes coming in the 3rd quadrant will be having low performance but it is also having low stated priority. So, no need to bother much and will be given lower priority. The attributes coming in the 4th quadrant will be having low importance but are having high priority. It is not significant but will be good to be present.

IPA is having a major limitation of being one dimensional technique. The attributes in each quadrant will also be having properties in other quadrants also. It has not been explained in the IPA technique. The inter dependency are also not being explained in the IPA. This led to the proposal of a revised IPA technique. Three factor theory and fuzzy c means clustering is the improvisation which is integrated in the project. This is the primary aspect of this project. To propose a methodology for the improvised technique of IPA by using clustering techniques.

IPA is extensively used in the field of tourism but not much extensively used in the field of transportation. IPA has certain limitations even when it is widely used. So a revised IPA technique should be performed in this project for the better interpretation of results. This should improve the limitations of IPA.

A revised IPA technique that integrated three-factor theory is being used for this. Three-factor theory is used to identify the satisfaction factors of the respondents by using the stated importance and derived importance. According to this theory, customer satisfaction is influenced by three factors: basic, performance, and excitement. Basic factors are the minimum requirement that need to be satisfied for the customers. Otherwise, the system will be highly dissatisfied. Excitement factors does not result in the dissatisfaction, but will be good for the service if present. Performance factors will result in the dissatisfaction when the performance is low and will lead to high satisfaction is the performance of the attribute is high. Even though the IPA technique is well accepted and widely used in various fields of research, axis placement in an IPA evaluation matrix has been a subject of continuous debate. With this background, the revised IPA and fuzzy *C*-means clustering were used in the present work to identify priority areas of intervention in the context of tourists using public transport facility at Alappuzha.

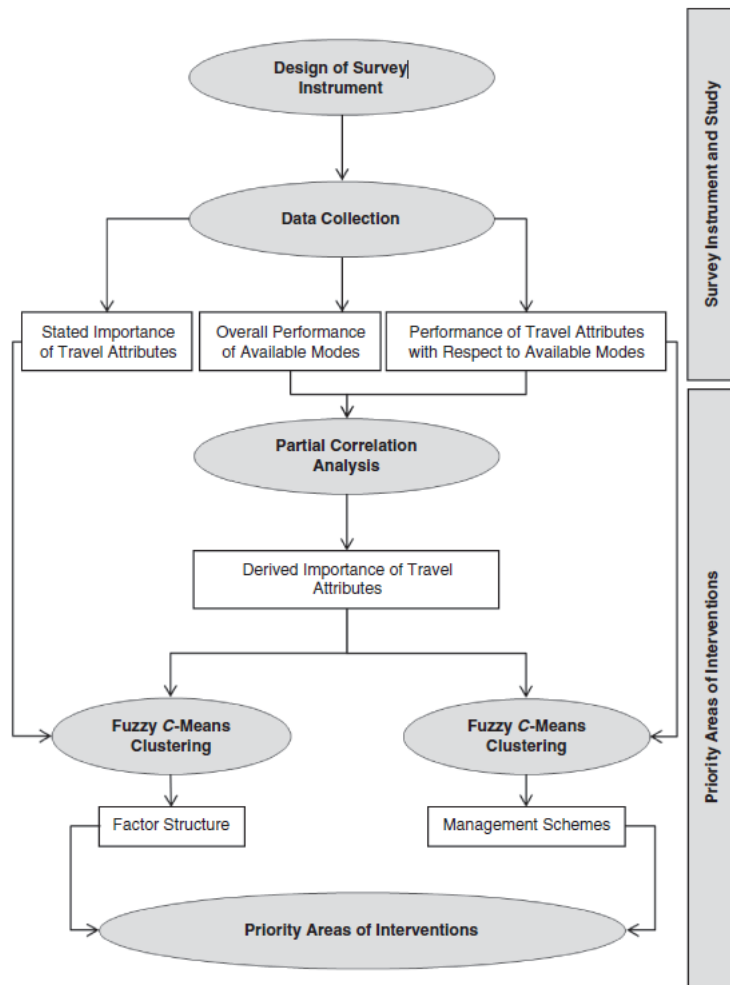


Figure 3.2 Methodology for identifying priority areas of intervention. (Cheranchery and Maitra, 2017)

Steps for future methodology are:

1. Data collection

Data collection has been done at tourist places of Alappuzha, Kerala. The tourist places in which survey is being conducted are Alappuzha beach, Punnamada, Marari beach, Kainakary and floating bridge. The importance and satisfaction of various attributes are being collected from tourists coming in these destinations at a scale of 1 to 5. The data has been collected by using questionnaire survey. The overall satisfaction with the services is also being collected from the tourist users. Also, the socio-economic characteristics are being collected like age, gender, education, occupation, monthly income etc.

2. Revised IPA

Revised IPA is being done by using the three-factor analysis: basic, performance and excitement factors and fuzzy c means clustering.

3. Partial correlation analysis

Partial correlation between the satisfaction and the overall satisfaction of the users are being found out by using SPSS software.

4. Normalization

The data collected in a scale of 1 to 5 has been converted into a scale of 0 to 1 for normalizing the values.

5. fuzzy C-means clustering

Ban et al. proposed a fuzzy C-means clustering algorithm for IPA so that it can solve the imitations due to the axis separation in the IPA. This clustering technique will divide the attributes into 4 clusters according to their characteristics. The probability of being falling in a cluster is being calculated as the membership degree for each attribute. the attribute having highest membership degree towards a particular cluster will fall into that cluster. Likewise, the attributes are being clustered removing the axis separation in IPA.

6. Factored structure and management scheme

Factored structure is the graph of normalized stated importance v/s derived importance. Management scheme is the graph of derived importance v/s normalized stated satisfaction. Derived importance is being calculated by finding the partial correlation between the stated satisfaction and the overall satisfaction using SPSS software.

7. Priority areas of interventions

According to this theory, customer satisfaction is influenced by three factors: basic, performance, and excitement. Basic factors are the minimum requirements that lead to consumer dissatisfaction when not fulfilled but not to customer satisfaction when fulfilled. Excitement factors increase customer satisfaction when fulfilled but do not result in dissatisfaction when not fulfilled. Performance factors result in satisfaction when performance is high and dissatisfaction when performance is low. In this the attributes of priority

intervention areas are being identified as the following rational order:

- Basic factors under concentrate here,
- Basic factors under least priority,
- Performance factors under concentrate here, and then
- Excitement factors under concentrate here.

3.2 Economic Analysis

In transport economics, the generalized cost is the sum of the monetary and non-monetary costs of a journey. Though the valuing of attributes gives an idea about how different categories of trip makers value travel time and its variation stated as traffic information, yet a generalized cost model is necessary for rational estimation of use.

The priority intervention areas are being identified and then the transportation engineering aspect related attributes are being selected from them. Those attributes are being analysed with the generalised cost model and the benefits are being analysed. For that, the similar condition data and a pilot survey of the present system has also been done.

3.3 Pilot Survey

A pilot study has been conducted in various tourist destinations of Alappuzha: Alappuzha beach, Punnamada, Marari beach, Kainakary. 30 responses were taken for the survey. The importance and satisfaction were taken in a scale of 1 to 5. Most of the people were responded to be willing to use public transport for tourism if facilities are improved. Information provisions in bus stand and railway station should be improved for tourist travel information. Scale of 1 to 5 is more comfortable to answer than 1 to 10 or 1 to 7. More effective to fill questionnaire by the enumerators rather than asking them to fill. Kerala Tourism Development Corporation office facility can also be used for faster collection of data. The cost related data of the present system has also been collected during the pilot survey. The cost for safety, security, installment, insurance, wage, fuel etc. for the calculation of cost estimate and benefits due to the improvement of system.

4. DATA COLLECTION FOR THE STUDY

In order to collect responses, a survey instrument was designed. The target group to collect sample were the tourists coming to the various tourist destinations of Alappuzha. The importance and satisfaction data of the identified attributes influencing the choice of tourists are being collected in Likert 5- point scale was adopted for the questionnaire, with response choices ranging from 1 to 5. The data collection was conducted from the month of February 2022 to June 2022. The tourists are being interviewed thoroughly and collected the importance and satisfaction for all the attributes. The overall satisfaction for the service was also being collected. Various Also the socio-economic characteristics are being collected like age, gender, education, occupation, monthly income etc. The questionnaire data was been collected fully by face-to-face interview during this period. 385 responses were being collected from the various tourist destinations of Alappuzha. The tourist destination surveyed were Alappuzha beach, Punnamada, Marari beach, kainakary and floating bridge. To make the research results more accurate, data cleaning was conducted on the collected responses to remove unstable and unwanted responses. By analyzing tourists' perceptions, the current study reports on an investigation into the identification of priority attributes influencing the choice of a public transport system.

The socio-economic characteristics collected are as follows:

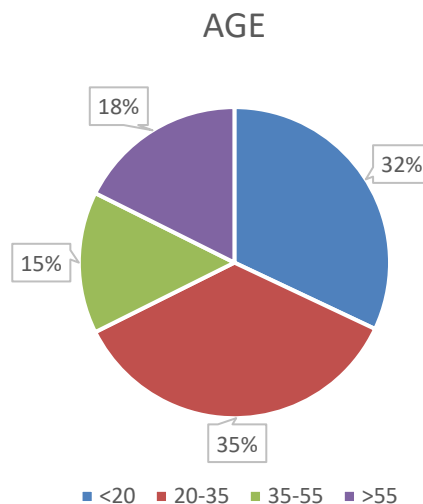


Fig 4.1: Age distribution of tourists

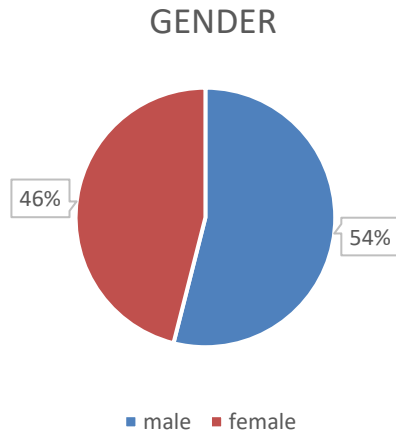


Fig 4.2: Gender distribution of tourists

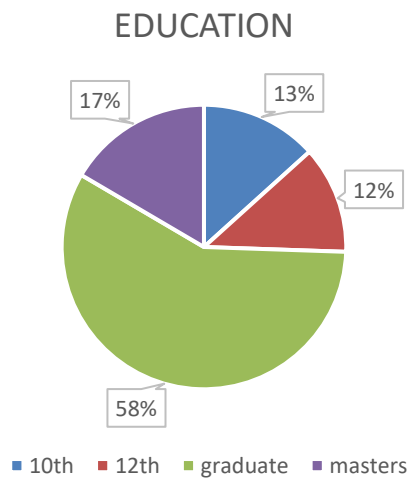


Fig 4.3: Educational qualification of tourists

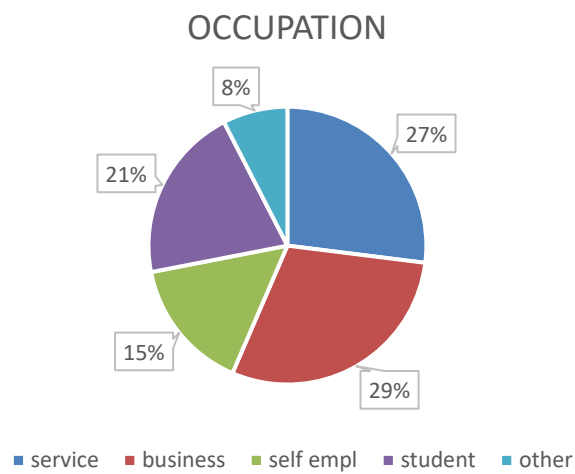


Fig 4.4: Occupation of tourists

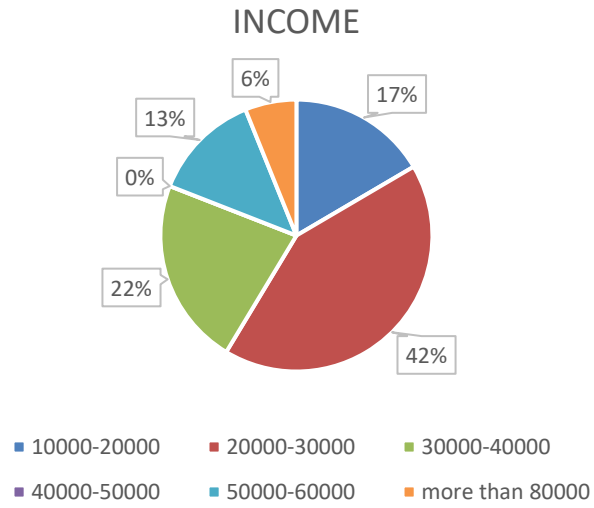


Fig 4.5: Income distribution of tourists

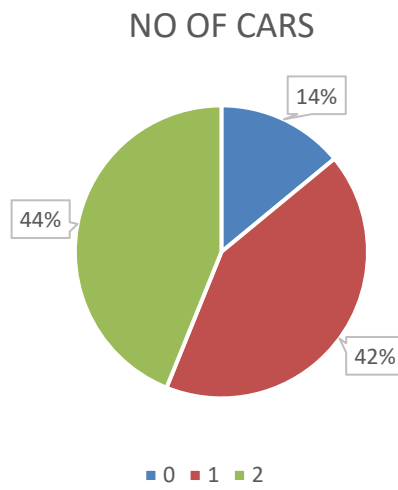


Fig 4.6: No. of cars in household of tourists

5. ANALYSIS OF THE STUDY

5.1 Partial Correlation Analysis

While accounting for the impact of one or more additional variables, partial correlation assesses the strength of a link between two variables. To determine the derived importance, a partial correlation study was performed in the SPSS software.

By doing a partial correlation analysis between the overall satisfaction and the satisfaction of specific criteria, the significance of each tourist attribute was determined.

The results from partial correlation analysis are summarized in table 5.1.

Table 5.1: Derived importance value by partial correlation

Attributes	Derived importance
SF	0.617
SE	0.665
ST	0.401
CL	0.648
CR	0.583
TT	0.687
NT	0.434
FO	0.454
FR	0.300
IV	0.132
SO	0.063
CO	0.482
TS	0.723
OI	0.385
WS	0.598
PT	0.662
OT	0.008
EN	0.332
TF	0.214
FA	0.856

5.2 Cluster Analysis

The process of locating similar groups of data in a dataset is called clustering. The data are homogeneous within the cluster and diverse between the clusters.

Utilizing fuzzy C- means clustering, partial correlation analysis, revised importance performance analysis, and cluster analysis, the responses gathered were examined. With total satisfaction as the dependent variable, a partial correlation analysis was conducted using the SPSS software to determine the inferred importance. Using fuzzy C-means clustering and Importance Performance Analysis (IPA), the attributes that need improvement the most were found.

5.3 Factor Structure Of The Respondents

IPA was carried out to determine which characteristics of a good or service need to be improved the most. In contrast to conventional IPA, the fuzzy C-means clustering technique was used to determine the respondents' factor structure. The goal is to determine which characteristics—or combinations of characteristics—have a greater impact on consumer satisfaction and encourage repeat purchases.

CLUSTER I Excitement factors	CLUSTER II Important performance factors
CLUSTER III Unimportant performance factors	CLUSTER IV Basic factors

Fig 5.1: Clusters of factored structure

A scale of 0 to 1 has been used to normalise values that were gathered on a scale of 1 to 5. Additionally, the data set's estimated relevance is normalised onto a scale from 0 to 1. The modified version of IPA groups the findings into clusters instead of the traditional IPA's quadrants. Every attribute will have a degree of membership in the appropriate cluster. With normalised values, graphs for stated importance vs. derived importance have been plotted. Fuzzy c- Means clustering is used to determine the likelihood or membership degree of each parameter to each cluster. A data set is divided into a number of clusters using the fuzzy c-means data clustering approach, and each data point in the dataset to some extent belongs to each cluster. The data point may have a membership degree or a possibility that it belongs to more than one cluster. Each parameter's likelihood or participation in the relevant cluster is calculated. The factored structure's membership degree values are as table 5.2.

Table 5.2: Membership degree values of factored structure

		Excitement factor	Important performance factor	Unimportant Performance factor	Basic factor
safety on board	SF	0.023331031	0.877454879	0.021075421	0.078138669
security	SE	0.934735753	0.017937985	0.036774837	0.010551425
staff behaviour	ST	0.025330921	0.108293142	0.035656582	0.830719355
cleanliness	CL	0.038410035	0.895031203	0.02436077	0.042197992
crowding level	CR	0.040894018	0.799592983	0.037922156	0.121590843
transfer time	TT	0.942511527	0.013805495	0.034720271	0.008962708
number of transfers	NT	0.061611751	0.036744287	0.84297125	0.058672712
food	FO	0.071151269	0.019318757	0.887974055	0.02155592
frequency	FR	0.009019739	0.034396989	0.014319912	0.94226336
in vehicle travel time	IV	0.008292789	0.021204364	0.015606818	0.954896028
span of operation	SO	0.04352934	0.086553889	0.104703804	0.765212968
cost	CO	0.021993229	0.08013058	0.035851665	0.862024527
ticketing system	TS	0.062404805	0.835086881	0.036809102	0.065699212
on board information	OI	0.023280475	0.012189774	0.944501195	0.020028557
way side information	WS	0.909330969	0.034566247	0.039229575	0.01687321
pre trip information	PT	0.034086538	0.822137521	0.030170295	0.113605646
on board temperature	OT	0.042374378	0.077259671	0.099856971	0.780508981
entertainment	EN	0.095022732	0.03111463	0.8348547	0.039007937
transit station facilities	TF	0.013120053	0.044129942	0.020669814	0.92208019
facilitate aesthetic enjoyment	FA	0.046257627	0.884569776	0.025948879	0.043223718

Following clustering, the attributes are clustered with the highest degree of membership to the corresponding quadrants or clusters. Additionally, the attribute factor structure for each tourist is created. The Factored Structure is as follows.

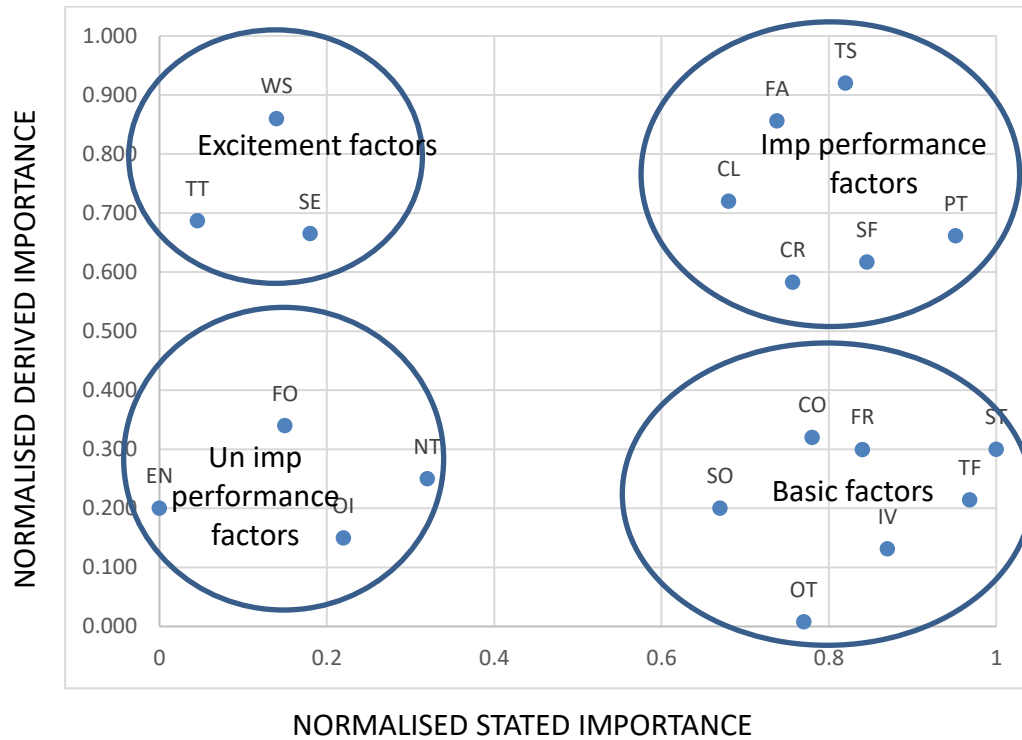


Fig 5.2: Factored structure

The attributes that come under excitement factors are security, transfer time and way side information. The attributes that come under important performance factors are facilitate aesthetic enjoyment, crowding, cleanliness, safety on board, pre-trip information and ticketing system. The attributes that come under unimportant performance factors are food, entertainment, number of transfers and on-board information. The attributes that come under basic factors are on board temperature, in vehicle travel time, transit station facilities, staff behavior, frequency, cost and span of operation.

5.4 Management Scheme

The fuzzy C-means clustering approach was used to determine the management strategies for different properties of EV and conventional automobiles. The management plan used derived importance and the performance ratio of attributes in relation to respondents to establish four clusters: concentrate here, keep up the excellent job, possibly overkill, or least priority.

CLUSTER I Excitement factors	CLUSTER II Important performance factors
CLUSTER III Unimportant performance factors	CLUSTER IV Basic factors

Fig 5.3: Clusters of management scheme

A scale of 0 to 1 has been used to normalise values that were gathered on a scale of 1 to 5. Additionally, the data set's estimated relevance is normalised onto a scale from 0 to 1. The modified version of IPA groups the findings into clusters instead of the traditional IPA's quadrants. Every attribute will have a degree of membership in the appropriate cluster. For derived importance v/s expressed satisfaction with normalised values, graphs have been shown. Fuzzy c- Means clustering is used to determine the likelihood or membership degree of each parameter to each cluster. A data set is divided into a number of clusters using the fuzzy c-means data clustering approach, and each data point in the dataset to some extent belongs to each cluster. The data point may have a membership degree or a possibility that it belongs to more than one cluster. Each parameter's likelihood or participation in the relevant cluster is calculated. The values for the management scheme's membership degree are shown in the table below:

Table 5.3: Membership degree values of Management scheme

	Possible overkill	Keep up good work	Least priority	Concentrate here
safety on board	SF 0.016931917	0.020724988	0.043331553	0.919011543
security	SE 0.04721851	0.066610061	0.077774419	0.80839701
staff behaviour	ST 0.862485207	0.075099726	0.037194866	0.025220201
cleanliness	CL 0.029159079	0.942318605	0.010212621	0.018309695
crowding level	CR 0.033241118	0.066264591	0.04369639	0.856797902
transfer time	TT 0.105007977	0.826613107	0.028659733	0.039719183
number of transfers	NT 0.937816775	0.026233702	0.023109397	0.012840126
food	FO 0.147807214	0.066847903	0.656202577	0.129142306
frequency	FR 0.024186428	0.013068012	0.930632847	0.032112713
in vehicle travel time	IV 0.071315346	0.025696173	0.860606464	0.042382017
span of operation	SO 0.778117884	0.061631901	0.117738375	0.04251184
cost	CO 0.926168779	0.042825435	0.017970878	0.013034908
ticketing system	TS 0.029423474	0.928607076	0.01333042	0.02863903
on board information	OI 0.015112667	0.008362451	0.953014991	0.023509891
way side information	WS 0.077936042	0.165234637	0.086030223	0.670799099
pre trip information	PT 0.021893629	0.028787453	0.050030744	0.899288174
on board temperature	OT 0.083402101	0.030896868	0.836725838	0.048975193
entertainment	EN 0.012067943	0.006523395	0.964690508	0.016718154
transit station facilities	TF 0.013267476	0.007457846	0.958469549	0.020805128
facilitate aesthetic enjoyment	FA 0.020142276	0.02972822	0.03886134	0.911268164

Following clustering, the attributes are clustered with the highest degree of membership to the corresponding quadrants or clusters. The management plan for the characteristics of tourists is created. The management plan is as follows:

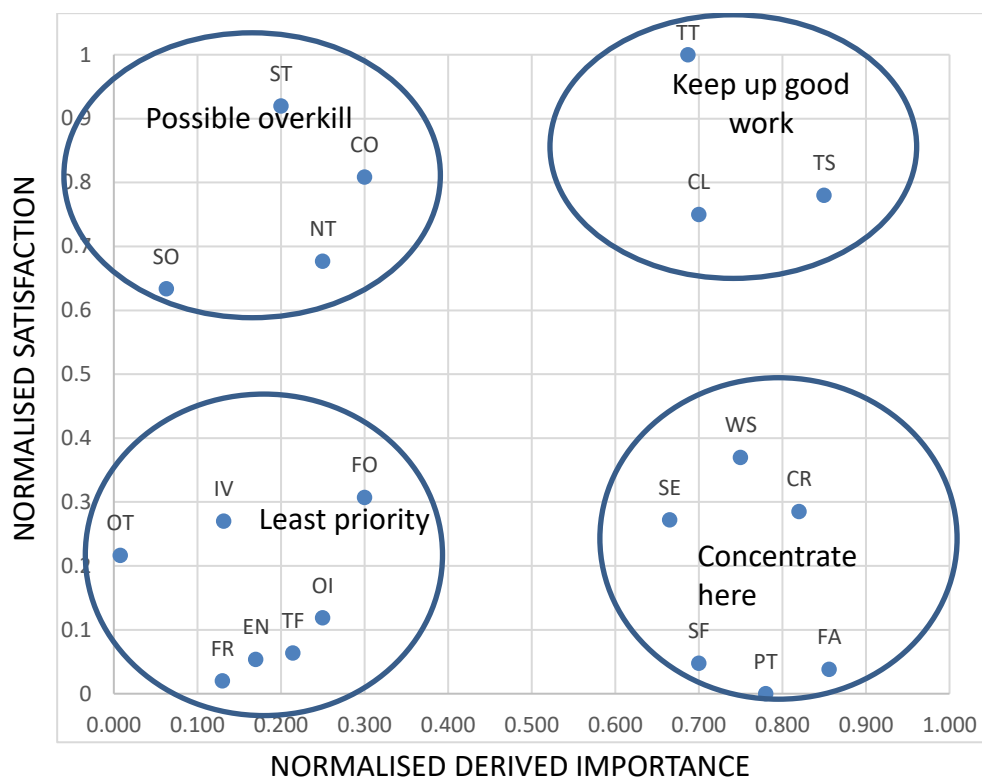


Fig 5.4: Management scheme

The attributes that come under the possible overkill are cost, no of transfers, staff behaviour and span of operation. The attribute that comes under keep up good work are transfer time, ticketing system and cleanliness. The attributes that come under least priority are frequency, entertainment, transit station facilities, on board information, on board temperature, in vehicle travel time and food. The attributes that come under concentrate here are safety on board, pre-trip information, facilitate aesthetic enjoyment, crowding level, security and wayside information.

5.5 Priority Areas Identified

The component structure of problematic users was compared with management plans for different tourist attribute qualities in order to determine priority areas of intervention for tourists. According to the criterion that underperforming basic factors (concentrate here and least priority) should obtain the greatest priority, followed by underperforming performance and excitement factors, factors that needed improvement were prioritised. Consequently, a reasonable hierarchy of qualities is

1. Basic factors under concentrate here,
2. Basic factors under least priority,
3. Performance factors under concentrate here, and then
4. Excitement factors under concentrate here.

Attributes that are in priority areas of intervention according to the ranks are:

1. Transit station facilities
2. Frequency
3. In vehicle travel time
4. On board temperature
5. Safety on board
6. Facilitate aesthetic enjoyment
7. Pre trip information
8. Crowding level
9. Security

5.6 Economic Analysis

The generalised cost in transport economics is the total of a trip's financial and non-financial costs. A generalised cost model is required for the rational assessment of use, even though the valuing of attributes provides an understanding of how different types of trip makers value travel time and its variance stated as traffic information.

Four attributes in all, with four levels each, are taken into consideration for the creation of the generalised cost model. Thus, there are 256 different combinations that might be made. By limiting the number of levels taken into account, the number of situations is decreased. For instance, only the highest standards of safety and security are taken into account. Additionally, the service period is fixed at 16 hours. There are a total of 16 situations, with the four IVTT levels (in minutes) being 40, 35, 30, 20, and the four headway levels (in minutes) being 15, 20, 30, and 40. Divide the span of operation by the roundtrip time to get the total number of trips per day, and divide the span of operation by the headway to get the total number of buses per day. A layover time of 30 minutes is considered along with IVTT. The minimum fare that should be assigned to prevent from any loss was also calculated. For the base scenario, the existing parameters were noted. Minimum fare at present condition is INR 2.00/km.

The determination of various cost is explained below:

- 1. Security:** The cost of a CCTV camera installed for security is INR 5,000. It is installed inside the boat and at the waiting shed. The return period of CCTV is taken as 5 years.
- 2. Instalment:** Instalment is the sum of money paid in small parts in a fixed period. The cost of a bus of return period 10 years is taken as INR 30,00,000.
- 3. Insurance:** Boat insurance helps to provide financial protection for the bus and its contents, liability protection, medical coverage etc. The insurance of a bus is estimated as INR 50,000 annually.
- 4. Wage:** A single boat is operated by a total of 2 workers, with an average salary of INR 25,000 per month.
- 7. Fuel:** Boat runs on diesel and cost of diesel is taken as INR 90 per litre.
- 8. Maintenance:** The annual cost of boat maintenance is around INR 1,00,000.

Table 5.4 : Generation of Alternate Improvement scenario

Scenario	IVTT(min)	Span(hour)	Headway(min)	No: of trip	No. of bus
Base	45	13	60	7	2
1	50	16	15	8	9
2	50	16	20	8	7
3	50	16	30	8	5
4	50	16	40	8	4
5	40	16	15	9	8
6	40	16	20	9	6
7	40	16	30	9	4
8	40	16	40	9	3
9	35	16	15	10	7
10	35	16	20	10	5
11	35	16	30	10	4
12	35	16	40	10	3
13	30	16	15	11	6
14	30	16	20	11	5
15	30	16	30	11	3
16	30	16	40	11	3

Table 5.5: Cost Analysis

Scenario	Instalment	Insurance	Wage	Fuel	Maintenance	Safety	Total cost
Base	1666.67	277.78	3,333	10080	277.78	0.00	15,636
1	7500.00	1250.00	15,000	51840	1250.00	30.56	76,871
2	5833.33	972.22	11,667	40320	972.22	25.00	59,789
3	4166.67	694.44	8,333	28800	694.44	19.44	42,708
4	3333.33	555.56	6,667	23040	555.56	16.67	34,168
5	6666.67	1111.11	13,333	51840	1111.11	27.78	74,090
6	5000.00	833.33	10,000	38880	833.33	22.22	55,569
7	3333.33	555.56	6,667	25920	555.56	16.67	37,048
8	2500.00	416.67	5,000	19440	416.67	13.89	27,787
9	5833.33	972.22	11,667	50400	972.22	25.00	69,869
10	4166.67	694.44	8,333	36000	694.44	19.44	49,908
11	3333.33	555.56	6,667	28800	555.56	16.67	39,928
12	2500.00	416.67	5,000	21600	416.67	13.89	29,947
13	5000.00	833.33	10,000	47520	833.33	22.22	64,209
14	4166.67	694.44	8,333	39600	694.44	19.44	53,508
15	2500.00	416.67	5,000	23760	416.67	13.89	32,107
16	2500.00	416.67	5,000	23760	416.67	13.89	32,107

Table 5.6: Benefit- Cost ratio Analysis

Scenario	Headway(min)	IVTT(min)	Span(hour)	No. of bus	No: of trip	Total cost	Min fare	GC	Benefit	GC total	Benefit total	Benefit/ Cost
Base	60	45	13	2	7	15,636	2.000	38.555		26988.2		
1	15	50	16	9	8	76,871	3.813	14.634	23.920	52684.2	-25696.0	-0.334
2	20	50	16	7	8	59,789	3.813	16.105	22.450	45093.5	-18105.3	-0.303
3	30	50	16	5	8	42,708	3.813	19.045	19.509	38090.8	-11102.6	-0.260
4	40	50	16	4	8	34,168	3.813	21.986	16.569	35177.4	-8189.2	-0.240
5	15	40	16	8	9	74,090	3.675	11.454	27.100	41235.8	-14247.6	-0.192
6	20	40	16	6	9	55,569	3.675	12.925	25.630	34896.9	-7908.7	-0.142
7	30	40	16	4	9	37,048	3.675	15.865	22.689	28557.9	-1569.7	-0.042
8	40	40	16	3	9	27,787	3.676	18.806	19.748	25388.4	1599.8	0.058
9	15	35	16	7	10	69,869	3.565	9.699	28.856	33946.0	-6957.9	-0.100
10	20	35	16	5	10	49,908	3.565	11.169	27.385	27923.3	-935.1	-0.019
11	30	35	16	4	10	39,928	3.565	14.110	24.445	28219.4	-1231.2	-0.031
12	40	35	16	3	10	29,947	3.565	17.050	21.504	25575.6	1412.6	0.047
13	15	30	16	6	11	64,209	3.475	8.024	30.531	26478.0	510.2	0.008
14	20	30	16	5	11	53,508	3.475	9.494	29.061	26108.1	880.1	0.016
15	30	30	16	3	11	32,107	3.475	12.435	26.120	20517.5	6470.7	0.202
16	40	30	16	3	11	32,107	3.475	15.375	23.180	25368.5	1619.7	0.050

The generalised cost of travel is the summation of attributes which are converted into a common unit in monetary terms from origin i to destination j . The GC model for bus

$$GC_{nij} = \alpha_{ivtt} \times IVTT + \alpha_{hw} \times HW - \alpha_{sp} \times SPAN + (\alpha_{st} + \alpha_{sa}) \times d_{nij} + f_{nij}$$

Eq 2.1

where,

GC_{nij} = generalized cost to a passenger traveling from stop i to j

$IVTT$ = in-vehicle travel time in min = 60 min

HW = headway in min = 45 min

SPN = span of operation in hours = 16 hr

d_{nij} = distance travelled by a passenger from stop i to j = 15 km

f_{nij} = fare paid by a passenger to travelling from stop i to j = 30 INR

α_{ivtt} , user cost associated with $IVTT$ = 0.128 INR/min

α_{hw} , user cost associated with headway = 0.618 INR/hr

α_{sp} , user cost associated with span = 0.437 INR/hr

α_{st} = user cost associated with security arrangement = 0.457 INR/hr

α_{ti} = user cost associated with safety arrangement = 0.604 INR/hr

5.7 Scenario Analysis

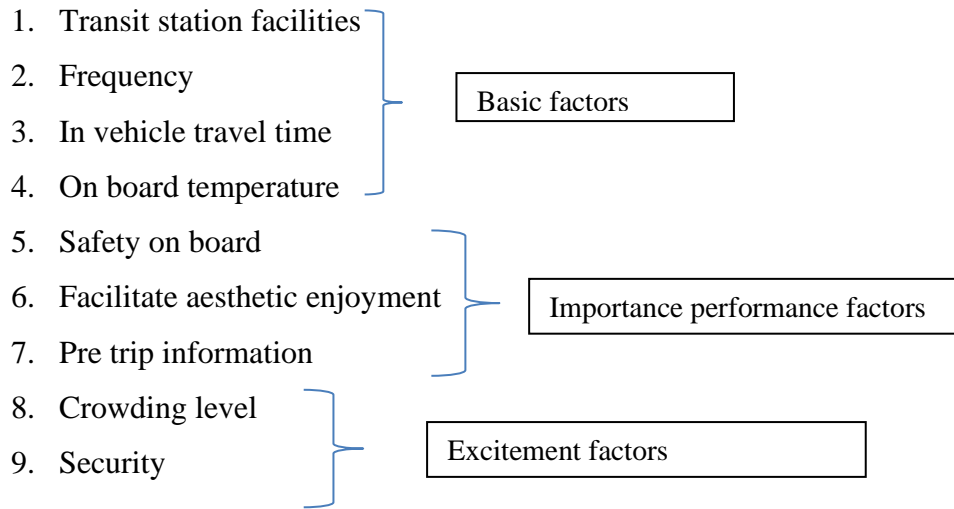
For scenario analysis, the route selected is from Alappuzha to Floating bridge. To proceed with scenario analysis, the various operational cost associated with existing bus service was tabulated along with the generalised cost of different scenarios considered. The difference between generalised cost of base scenario and generalised cost of scenario considered gives the corresponding benefit. The ratio of benefit to cost is taken. The scenario with maximum benefit to cost ratio is highlighted and is considered the best scenario. This economic technique applied to public decision making that attempts to quantify the benefits and costs associated with a particular project is called benefit-cost analysis. It is evident that the 15th scenario will be having the highest benefit to cost ratio. So the best scenario suggested for the route will be having 3 buses with 11 schedules circulated at a headway of 30 mins. The total operating cost of this scenario is 32,107 per day and the minimum fare to be employed was found to be INR 3.475/km. Generalized cost calculated using the equation was INR 12.435 and benefit was INR 26.120. The benefit-cost ratio in this scenario is 0.814.

5.8 Recommendations

- Transit Station facilities can be improved by providing short term stay facilities, waiting rooms, freshen up facilities, locker rooms etc. at the public transport terminal. This will definitely improve the attraction of long distance tourists using public transport.
- Frequency can be improved by studies of optimal headway time and no. of services can be determined by studying the demand of passengers.
- In vehicle travel time can be reduced by reducing number of pickup points and tourism separate services with specified origin and destination.
- On board temperature can be improved by AC low floor urban bus services.
- Safety on board can be improved by the implementation of CCTV cameras on board and implementation of seat belts can also be introduced which is now absent.
- Facilitate aesthetic enjoyment can be done by increasing the glass area by adopting AC low floor buses for the services and also the introduction open double ducker buses can improve this.
- Pre trip information can be improved by online promotion services and various information services provided at transport facilities
- Crowding level can be reduced by providing adequate no. of services
- Security can be improved by employing professional security system and including police enforcement in management
- Way side information can be provided digitally by TV in buses or by employing tourist guides in the service making the journey productive

6. RESULTS

Attributes that are in priority areas of intervention according to the ranks are:



From the results of the economic analysis, it is evident that the 15th scenario will be having the highest benefit to cost ratio and will be having the best results. So the best scenario suggested for the route will be having 3 buses with 11 schedules circulated at a headway of 30 mins. The total operating cost of this scenario is 32,107 per day and the minimum fare to be employed was found to be INR 3.475/km. Generalized cost calculated using the equation was INR 12.435 and benefit was INR 26.120. The total benefit was INR 6470. The benefit-cost ratio in this scenario is 0.814.

7. CONCLUSION

Tourism plays a major role in the development and socio-economic progress of nation. Without proper transportation system, it is not possible to improve tourism. So, by facilitating a better public transport system will increase the tourist attraction of the destination. A study has been conducted in various tourist destinations of Alappuzha: Alappuzha beach, Punnamada, Marari beach, Kainakary. 395 responses were taken for the survey. The importance and satisfaction were taken in a scale of 1 to 5. Most of the people were responded to be willing to use public transport for tourism if facilities are improved. From the data collected, an improved Importance Performance analysis has been done. For that, partial correlation analysis and fuzzy c means clustering has been done using the software SPSS and MATLAB respectively. From the results, the key intervention areas are being identified and they need to be improved. They were also ranked in the following order of Transit station facilities, Frequency, in vehicle travel time, on board temperature, Safety on board, facilitate aesthetic enjoyment, Pre trip information, Crowding level, Security. Also, an economic analysis has been done with different scenarios and the best scenario has also been identified. Also, the overall suggestion has been done for various key intervention area attributes according to the survey conducted. By improving the key intervention areas and by imparting the best scenario for the tourist attributes, we can surely improve the public transport system in the context of tourism. By this, it can improve the tourist destination attraction and the overall economy of the state.

8. FUTURE SCOPE OF WORK

- Even if this study is case specific, the methodology can be adopted for the design and improvement of public transport facilities in other districts as well as the service of other states.
- Economical analysis based on the public transport system for the study should be separately done for identifying and better planning of tourism related projects.

REFERENCES

1. Antoniou, C., & Tyrinopoulos, Y. (2013). Factors affecting public transport use in touristic areas. *International Journal of Transportation*, 1(1).
2. Cao, J., & Cao, X. (2017). Comparing importance-performance analysis and three-factor theory in assessing rider satisfaction with transit. *Journal of Transport and Land Use*, 10(1), 837-854.
3. Cheranchery, M. F., & Maitra, B. (2017). Priority areas of intervention for improving urban bus services: Experience in Kolkata, India. *Transportation Research Record*, 2634(1), 17-27.
4. Cheranchery, M. F. and Maitra, B. (2019). Improving Ridership and Reducing Subsidy for Premium Bus Service in Kolkata Metro City. *Journal of Transportation Engineering, Part A: Systems*, 145(7), 04019030.
5. Cheranchery, M. F., Noushad, A., Choyimadathil, A., Jose, J. T., Padu, K. and Nivedita, S. (2021). Identifying areas of intervention for enhancing the attractiveness of Inland waterway transport based on users' perception: A case study of Kerala. *Case Studies on Transport Policy*, 9(3), 1006–1014.
6. Fernandes-Ferreira, A., Damaceno-Leite, A., & Chang, S. J. (2020). Accessible tourism and the role of public transport provision: Comparing the access to attractions for tourists with and without disabilities in Bangkok. In *Resilience and Sustainable Transportation Systems* (pp. 19-27). Reston, VA: American Society of Civil Engineers.
7. Gronau, W., & Kagermeier, A. (2007). Key factors for successful leisure and tourism public transport provision. *Journal of Transport Geography*, 15(2), 127-135.
8. Gutiérrez, A., & Miravet, D. (2016). The determinants of tourist use of public transport at the destination. *Sustainability*, 8(9), 908.
9. Hall, C. M., Le-Klähn, D. T., & Ram, Y. (2017). *Tourism, public transport and sustainable mobility*. Channel View Publications.

10. Ivandić, N., & Vidović, K. (2020). Tourism as a factor of demand in public road passenger transportation in the republic of Croatia. *Tehnički glasnik*, 14(1), 76-87.
11. Kołodziejczyk, K. (2020). Cross-border public transport between Poland and Czechia and the development of the tourism functions of the region. *Geographia Polonica*, 93(2), 261-285.
12. Łapko, A. (2014). Urban tourism in Szczecin and its impact on the functioning of the urban transport system. *Procedia-Social and Behavioral Sciences*, 151, 207-214.
13. Le-Klaehn, D. T., & Hall, C. M. (2015). Tourist use of public transport at destinations—a review. *Current Issues in Tourism*, 18(8), 785-803.
14. Le-Klaehn, D. T., Gerike, R., & Hall, C. M. (2014). Visitor users vs. non-users of public transport: The case of Munich, Germany. *Journal of Destination Marketing & Management*, 3(3), 152-161.
15. Le-Klähm, D. T., Roosen, J., Gerike, R., & Hall, C. M. (2015). Factors affecting tourists' public transport use and areas visited at destinations. *Tourism Geographies*, 17(5), 738-757.
16. Li, Y., Yao, E., Yang, Y., & Zhuang, H. (2020, September). Modeling the Tourism Travel Mode and Route Choice Behaviour based on Nested Logit Model. In *2020 IEEE 5th International Conference on Intelligent Transportation Engineering (ICITE)* (pp. 28-32). IEEE.
17. Lumsdon, L., Downward, P., & Rhoden, S. (2006). Transport for tourism: can public transport encourage a modal shift in the day visitor market?. *Journal of Sustainable tourism*, 14(2), 139-156.
18. Nwachukwu, A. A., Gladys, N. I., & Chikezie, O. K. (2019). Tourists' satisfaction with public transport services in Lagos, Nigeria. *AUC Geographica*, 54(1), 67-80.
19. Van Truong, N., & Shimizu, T. (2017). The effect of transportation on tourism promotion: Literature review on application of the Computable General Equilibrium (CGE) Model. *Transportation Research Procedia*, 25, 3096-3115.

20. Xue, M., Wu, H., Chen, W., Ng, W. S., & Goh, G. H. (2014, August). Identifying tourists from public transport commuters. In *Proceedings of the 20th ACM SIGKDD international conference on Knowledge discovery and data mining* (pp. 1779-1788).
21. Yang, Y., Li, D., & Li, X. (2019). Public transport connectivity and intercity tourist flows. *Journal of travel research*, 58(1), 25-41.
22. Yuksek, G., Akkoç, I. T., & Bayer, R. U. (2016). The effects of public transport performance on destination satisfaction. *African Journal of Hospitality, Tourism and Leisure*, 5(4), 1-12.

APPENDIX

This appendix includes the questionnaire designed for developing the perception of tourists towards public transport system.

TKM COLLEGE OF ENGINEERING, KOLLAM

Dept. of Civil Engineering

**INTEGRATED DEVELOPMENT OF PUBLIC TRANSPORT FOR
TOURISM: A CASE STUDY OF ALAPPUZHA**

Dear Respondent,

As part of my M.Tech thesis, I would like study the perceptions of tourists in public transport facilities in Alappuzha. In order to carry out the project, it is important to know your perceptions towards various aspects/attributes associated with public transport services. We shall be thankful to you for spending a little part of your precious time in filling this questionnaire.

Part-A:

Origin:

Destination:

1. How did you arrive at Alappuzha? After that, how did you reach this destination?

(a) Bus (b) Private vehicle (car, bike etc.) (c) Auto Rickshaw (d) Taxi (e) Boat service(e) Other (mention both:)

2. Why did you chose the above mode of transportation?

3. Did you travel for tourism using Public Transport?

(a) Never (b) Rarely (c) Sometimes (d) Often (e) Always

4. Are you travelling alone / group / with family or friends?

If travelling by group, how many members are there? Nos:

B: Importance of Attributes

Rate the IMPORTANCE of various attributes in the context of public transport, on a scale of 1 to 5, with **1→least important, 2→somewhat important, 3→important, 4→very important and 5→most important.**

Attributes	Imp orta nce (1- 5)	Attributes	Imp orta nce (1-5)
Safety on-board		Span of operation	
Security		Cost	
Staff behavior		Ticketing system	
Cleanliness		On board information	
Crowding level		Way side information	
Transfer time		Pre-trip information	
Number of transfers		On-board temperature	
Food		Entertainment	
Frequency		Transit station facilities	
In-Vehicle Travel Time		Facilitate aesthetic enjoyment	

C: Satisfaction with different modes

Rate the LEVEL OF SATISFACTION about each mode on a scale of 1 to 5, with 1 → Highly dissatisfied; 2 → Dissatisfied; 3 → Neutral, 4 → Satisfied; 5 → Highly satisfied

Fill-up the cells for all the modes which are either chosen or available as alternative modes for your trip. If a particular mode is not available for you, you may leave the corresponding entries blank.

Fill-up the column ‘Other’ if your current transportation mode is other than Buss, private vehicle, AutoRickshaw, Taxi or boat service

Overall level of satisfaction is expected to reflect your preference of available modes for trips.

	Bu s	Priva te Vehic le (car, bike etc.)	Auto Rick shaw	Ta xi	Boat Servi ce	Othe r
Overall Level of Satisfaction (1 to 5 Scale)						

Rate the LEVEL OF SATISFACTION about each mode with respect to the specific attribute on a scale of 1 to 5, with

1 → Highly dissatisfied; 2 → Dissatisfied; 3 → Neutral, 4 → Satisfied; 5 → Highly satisfied

Modes Attributes	Private vehicle (car, bik e etc.)	Bus	Auto Ricksh aw	Taxi	Boat servic e	Other
Safety on-board						
Security						
Staff behavior						
Cleanliness						
Crowding level						
Transfer time						
Number of Transfer						
On-board temperature						
Frequency						
In vehicle Travel time						
Span of service						
Cost						

Ticketing system						
On board information						
Way side information						
Entertainment						
Food						
Transit station facilities						
Facilitate aesthetic enjoyment						

D : Socio-Economic characteristics

1. Gender: (a) Male (b) Female
2. Age : (a) < 20 years (b) 20 to 35 years (c) 35 to 55 years (d) > 55 years
3. Education: (a) up to 10th Standard (b) 12th Standard (c) Graduate (d) Masters/Above
4. Occupation: (a) Service/Job (b) Business (c)Self-employment (d) Student (e) Other
5. Monthly Family Income (in Rs./-) :

(a) Up to 10, 000/-	(b) 10, 000/- to 20, 000/-	(c) 20, 000/- to 30,000/-
	(d)30000/- to 40000/-	(e) 40000/- to 60000/-
	(f) 60000/- to 80000/-	(g) More than 80000/-
6. No. of cars in the household: (a) 0 (b) 1 (c) 2 (d) More than 2