A Study on Passenger Satisfaction of EV Buses in Goa

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DECLARATION BY STUDENT

I hereby declare that the data presented in this dissertation report entitled, "A Study on Passenger Satisfaction of EV Buses in Goa" is based on the results of investigations carried out by me in the commerce department at Goa Business School, Goa University under the supervision of Asst. Professor Aakruthi. A Alarnkar and the same has not been submitted elsewhere for the award of a degree or diploma by me. Further, I understand that Goa University or its authorities/college will not be responsible for the correctness of observations / experimental or other findings given the dissertation.

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COMPLETION CERTIFICATE

This is to certify that the dissertation report "A Study on Passenger Satisfaction of EV Buses in Goa" is a bonafide work carried out by Ms. Sheejal Shripad Parsekar under my supervision in partial fulfillment of the requirements for the award of the degree of Masters of Commerce in the Discipline commerce at the Goa Business School, Goa University/College.

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ABSTRACT

Public transport is a favorable way to solve mobility problems such as traffic congestion and vehicular emissions. However, to encourage travelers to use public transport facilities, the transportation system needs to provide a high level of service to ensure their satisfaction, which is one of the crucial factors affecting their choice to use electric buses as their mode of transportation. Despite this, there is limited understanding of the factors affecting passenger satisfaction with Electric buses in Goa. To address this knowledge gap, the present study explores the factors affecting passenger satisfaction of electric buses and their loyalty towards them in Goa, and to understand the demographic profiles having a significant effect on the base of location of Goa. The study utilizes the Jamovi software, and Partial Least Square Structural Equation Modelling (PLS-SEM) to explore passengers' satisfaction based on 7 key attributes of the electric buses. A total sample of 450 passengers was examined to uncover the relationship between the variables. The results show that there is a significant difference between the Locations among the passengers, and the variables have a significant effect on the passenger's satisfaction leaving the network and operation factors, and the passenger's satisfaction partially mediates the choices of the passengers to be loyal towards electric buses. The conclusion of it that electric buses should focus on their service quality, comfort and convenience, and environmental performance to increase passenger satisfaction.

CHAPTER 1: INTRODUCTION

Transportation is often called the blood system of society, Across the world, public transportation is essential for giving various societal segments access to high-quality transportation options. (Munim & Noor, 2020) It offers residents a sufficient means of transportation to get to their places of employment, education, and recreation. Unlike private vehicles, public transportation enables multiple drivers to travel together on a predetermined route. they are proving to be0020a viable means of lowering vehicle emissions and traffic congestion. The recent introduction of electric buses has decreased the amount of CO2 released into the atmosphere. (Singh, H., & Kathuria, A. (2023). About 87% of all transport emissions, which include pollutants like carbon monoxide (CO), non-methane volatile organic compounds (NMVOCS), sulphur dioxide (SO2), PM, and oxides of nitrate (NOx), are produced by road-based transportation. These emissions also include carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O). (Of, 2022)

In 2015, almost half of the global vehicle-related air pollution health effects were attributed to on-road diesel vehicles, with two-thirds occurring in India. Cities with strong public transportation systems typically have lower per capita emissions, which improves the quality of the air and public health. The air quality in Indian cities is constantly deteriorating. The number of cars and two-wheelers has steadily increased, exacerbating the issue. Electric buses can help alleviate traffic congestion by reducing pollution, noise, and fuel costs compared to diesel buses. The benefits of electrifying buses for the environment in reducing air pollution are contingent upon the ratio of damages incurred by the electric bus to those incurred by the non-electric vehicle. Damage to the environment caused by non-electric buses is caused by a range of pollutants that are released straight from the buses' tailpipes. While electric buses have numerous advantages, there are still some challenges to overcome. Most State Transport Undertakings (STUs), the agencies in charge of public bus operations in India, lack the technical knowledge to procure, deploy, and manage their e-bus fleet optimally. (Of, 2022)

India produces the best electric buses; the availability of several models for each kind of vehicle has led to a new high in EV development. Electric cars, buses, and scooters are now available in India. Although there have previously been electric buses, improvements have been made in recent years. The state and federal governments' unwavering efforts to electrify public

transportation will lead to the fastest-ever growth peak in the Indian electric bus market. By 2030, the Indian government wants all public transportation to run entirely on electricity. Globally, several significant auto and bus manufacturers are developing electric cars. To get people to give up their cars and two-wheelers and use public transportation instead of their freedom and privacy, electric buses must simply replace diesel buses. Approximately 40,000 public transportation buses are in service in India, with the majority—80%—operating in the top eight cities. For a nation the size of India, there are not enough buses, which has sped up the development of private automobiles and resulted in extreme traffic jams and pollution. (Of, 2022).

Individuals base significant life decisions on the accessibility of transportation options. For instance, the accessibility of transportation in a given area influences the location of a home, place of employment, place of education, place of recreation, and neighborhood quality (Munim & Noor, 2020). Numerous factors influence satisfaction, and there is no shortage of literature on the topic. We examine a few studies that have been conducted in this area to identify the elements that contribute to customer satisfaction. Research indicates that passengers demand the highest quality of service and personalized attention to their needs (Islam, 2014). Certain studies indicate that the evaluation of public transportation level-of-service attributes varies for various modes of public transportation and private vehicles, and these variations also exist between users of public transportation and private vehicles (Shiftan et al., 2015). The service quality of public transport becomes an important issue to have a better and more comfortable environment (Mat et al., 2019). Passenger satisfaction is “the sense of either enjoyment or displeasure, which results from a comparison between the passenger’s expectation of the service and the real service provided” (H. Singh & Kathuria, 2023). Conversely, loyalty is most effectively delineated by considering users' intentions to stick with the service, their propensity to refer others to it, and their perception of and engagement with public transportation (Vicente et al., 2020). The idea of passengers' perceptions of public transportation's impact on society and their well-being forms the basis of this concept (Vicente et al., 2020).

India doesn't have many manufacturers of electric buses, but the well-known ones are listed below.

1.1 List of Top Electric Bus Manufacturers in India.

The list of leading Indian Electric Bus Manufacturers along with their E-bus Models is provided below. (Shah, 2023)

Name of the Company	**Models**
PMI Electro Mobility	PMI Foton
Olectra GreenTech	Electric Bus K9
Switch Mobility	Switch e1 electric bus
Tata Motors	Starbus
Mytrah Motors	MOZEV
JBM Motors	JBM Ecolife Electric bus
VE Commercial Vehicles Ltd	Skyline Pro

Foreign Electric Bus Manufacturers working in India. (Shah, 2023)

Name of the Company	**Models**
Solaris Bus & Coach S.A.	Solaris Urbino 15 LE electric
BYD Company Limited	BYD K9

Zhongtong Bus & Holding Company Limited	Zhongtong Bus LCK6122EVG Electric Bus

This study is focused on investigating the factors that affect passengers' satisfaction in Goa on Electric buses and loyalty towards. The twenty-fifth state of India, Goa, with a population of 1,521,992 and a land area of 3702 square kilometers, is known as the paradise of India. Eleven talukas, fifteen towns, and two districts define the State. Although Goa offers a range of transportation options, such as train and ferry services, road transportation is crucial to the state's overall transportation network. Because most of Goa's locations are connected by a vast network, getting around the island is comparatively simple. All the main locations are connected by bus services operated by the state-owned Transport Corporation and private companies. The Kadamba Transport Corporation Ltd. maintains government-operated buses that connect the state's major routes with some of its more isolated areas. (Scholar & J-gage, 2016)

The Goan government owns Kadamba Transport Corporation, which is a state-owned corporation. It was founded in 1980 under the Companies Act of 1956 to offer the traveling public a safe, dependable, comfortable, timely, effective, and efficient passenger service. Providing "safe, reliable, timesaving, efficient, comfortable and affordable" services to Goa is the primary goal of Kadamba Transport Corporation. Like most state-run road transport companies in India, it receives significant government subsidies. The Corporation's registered office can be found in Parasio de Goa, Alto Porvorim, Goa. The Corporation operates a central workshop at Porvorim and four, major depots: Margao, Panaji, Porvorim, and Vasco. (Scholar & J-gage, 2016)

Goa provides shuttle and non-shuttle services to its passengers for fast and easy mobility. Shuttle services are connected to major commercial towns like Panaji, Margao, Vasco, Mapusa, Ponda, Curchorem, Bicholim, etc. In addition to dropping off passengers inside the city during office hours, these services are non-stop and standee-free, which results in shorter travel times. Kadamba Transport Corporation's shuttle bus service in Goa is practical and helpful for those with regular commutes and blue-collar jobs. Given that most of Goa's working population relies on public transportation, Kadamba Transport Corporation is crucial to the state's commercial and economic growth. (Scholar & J-gage, 2016)

In Goa, there are 2 types of electric buses currently operating, Olectra and PMI. The first batch of EV buses was delivered in April. A count of 48 buses ordered from Haryana-based PMI electric mobility, under the smart city mission and Goa liberation fund, will start in April. Goa is currently running 83 EV buses of the company having 28- and 48-seater buses. Goa will add 100 more electric vehicles (EVs) to its fleet of Kadamba buses under the FAME II Scheme. Electra has thirty environmentally friendly electric buses in Goa, and five more are Being added. olestra buses are also deployed at Mumbai, Pune, Nagpur, Hyderabad, Surat, and Silvassa.

1.2 Olectra GreenTech

The first company in India to operate and implement electric buses for public transportation is called Olectra. Olectra has the largest market share in this category and is India's top electric bus manufacturer. In more than 320 STUs across India, Olectra has already installed electric buses. To provide passengers with a comfortable and safe ride, these 12-meter air-conditioned buses are Unibody models with seating for more than 48 drivers and electronically controlled air suspension in the front and rear. They also feature disc brakes with ABS in the front and rear. These buses have GPS tracking, USB ports for charging mobile devices, emergency buttons, CCTV cameras to protect the safety of the commuters, and other features. Depending on traffic conditions, the bus's lithium-ion (Li-ion) battery allows it to travel up to 200–250 km on a single charge. Four to five hours are needed for the full charge.

According to the news and report, Olectra pledged to continue its efforts to lower pollution levels by implementing an effective Electric Public Transport System, and they are grateful to Kadamba for giving them the chance to operate their buses in Goa.

1.3 PMI Electro Mobility

The goal and vision of PMI is to embrace sustainability and offer eco-friendly mobility solutions. Mr. Satish Kumar Jain and Mr. Anurag Agarwal founded PMI Electro in 2017. By moving forward and building industrial and battery plants, PMI Electro overtook the top OEM in India to become the country's second-largest OEM. With more than 1200 buses spread across more than 27 cities, PMI was able to improve both the passenger experience and environmental changes.

According to Satish Jain, Chairman of PMI Electro Mobility, "With its electric buses, PMI will contribute towards making Goa's public transport system cleaner and help facilitate the switch

to green mobility, which is one of Goa's priorities." In its transition to clean mobility, the state will be able to avoid emitting more than 13,000 tons of CO2 over ten years with the aid of these electric buses, he said. PMI will run and oversee these buses using technologically advanced electric bus depots to ensure dependable service for Goan residents.

This paper begins with an introduction in Section 1 to the background of Goa with its transport system and the objective of this study understanding its factors. Then, in Section 2, we conduct a literature review regarding the public's acceptance of electric buses, and the factors influencing their decisions to use Electric buses as their mode of transportation.

1.4 Scope of the Study

The scope of the study is to examine passengers' satisfaction with electric buses in Goa. The survey is conducted in Goa, the passengers traveling in electric buses about their satisfaction and loyalty to travel in electric buses, and to investigate the factors affecting passenger satisfaction and loyalty. There are two research approaches such as deductive (quantitative) and inductive (qualitative). The quantitative research approach mostly relies on deductive logic. The researcher begins with hypothesis development and then collects data. Data are used to determine whether empirical evidence supports the hypotheses (Rajput & Gahfoor, 2020). In this research the first part is qualitative data which is collected through a questionnaire, taking a survey of passengers of north Goa and south Goa. Traveling around Goa is easy because there is an extensive road network that connects most places in Goa (Scholar & J-gage, 2016). The factors considered when examining the degree of satisfaction include service quality in terms of the tangible aspects of electric vehicles (EVs), passenger acceptance of EVs in terms of technology, and the quality of EVs as perceived by bus drivers. When it comes to EV bus operation, factors like speed, dependability, and network availability are considered. Bus crowding, ticketing, temperature, and noise levels are also taken into consideration. Additionally, the environmental performance of EV buses in Goa is monitored, and passengers' satisfaction and loyalty are evaluated. It is evident that better service quality results in increased usage of public transport facilities, which further reduces traffic congestion and environmental emissions (Munim & Noor, 2020). To investigate several hypotheses regarding the connections between comfort and convenience, network, operations, service quality, passenger satisfaction, and passenger loyalty, a total of 8 variables are being tested with passenger satisfaction structural equation modeling (SEM) used. The dissertation's findings will enable us to understand better how satisfied passengers are with EV buses, whether Kadamba Transport's

EV bus services meet up to customer's expectations, and whether EV buses are practical for daily use.

1.5 Objective of the study

1. "To analyze the demographic characteristics of passengers using electric buses in Goa."
2. "To investigate the factors affecting passenger satisfaction and loyalty."

1.6 Hypothesis

1. H0: There is no significant difference between the Location among the passengers concerning gender, age, education, monthly income, occupation, and place of residence.
2. H0: There exists no significant association between service quality and passenger satisfaction.
3. H0: There exists no significant association between network and passenger satisfaction.
4. H0: there is no significant association exists between operations and passenger satisfaction.
5. H0: There exists no significant association between comfort and convenience and passenger satisfaction.
6. H0: There exists no significant association between environmental performance and passenger satisfaction.
7. H0: There exists no significant association between passenger satisfaction and passenger loyalty.

1.7 Research Gap

Significant research on electric buses has been conducted globally but the gap in this topic is that there is no study conducted on passenger satisfaction and loyalty in Goa. This study aims to address this gap by analyzing the demographic characteristics of current electric bus users in Goa, assessing passenger satisfaction and passenger loyalty toward electric buses in the state, and identifying key factors affecting passenger choices regarding electric bus adoption.

CHAPTERISATION SCHEME

The entire research is divided into four chapters,

Chapter1: Introduction

This chapter includes an Introduction, background of Goa transportation, and background of the electric buses used in Goa. Scope of the study, objectives of the study, Hypothesis for study, and, research Gap.

Chapter2: Literature Review

This chapter thoroughly examines and investigates the existing literature on passenger satisfaction and loyalty towards electric buses in Goa. It is divided into six parts based on the variables used in this study. The variables are based on the factors which affect passenger's satisfaction with electric buses.

Chapter 3: Research Methodology

This chapter outlines the different methodologies employed to address the research questions. The source of the study is the primary and secondary data used to analyze the variables. The different statistical tools used in analyzing the data that is a descriptive test, a chi-square test of independence, and, structural equation modeling. For objective one descriptive analysis was used along with chi-square, for objective two, Structural Equation Modeling (SEM) was applied to investigate the factors affecting passenger satisfaction and loyalty regarding electric buses (EV- -buses) in Goa. Measures such as Cronbach's Alpha (CA), Composite Reliability (CR), and Average Variance Extracted (AVE) are also stated to assess the reliability and validity of the constructs, hypothesis testing, and mediation effects to analyze the indirect effects of the variables.

Chapter 4: Data Analysis, Results, Discussion

The last chapter includes data analysis, results, and discussion of the findings for objective 1, Jamovi was utilized to ascertain the demographic profile of respondents, and the Satisfaction Level was measured with factors loading results along with measures of Cronbach alpha, composite reliability, its Average variance extracted were measured, along with is hypothesis testing and the mediation effects of the variables on passengers loyalty, Additionally, path coefficients, T-values, R^2, were examined to analyze the relationships between variables and

the explanatory power of the model. The chapter also provides a discussion of the findings, managerial implications, and limitations.

CHAPTER 2: LITERATURE REVIEW

The previous study has focused on Numerous measurement scales that are available for estimating how loyal a passenger is to an electric bus. Although it is measured indirectly through passenger satisfaction, Oliver's four-stage theoretical model of loyalty—cognitive, affective, conative, and action—is taken into consideration. Variables like perceived service quality, passenger satisfaction, and environmental friendliness strongly impact passenger loyalty to electric buses. (Shiftan et al., 2015). Passenger satisfaction is a multifaceted, intricate concept acknowledged as one of the key success factors for businesses (Yeung et al., 2002). since passenger loyalty and passenger satisfaction are strongly correlated. Put differently, passengers are satisfied when they feel that the performance has met or exceeded their expectations; however, when the opposite is true, they are not entirely satisfied and have a negative reaction to the experience (Kotler, 2003). When a passenger is pleased with the services offered by an electric bus, they are more likely to be loyal passengers, which encourages other passengers to use the bus through referrals, word-of-mouth, etc. (Vicente, P., Sampaio, A., & Reis, E, 2020). A key idea in this study is passenger satisfaction. A passenger's assessment of whether a product or service offers an enjoyable level of consumption-related fulfillment—including under- or over-fulfillment—is known as customer satisfaction. (Munim & Noor, 2020). Customer satisfaction with public transportation depends on several service quality factors, including availability, travel route, cleanliness and view of the mode of transportation, and the presence of necessary emergency services, among others. (Eboli & Mazzulla, 2007). The study employs structural equation modeling (SEM) to investigate the correlation between passenger satisfaction and service quality attributes in public transportation. (Eboli & Mazzulla, 2007). According to the study, station services, safety, cleanliness, comfort, convenience, and connectivity, all have a positive impact on passenger satisfaction. (H. Singh & Kathuria, 2023). The SERVQUAL measurement scale developed by Parasuraman et al. (1988) has been used by previous studies to assess service quality in different contexts, for example, to assess service quality in the transport industry (Morton et al., 2016), travel and tourism (Fick and Brent Ritchie, 1991), airlines (Tsaur et al., 2002) and many more. Morton et al. (2016) adopt the SERVQUAL approach to measure convenience, cabin environment, and ease of use of public bus service. (Munim & Noor, 2020). (Munim & Noor, 2020)used the SERQUAL model to understand service quality and environmental performance with customer satisfaction to life satisfaction. The previous study made by (Hsieh, 2023) about the post-COVID-19 hierarchy of public transport explored the relationship

between service attributes, satisfaction, and loyalty. They analyzed loyalty in two ways partial mediation and full mediation, The results supported a full mediation model, indicating that attribute effects on loyalty were indirect via overall satisfaction. However, they have considered the stage of COVID-19 and took different variables on non-eco-friendly buses so to find the passengers' satisfaction with passengers' loyalty (Hsieh, 2023).

2.1 Service Quality to Passenger Satisfaction (SQ)

Since most services cannot be counted, measured, inventoried, tested, or verified before sales, they are more challenging to describe than products. Assessments of quality consider more than just the final product of a service; they also assess how the service is delivered (Vicente et al., 2020) (Laisak et al., 2021). In the case of public transportation services, the correlation between passenger satisfaction and service quality is critical. Bus service quality attributes that have a big impact on passenger satisfaction are tangibles, technology acceptance, and bus drive quality. Below is a summary of how these variables affect passengers' satisfaction: The uptake of technological innovations, like electric buses, has a significant impact on passenger satisfaction and service quality. Passenger satisfaction and loyalty to sustainable urban mobility solutions are influenced by factors such as the perceived environmental performance, convenience, dependability, and reliability of electric buses. (Oljira, 2020), Another crucial element that affects how satisfied passengers are with public transportation is the caliber of bus drivers. The overall experience and satisfaction levels of passengers are improved by bus drivers' qualities of empathy, professionalism, and service. (Ni et al., 2020), Concrete features of public transportation, such as bus temperature, noise level, and physical comfort greatly influence passenger satisfaction. A bus's comfort, cleanliness, and design are important factors that contribute to improving the overall travel experience and increasing passenger satisfaction.(Laisak et al., 2021). The key to improving passenger satisfaction with public transportation services is to maintain bus driver quality, embrace technology, embrace high service quality, and concentrate on tangible aspects. Positive or negative, expectations are shaped by a variety of factors, including consumer-to-consumer communication (word-of-mouth), prior customer experiences with the service and the service provider, external communication that the service provider promotes (promises of high-quality service typically raising customer expectations), and the desires of individual customers (Laisak et al., 2021). Tangibles include crew appearance, communication options, equipment and appliance views, and the physical layouts, surroundings, and facilities offered by the service (Laisak et al., 2021). Service quality is an illusory construct due to the intangibility, heterogeneity, and inseparability

of production and consumption (Parasuraman et al., 1985). It can also be very important that the emergency safety toolkit and required signs are easily accessible. Unavoidable features include the capacity to accommodate special care needs like wheelchair and children's stroller users, a wheelchair-friendly boarding system, room for large luggage, etc (Eboli & Mazzulla, 2007). In terms of technology acceptance of EV buses, the purchase intention and expected satisfaction level were positively impacted by EVs' characteristics, performance problems, and incentive policy measures, according to a survey of prospective EV users (Jiang et al., 2021). The bus driver's quality of EV buses is a very important factor that influences the use of Electric buses. Bus drivers are crucial to the passengers' smooth and comfortable travel experience. Perceived utility, perceived ease of use, environmental performance, and technology are influencing factors of drivers' overall satisfaction with electric buses, according to a study looking at how E-bus satisfaction affects driving behavior (Jiang et al., 2021). This implies that bus drivers' happiness with the electric bus's quality may also influence passengers' satisfaction because contented drivers might give passengers better service.

2.2 Network to Passenger Satisfaction (NW)

According to the search results, there is a lot of research being done on the network between bus stop availability, timing, and passenger satisfaction for electric buses (EVs). Electric bus scheduling and timetabling seek to maximize passenger satisfaction by arranging charging schedules and ideal arrival and departure times. (Islam, 2014). It has been demonstrated that electric buses arrive on time, which may increase passenger satisfaction. Electric bus scheduling and charging optimization are essential to ensure that the bus network operates efficiently (Review, 2022). This includes the incorporation of infrastructure for charging into the bus network, which may affect bus scheduling and timetabling. (Review, 2022). The operation of public transportation systems, including electric buses, can be optimized with the use of fuzzy dynamic timetable scheduling. Passenger satisfaction is significantly influenced by the accessibility and practicality of bus stops, as well as the frequency and timing of bus services. According to a study, bus stops that were easily accessible and had frequent bus service had higher passenger satisfaction. The relationship between productivity and the availability of transit services also impacts passenger satisfaction. Several variables, including fare, comfort, safety, service fare, travel time, and convenience of intra-urban services, can be used to forecast passenger satisfaction. (Shbeeb, 2022). planned departure time, advance departure time, delayed departure time, average delay time, and delayed arrival time of vehicles at data collection points were used to study the reliability of public transportation operations.

To prevent on-trip traffic jams and bus stop delays, optimal road operating conditions are also necessary, which makes controlling the bus's arrival time fluctuation seem challenging. Enhancing the dependability of bus transportation is a useful strategy for middle-aged and younger commuters on business. Because shorter travel times would have positive emotional effects, enhancing the bus's reliability is beneficial for a positive perception of dependability (Weng et al., 2023). Passengers' satisfaction with punctuality can rise when time fluctuations are reduced.

2.3 Operations to Passenger Satisfaction (OP)

The overall networking efficiency of bus services and the degree of passenger satisfaction are significantly influenced by the speed of electric buses. Bus speed has an impact on passenger convenience and experience by influencing travel time, connectivity, and reliability of the transportation network. Increased speeds can result in shorter travel times, better connectivity between routes, and an overall improvement in the bus network's efficiency. Meeting passenger expectations, improving the allure of public transportation, and encouraging the adoption of sustainable urban mobility solutions all depend on electric buses operating at optimal speeds. (Yang, X., & Liu, L. To satisfy passengers, shorten wait times, and enhance the overall travel experience, schedules, and timetables must be followed on time. When electric buses are timed effectively, the transportation network becomes more connected and appealing to passengers. To encourage the adoption of sustainable urban mobility solutions and raise passenger satisfaction levels with public transportation services, electric buses must operate at the best possible time. (Perumal et al., 2022)**.** The sources offered to shed light on several related topics, such as the difficulties in balancing the amount of charging that electric buses receive in city bus route networks and scheduling charging times. It also stressed how crucial effective scheduling and charging management is to guarantee the punctuality and dependability of electric bus services, which in turn affects passenger satisfaction. The intricate matter of how operations, speed, timing, and reliability affect passenger satisfaction on electric buses encompasses the effective management of electric bus services, the optimization of charging schedules, and the integration of charging infrastructure into bus networks. The effectiveness of electric bus systems and passenger satisfaction may both be strongly impacted by these variables (Package, 2023). Reliability is one issue that frequently arises with public transportation. Measuring a service provider's reliability involves determining how consistently and precisely they can deliver on their commitments (Mat et al., 2019).

2.4 Comfort & Convenience to Passenger Satisfaction (CC)

In addition to affecting, one's physical comfort, crowding can have a negative psychological impact on one's stress level, anxiety, and sense of privacy invasion. Several variables, including the availability of seats, the standing conditions, and the general level of crowding on buses with getting down during travel, have a substantial impact on passengers' perceptions of comfort. Improving comfort levels and fostering a positive experience for users of public transportation requires addressing issues of crowding and guaranteeing sufficient space for passengers. Reducing crowding can improve comfort, which will boost passenger satisfaction and promote public transportation over private vehicles, both of which will support sustainable urban mobility. (Roncoli, C., Chandakas, E., & Kaparias, I. (2023).

The study by (Kwon et al., 2020) highlights how important external design is in setting electrified buses apart from conventional buses. The importance of ride comfort—which includes comfort with vibration and noise during take-off, driving, and stopping—is highlighted in the study by Lin and Wu (2018). The search results show that indoor crowding brought on by bus passengers and seat comfort are important elements that influence passenger satisfaction in electrified buses in terms of temperature and crowding. (Kwon et al., 2020)

2.5 Environmental Performance to Passenger Satisfaction (EP)

Passenger perceptions and satisfaction levels are significantly influenced by using electric buses, which are more ecologically friendly than conventional diesel buses. When compared to diesel buses, electric buses lessen their overall environmental impact, noise pollution, and CO2 emissions. In addition to helping passengers, adopting electric buses due to their superior environmental performance also makes public transportation cleaner and more sustainable, which in turn improves passenger satisfaction and the public's opinion of public transportation services (Munim & Noor, 2020). Since countries realized that issues like acid rain, ozone layer damage, and global warming have a substantial negative impact on people's quality of life, they have become more concerned about protecting the environment (Vicente et al., 2020). Moving to more environmentally friendly buses, like HEBs and electric buses, is a feasible option for bus service providers as public awareness of environmental sustainability has grown (Munim & Noor, 2020). Passengers are becoming more environmentally aware, educated, and appreciative of sustainability, which is likely to support transit agencies' dedication to environmental sustainability. Additionally, studies have started looking into how users' perceptions of public transportation affect their loyalty and level of satisfaction in recent years. (Vicente et al., 2020). Furthermore, consumers are more inclined to choose environmentally

friendly options even if they are more expensive and are avoiding goods and services altogether because they are concerned about the environment. Although the main objectives of these goals are to cut costs, boost productivity, and ensure sustainability in the future, passenger environmental awareness may motivate transit agencies to go above and beyond in their pursuit of retaining the support of transit users, as sustainable business practices are currently one of the key elements influencing consumer brand loyalty (Vicente et al., 2020).

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Source Of The Study

The primary focus of this study is how satisfied Goan passengers are with the services offered by electric buses. Most of the data used in this study are secondary and primary data. Secondary data is obtained from the applicable corporation, while primary data is based on empirical analyses using survey methodology.

Primary data: The primary data was gathered from Electric Bus passengers who were given a Google questionnaire containing questions that would be useful in examining the passengers' satisfaction with Electric Buses. The questionnaire was distributed to all age groups, genders, income brackets, and regions of Goa—both north and south—and was found to be complete, comprehensive, and useful for data analysis. The survey has a sample size of 450 electric bus passengers.

Secondary data: Newspapers, magazines, internet websites, and annual reports released by Kadamba Transport Corporation Ltd. were the sources of secondary data.

3.2 Statistical Tools Used In The Analysis The Data

3.2.1 Descriptive Analysis

A variety of socioeconomic and demographic factors are taken into consideration when analyzing passenger satisfaction in a descriptive analysis (S. Singh, 2016). Part and parcel of descriptive analysis, descriptive statistics offers concise synopses of a sample and the observations recorded, emphasizing data summarization overpopulation inference (*Descriptive Statistics*, 2023). To summarize and comprehend the distribution of data, descriptive analysis in the context of a frequency table entails the computation of various descriptive statistics. This comprises quartiles, percentiles, kurtosis, mean, median, variance, and median absolute deviation (MAD) as well as the interquartile range (IQR). These statistics help identify patterns and outliers by revealing information about the central tendency, variability, and location of data points within the frequency table (Jones & Goldring, 2022).

3.2.2 Chi-Square Test Of Independence

A statistical test called the Chi-square test of independence is used to investigate the relationship between two categorical variables, each having two or more categories (Expert Help Guides: SPSS: Chi-square Test for Independence, n.d.). It is predicated on a contingency

table that displays the number of observations within every permutation of groups. The test contrasts the frequencies that are observed with those that would be predicted in the absence of any relationship between the two variables. According to Turner (2023), the proportions of one variable remain constant for every value of the other variable because of the expected frequencies. A null and alternative hypothesis is evaluated using the Chi-Square Test of Independence. The two variables are unrelated, according to the null hypothesis (H0), but they are related, according to the alternative hypothesis (Ha), Based on the significance level and degrees of freedom, the test statistic is compared to a critical value from the Chi-Square distribution. A significant relationship between the two variables is indicated if the test statistic exceeds the critical value, rejecting the null hypothesis (Turney, 2023).

3.2.3 Structural Equation Modeling

Researchers use a core set of statistical techniques known as first-generation multivariate data analysis techniques, like multiple regression, logistic regression, and analysis of variance, to test hypothesized relationships between variables of interest through empirical research. “These techniques have three important limitations in common, namely (1) the postulation of a simple model structure, (2) requiring that all variables can be considered observable, and (3) the assumption that all variables are measured without error (Haenlein & Kaplan, 2004)”. Researchers are increasingly using second-generation techniques to get around these limitations. These techniques, known as structural equation modeling (SEM), allow researchers to estimate and model complex relationships between several independent and dependent variables at the same time. Covariance-based SEM (CB-SEM) and partial least squares SEM (PLS-SEM, also known as PLS path modeling) are the two widely used approaches that dominate SEM in practice. There are two components to a PLS path model. The structural model that connects the constructs (ovals or circles) is the first step in the PLS-SEM process. It is also referred to as the inner model. The structural model also displays the relationships. (paths) that connect the constructs. Second, there are the measurement models of the constructs, which show the connections between the constructs and the indicator variables (rectangles) and are also known as the outer models in PLS-SEM.

3.3 Measurement Model

SEM, which links measurement items to their corresponding latent variables, requires a measurement model. The theoretical foundation and statistical analysis used to support the measurement model's validity and reliability are presented in this section. To ensure the study's

model's reliability and validity, convergent and discriminant validity were assessed using standard criteria (Hair et al., 2019).

3.3.1 Operationalization Of Latent Variables

Figure 1 depicts a conceptual model with seven latent variables that cannot be measured using a single observed variable due to their complexity. Thus, we use multiple observed items to assess each of the conceptual model's latent variables. Exogenous variables include service quality, operation, network, comfort and convenience, and environmental performance, while endogenous variables are passenger satisfaction and loyalty. The service quality and environmental performance are taken from (Munim & Noor, 2020), thus relying the on previous study of (Parasuraman et al., 1985) we adopted the measurement scales. Passenger satisfaction is taken from the above research paper. The other three variables are taken from (H. Singh & Kathuria, 2023) operations, network, comfort, and convenience. The last variable that is passenger satisfaction is the authors' contribution. We dropped the eight variables of shuttle and non-shuttle services as it has low factor loadings. For the environmental performance of electric buses in Goa to the best of the author's knowledge, no previous study has been developed using the multiple observed variables.

3.4 Measurement Theory

The method used to measure the latent variables, or constructs, is defined by measurement theory. Unobservable variables can be measured in two ways in general. The formative measurement model is the other approach and reflective measurement. Reflective indicators show arrows pointing from the construct to the indicator variables, implying that the construct "causes" the measurement (covariation) of the variables.

3.4.1 Consistent Reliability And Validity

The study's constructs were evaluated for convergent reliability using factor loadings, MacDonald omega (ω), Cronbach's alpha (α), composite reliability (CR), rho_A (Dijkstra & Henseler, 2015), and Average Variance Extracted (AVE). Internal consistency reliability refers to the degree to which indicators measuring the same construct are related to one another. The primary measure in PLS-SEM is Jöreskog's (1971) composite reliability rhoc. Higher values indicate a higher degree of reliability. For example, reliability values between 0.60 and 0.70 are regarded as "acceptable in exploratory research," while values between 0.70 and 0.90 range from "satisfactory to good". Cronbach's alpha is another measure of internal consistency

reliability that uses the same criteria as composite reliability (rhoc). The average variance extracted (AVE) for all indicators on a construct is used to assess its convergent validity. The AVE is defined as the grand mean of the squared loadings of the construct's indicators. As a result, the AVE represents a construct's commonality. The minimum acceptable AVE is 0.50; an AVE of 0.50 or higher indicates that the construct explains 50% or more of the variance in the indicators that comprise the construct (Hair Jr, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, 2018). Furthermore, reliability and validity were evaluated, with reliability referring to the degree to which the variables produce consistent results and are error-free.

3.4.2 Discriminant Validity

The discriminant validity of the study's constructs was assessed using the standard criteria; Cross-loadings, (Fornell & Larcker, 1981) criterion, and Heterotrait-Monotrait (HTMT) ratio. the Fornell & Larcker criterion showed that the square root of the AVE value exhibited on the diagonal values for each construct is greater than its correlation with other constructs, implying construct-level discriminant validity has been established in this study's model (Fornell & Larcker, 1981).

3.5 Assessment Of The Structural Model

After establishing the convergent reliability and discriminant validity, the structural model was assessed to test the significance and relevance of the path coefficient (testing hypotheses), and the coefficient determination (R2) (Hair et al., 2019).

3.5.1 Hypotheses Testing

The bootstrapping procedure with 5000 subsamples was used to test the study's hypotheses (Gharsi et al., 2024). The bootstrapping procedure produces t-values for the indicator weights (among other model parameters). To determine whether the coefficients differ significantly from zero, we must compare these t-values to the critical values of the standard normal distribution. With a significance level of 5%, a t-value greater than 1.96 (two-tailed test) indicates that the indicator weight is statistically significant. Accordingly, the model hypotheses (H1–H7) in Table 5 are tested by deploying the PLS algorithm in SmartPLS 3.0 based on bootstrap re-sampling performed to examine the path significance levels of each hypothesis. Additionally, the structural model assessment is measured by examining the path coefficients value (β) which evaluates the association between variables based on their degree of significant levels (p-value) which is significant when p= <0.05. Moreover, the coefficient of

determination termed R^2 value is used to measure the predictive significance of the model hypotheses. Next, the t-value is employed to assess the effects of each hypothesis which is based on the regression coefficients and associated significances as shown in Table 5 where the t-value should be greater than 1.96.

3.5.2 Mediation Analysis

Mediation occurs when a construct, intervenes between two other related constructs. The change in the exogenous construct causes a change in the mediator construct, which, in turn, results in a change in the endogenous construct in the PLS path model. w. Indirect effects are those structural model paths that involve a sequence of relationships with at least one intervening construct involved. indirect effect is a sequence of two or more direct effects. Many PLS path models include mediation effects but are often not explicitly hypothesized and tested (Hair et al., 2022).

Complementary mediation: the indirect effect and the direct effect are significant and point in the same direction

No-effect non-mediation: neither the direct nor the indirect effect is significant.

CHAPTER 4: DATA ANALYSIS, DISCUSSION, RESULT

4.1 Data Analysis

SEM software and Jamovi software were used to analyze the data. Data on how satisfied passengers were with Goa's electric buses was gathered. A five-point Likert scale—where five points are given for strongly agreeing and one point is given for strongly disagreeing—is used to analyze this data. The study was conducted between January 10, 2024, and March 26, 2024. 450 respondents were given a structured questionnaire through convenience sampling. There were two sections to the structured questionnaire. The initial section aimed to evaluate the respondent's gender, age, education, income, occupation, and place of residence. The first hypothesis is tested, and the research question is addressed in this section. To determine whether there are any notable differences between the demographics and travel periods of passengers on electric buses, a chi-square test was used. The basic question of who the customers are is addressed using the analysis's outcome. The subsequent section pertained to diverse elements impacting commuter contentment and allegiance to electric vehicle buses. Customers were asked to rate on a 5-point Likert scale how much they agreed (scale of 5) or disagreed (scale of 1) with each statement. Eight variables were taken from previous research. Passengers were asked to rate their level of satisfaction with EV buses on a 5-point Likert scale, with 1 denoting strongly disagree and 5 denoting strongly agree. Eight variables were created using the SERVQUAL model (Gaonkar et al., 2021).

4.2 Result And Discussion

4.2.1 Demographic Profile

In this section, a cross-tabulation of customer demographic variables is performed alongside that of location, i.e., North Goa and South Goa, to determine whether there is a significant difference among passengers across the state of Goa. Table 1 shows that the majority of respondents (55.42%) in North Goa and South Goa are female, with fewer males. The age profile in both cases indicates that the majority are between the ages of 18 and 30 (66.27% in North Goa and 41.79% in South Goa). The majority of respondents have completed their college education (38.96% in North Goa and 33.33% in South Goa), and there are even respondents with post-graduate degrees in North Goa (23.29%). The majority of respondents are middle- or low-income earners (88.35% in North Goa and 66.17% in South Goa). In terms of occupation, the majority of respondents are students (51.81% in North Goa and 32.34% in South Goa), as well as employees (Pvt) (30.12% in North Goa and 23.38% in South Goa), and

even government employees in South Goa (22.39%). In terms of place of residence, the majority of respondents are urban (51% for North Goa and 58.21% for South Goa).

Table 1: Demographic profile of customers (N=450)

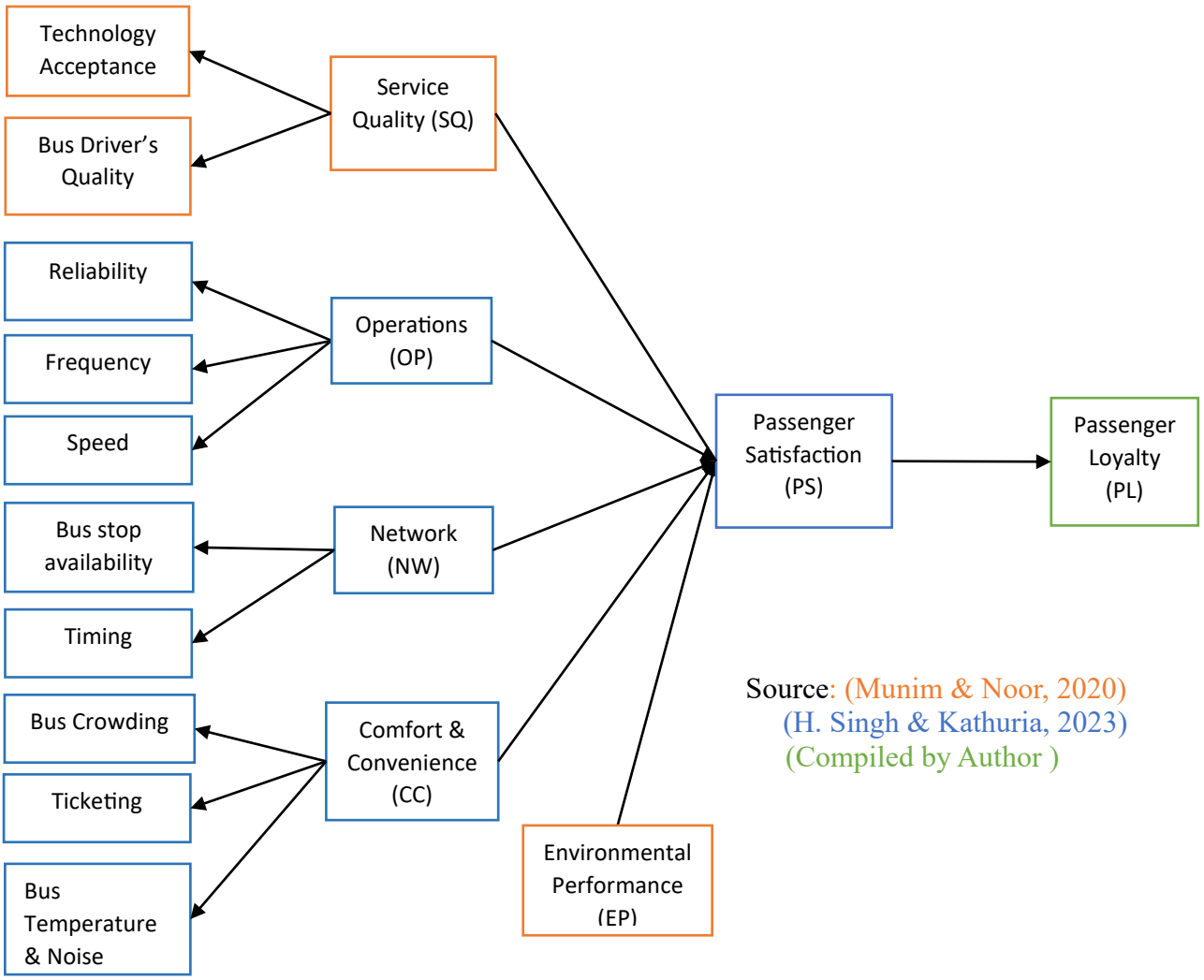
Demographic characteristics		$\chi 2$ value (p)	Location			
			North Goa		South Goa	
			#	%	#	%
Gender	Male	0.977	111	44.58	99	49.25
	Female	(0.323)	138	55.42	102	50.75
Age	Below 18 years	42.4 * (0.001)	21	8.43	10	4.98
	18 - 30 years		165	66.27	84	41.79
	31- 40 years		22	8.84	39	19.40
	41- 50 years		26	10.44	27	13.43
	More than 50 years		15	6.02	41	20.40
Education	10^{th} std	33.9* (0.001)	30	12.05	24	11.94
	12^{th} std		46	18.47	26	12.94
	Diploma		13	5.22	38	18.91
	Graduation		97	38.96	67	33.33
	Post Graduation		58	23.29	30	14.93
	Professional		5	2.01	16	7.96
Monthly Family Income	Up to Rs.15000	35.1* (0.001)	156	62.65	84	41.79
	15000 to 30000		64	25.70	49	24.38
	30000 to 45000		18	7.23	36	17.91
	Above 45000		11	4.42	32	15.92
Occupation	Student	40.8* (0.001)	129	51.81	65	32.34
	Employed (Govt)		15	6.02	45	22.39
	Employed (Pvt)		75	30.12	47	23.38
	Homemaker		17	6.83	22	10.95
	Unemployed		13	5.22	22	10.95
Place of residence	Urban	2.33 (0.127)	127	51	117	58.21
	Rural		122	49	84	41.79

Note: *Significant at 0.05 Source: Compiled by Author

Though it is clear that, except for gender, both North Goa and South Goa respondents have the same characteristic features, the Chi-square test result indicates that the chi-squared value is not significant (0.977, p=0.323). However, there is a slight difference in the distribution of urban and rural residents between North and South Goa, but it is not statistically significant ($\chi 2$ = 2.33, p=0.127), all other demographic variables (Age, Education, monthly income, and occupation) are significant having have of (age: $\chi 2$ = 42.4, p < 0.001, education: $\chi 2$ = 33.9, p<0.001, monthly income $\chi 2$ = 35.1, p<0.001, and occupation: $\chi 2$ = 40.8, p<0.001), hence the Null hypothesis (H0) that is "There is no significant difference between the Location among the passengers concerning gender, age, education, monthly income, occupation, and place of residence". Is rejected, apart from age and place of residence.

4.2.2 Satisfaction Level

Measurement model Fig 1.



Source: (Munim & Noor, 2020)
(H. Singh & Kathuria, 2023)
(Compiled by Author)

Table 2: Measurement items and their reliability

Constructs and their respective items	codes	Factor loadings
Service Quality of the buses	(SQ)	
1. The electric bus operation is simple and easy to understand.		0.788
2. The visibility of emergency exits in electric buses is clear.		0.798
3. the driver gives the passengers a comfortable and smooth ride.		0.815
4. The seating arrangement in electric buses is comfortable.		0.817
Network of the buses	(NW)	
1. I find the routes, schedules, and other related details easily accessible at EV bus stops to meet my needs.		0.804
2. I think the shades and seating availability at the EV bus are comfortable while waiting for the bus.		0.800
3. The electric bus arrives at the designated stops on time.		0.783
4. The departure time of the electric bus is convenient for my travel needs.		0.788
Operations of the buses	(OP)	
3 I believe that electric buses are reliable for my everyday transportation needs.		0.740
4 To what extent do you find the punctuality of EV buses satisfactory?		0.770
5 Electric buses followed all posted speed limits and traffic laws		0.790
6 The bus's speed was appropriate for the duration of the journey.		0.802
Comfort and convenience of the buses	(CC)	
1. The conductors' handling of the crowd is satisfactory.		0.716
2. I find it easy to get on and off during rush hour.		0.786
3. The ticketing process is efficient and quick in EV buses.		0.789
4. The payment options offered for ticket purchases are fair in EV buses.		0.781
5. The ticket cost was reasonable for the services provided by EV buses.		0.791
6. The overall temperature inside the bus was comfortable.		0.826
7. The heating or cooling system met your preferences.		0.795
8. The overall noise level inside the bus is low.		0.801
Environmental performance of the buses	(EP)	
1. The electric bus service is better for the environment.		0.857
2. The electric buses control clean energy sources.		0.833
3. Electric buses lower the emission of CO2 into the environment.		0.844
4. By benefitting from the electric bus service, I help improve the environment worldwide.		0.850
5. How much do you think the electric bus service represents eco-friendly initiatives?		0.838
Passenger Satisfaction of the buses	(PS)	
1. My satisfaction with the electric bus service has increased.		0.857
2. My impression of electric bus service has improved		0.878
3. I have a more positive attitude towards the electric bus service		0.902

Passenger Loyalty	(PL)	
1. I would like to continue using electric buses as a mode of transportation in the future.		0.867
2. I would recommend the electric bus services to others to use as a mode of transportation.		0.850
3. My loyalty to the electric bus services is strong.		0.868

Source: Compiled by Author

Table 3: Reliability And Validity

	Cronbach's alpha	Composite reliability (rho_c)	Average variance extracted (AVE)
SQ	0.818	0.880	0.647
NW	0.806	0.872	0.630
OP	0.779	0.858	0.602
CC	0.911	0.928	0.618
EP	0.899	0.926	0.713
PS	0.853	0.911	0.773
PL	0.827	0.896	0.742

Source: Compiled by Author

In reflective measurement models, factor loadings represent the strength of the relationship between latent factors and observable variables. High factor loadings indicate a strong connection between the latent factors and observable variables, suggesting good reliability and validity of the model. Factor loading is used in a variety of research to indicate the direction and degree of the relationship between distinct variables and underlying factors (Matuk et al., n.d.). As seen in Table 2, first, the results reveal that all the items' factor loadings are above the minimum recommended threshold value of 0.5 (Hair et al., 2019). In the model, the factor loading ranges from 0.7 to 0.9 which indicates a strong relation between the constructs and the items. Table 3 includes Cronbach's alpha (Cronbach, 1951) and composite reliability (CR) for each factor. Cronbach's Alpha and CR values for all factors exceed the recommended threshold of 0.70, as suggested by (Hair, Black, Babin, and Anderson (2010). This establishes the measurement model's reliability. Cronbach's alpha is widely used by researchers to assess the validity of their measurements (Kotian et al., 2022). A value of 0.6 is considered strong and acceptable reliability (Pallant, n.d.). All variables in the model have a reliability range of 0.7 to 0.9, which is a good indicator. The average variance extracted (AVE) is a commonly used metric to demonstrate convergent validity on the constructed level. An AVE value of 0.50 or higher, applying the same reasoning as with

the individual indicators, means that the construct, on average, explains more than half of the variance of its indicators. Table 3 shows that the AVE value is more than 0.50 which means that the constraints explain the indicators.

Table:4 Fornell Larcker

	CC	EP	NW	OP	PL	PS	SQ
CC	0.786						
EP	0.785	0.845					
NW	0.732	0.631	0.794				
OP	0.753	0.717	0.751	0.776			
PL	0.756	0.757	0.579	0.694	0.862		
PS	0.786	0.743	0.638	0.689	0.784	0.879	
SQ	0.778	0.748	0.654	0.762	0.743	0.731	0.805

Source: Compiled by Author

According to the widely recognized Fornell and Larcker methodology, discriminating validity is attained when the square root of AVE is greater than the correlations between the parts (Henseler et al., 2015). The same was applied to this investigation, and it was discovered that the outcomes satisfied the requirements. The square root of the provided service The correlation between Service quality, network, operation, comfort and convenience, environmental performance, passenger satisfaction, and passenger loyalty was higher than their correlation.

Table:5: Hypothesis Testing

Variable	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Remark
SQ -> PS	0.183	0.183	0.050	3.638	0.000	Significant
NW -> PS	0.047	0.048	0.057	0.828	0.408	Insignificant
OP -> PS	0.059	0.060	0.062	0.944	0.345	Insignificant
CC -> PS	0.380	0.380	0.064	5.901	0.000	Significant
EP -> PS	0.236	0.235	0.054	4.402	0.000	Significant
PS -> PL	0.784	0.784	0.024	32.349	0.000	Significant

Source: Compiled by Author

The table that follows shows the findings of a regression analysis that looked at the connections between different independent variables and dependent variables.

The first row indicates variables that is the independent variable and dependent variables, (SQ) are the service quality and (NW) network, (OP) operations, (CC) comfort and convenience, (EP) environmental performance, (PS) passenger satisfaction, (PL) passenger loyalty.

Original sample (O): The original sample coefficients, which indicate the direction and strength of each independent variable's relationship with the dependent variable, are shown in this

column. Statements regarding the relative significance of the exogenous latent variables in predicting an endogenous latent variable can be made by looking at the sizes of the significant path relationships.

T statistics (|O/STDEV|): The T-statistics' absolute values, which are determined by dividing the initial sample coefficients by their corresponding standard deviations, are displayed in the T statistics column. T values are computed to determine the significance of each indicator weight. At a significance level of 5% (a= 0.05; two-tailed test), we can therefore assume that the path coefficient is significantly different from zero when the size of the resulting empirical t value is above 1.96.

P values: P-values represent the probability of incorrectly rejecting the null hypothesis based on the available data. In the context of structural model assessment, the error probability for assuming a path coefficient significantly differs from zero. In applications, researchers compare the p-value of a coefficient to a significance level chosen before the analysis to determine whether the path coefficient is statistically significant. Smaller p-values indicate more evidence against the null hypothesis, implying that the relationship between the independent and dependent variables is statistically significant.

We have considered the Null hypothesis for our study where we assumed that there are no significant associations between the variables, the P-value is considered to evaluate the Null hypothesis whether to accept or reject the hypothesis.

1. H0: There exists no significant association between service quality and passenger satisfaction.

The first variable that is SQ->PS shows that the path coefficient is 0.183 which is less than 0.20 which is low. The T-value is 3.638 which is greater than 1.96 and is at a 5% significance level, and the P-value is <0.000 which is significant, and has a significant effect on the independent variable on the dependent variable, There for we reject the Null Hypothesis.

2. H0: There exists no significant association between network and passenger satisfaction.

The NW->PL has a path coefficient of 0.047, the T-value is 0.828 which is less than 1.96 and the P-value is 0.408 which is more than 0.05, therefore we accept the Null Hypothesis.

3. H0: There exists no significant association between operations and passenger satisfaction.

The OP->PL path coefficient is 0.059, the T-value is 0.944, and the P-value is 0.345 which is higher than 0.05 and is insignificant, therefore we accept the Null Hypothesis.

4. H0: There exists no significant association between comfort and convenience and passenger satisfaction.

The CC->PL has a path coefficient of 0.380 which is greater than 0.20 which means that the CC is comfort and convenience explains the dependent variable which is passenger satisfaction, the T-value is 5.901 and the P-value is 0.000 which is significant, we reject the Null Hypothesis.

5. H0: There exists no significant association between environmental performance and passenger satisfaction.

The EP->PL has a path coefficient of 0.236 and T-value of 4.402 and a P-value of 0.000 which is significant, therefor we reject the Null Hypothesis.

6. H0: There exists no significant association between passenger satisfaction and passenger loyalty.

The PS->PL has a path coefficient of 0.784, the T-value is 32.349, and the P-value is 0.000 which is significant there so we reject the Null Hypothesis.

TABLE 6: Indirect Effect

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Remark
SQ -> PS -> PL	0.143	0.143	0.040	3.557	0.000	(partial mediation) Significant
NW -> PS -> PL	0.037	0.037	0.045	0.831	0.406	(no mediation) Insignificant
OP -> PS -> PL	0.046	0.048	0.049	0.942	0.346	(no mediation) Insignificant
CC -> PS -> PL	0.298	0.298	0.051	5.850	0.000	(partial mediation) Significant
EP -> PS -> PL	0.185	0.184	0.043	4.312	0.000	(partial mediation) Significant

Source: Compiled by Author

The mediating effect of SQ on the PS and PL, NW on PS and PL, OP on PS and PL, CC on PS and PL, and EP on the PS and PL relationship was assessed. As seen in Table 6, it is observed that SQ has a positive and significant indirect effect on PL through PS (β 0.143, t-value 3.557, $p < 0.000$). This indicates that PS has a complementary partial mediating effect (Hair et al., 2021b) on the relationship between SQ and PL, as the direct effect of SQ on PS is positively significant (see Table 5). Hence, there is a partial mediation effect, as same as that CC has a positive and significant indirect effect on PL through PS (β 0.0.298, t-value 5.850, $p < 0.000$). This indicates that PS has a complementary partial mediating effect (Hair et al., 2021b) on the relationship between CC and PL, as the direct effect of CC on PS is positively significant,

Hence, there is a partial mediation effect. It is observed that EP has a positive and significant indirect effect on PL through PS (β 0.185, t-value 4.312, $p < 0.000$). This indicates that PS has a complementary partial mediating effect (Hair et al., 2021b) on the relationship between EP and PL, as the direct effect of EP on PS is positively significant Hence, there is a partial mediation effect. It is observed that NW has no significant effect on PL as there is no indirect effect for there is no mediation effect as there is no direct effect of NW on PS, hence there is no significant effect. In the observed that OP has no significant effect on PL as there is no indirect effect for that reason there is no mediation effect as there is no direct effect of OP on PS, hence there is no significant effect

Table 7: R-square

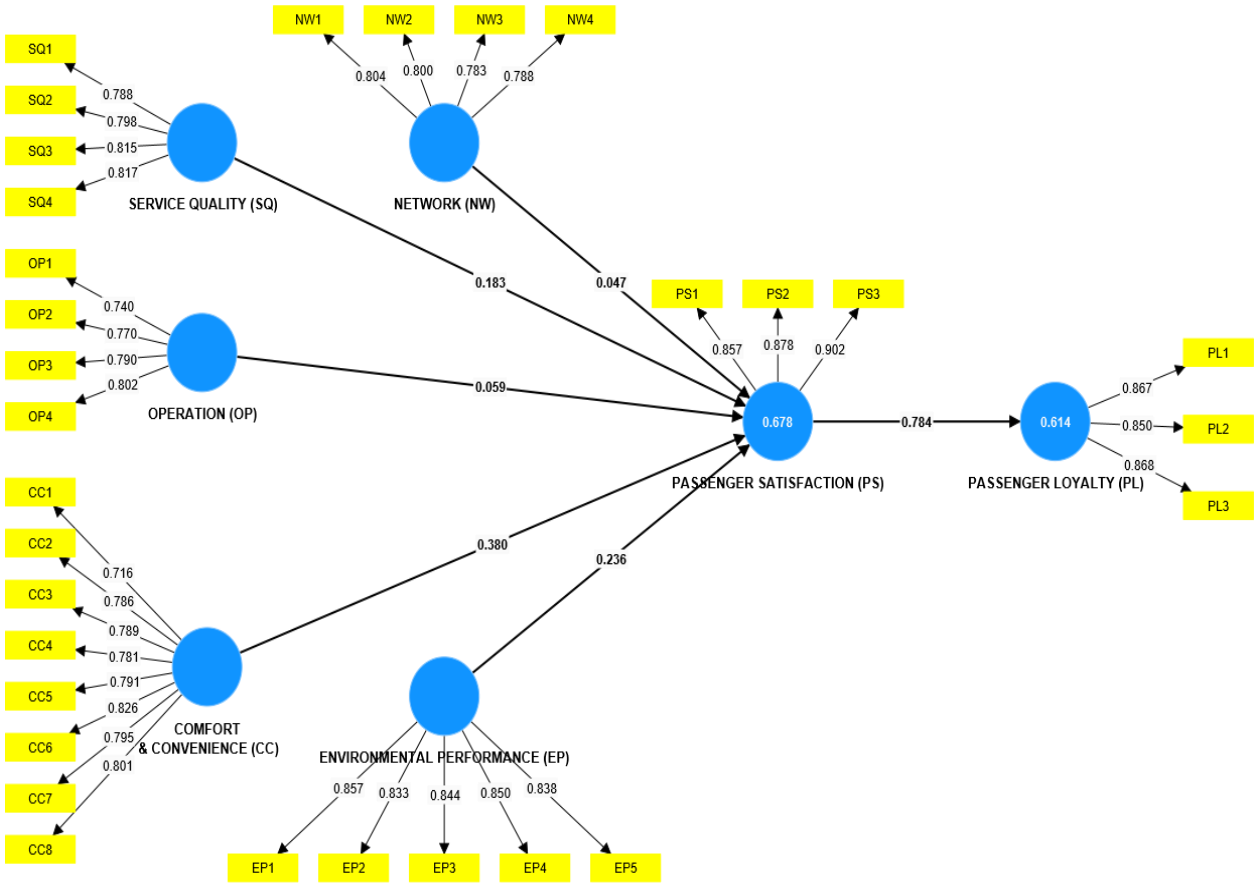
Variable	R-square	R-square adjusted
PASSENGER LOYALTY (PL)	0.614	0.614
PASSENGER SATISFACTION (PS)	0.678	0.675

Source: Compiled by Author

Assessment of the model's explanatory power

The in-sample explanatory power of this study's model was assessed using standard assessment criteria, which are coefficient of determination (R^2) values of the endogenous constructs (PS) and (PL) (Hair et al., 2019c). R^2 values of 0.25, 0.50, and 0.75 are generally considered weak, moderate, and substantial, respectively (Henseler et al., 2015a). As shown in Table 7, the R2 value for the dependent construct (PS) is 0.614, and the dependent PL is 0.678, indicating that this study's model has moderating explanatory power.

Fig. 2. Passenger satisfaction index model



Source: Compiled by Author

Source: Ringle, C. M., Wende, S., and Becker, J.-M. 2022. "SmartPLS 4."

4.3 Discussion of the findings

In this study, we found that people in Goa regard electric buses as an environmentally friendly mode of transportation when provided with adequate service quality. However, we discovered that the perceived environmental performance of electric buses has an impact on customer satisfaction, as well as service quality, comfort, and convenience. Electric buses are actively promoted, but there is little research on the factors that influence passenger satisfaction with electric buses in Goa.

To summarize the key findings, we first look at the demographic profit of Goan passengers based on age, gender, income, education, occupation, and residence place (north and south Goa). We discovered that leaving gender and residence has no significant effect on their satisfaction with the location ("There is no significant difference between the location among the passengers concerning gender, age, education, monthly income, occupation, and place of

residence"). However, age, education, income, and occupation all have a significant impact on the location of the passengers.

Second, we looked at factor loadings, which measure the strength of the relationship between latent factors and observable variables. In this study, we discovered that factor loading ranged from 0.7 to 0.9, indicating a strong relationship between the constructs and the items. The reliability and validity of this model were determined to be reliable because all of the variables in the model have a reliability range of 0.7 to 0.9, which is a good indicator. Along with its AVE value which is higher than the threshold limit.

We examined the potential factors influencing passengers' overall satisfaction with electric buses and their loyalty to them. As a result, we construct a hypothetical framework that includes service quality, networks, operations, comfort and convenience, environmental performance, passenger satisfaction, and loyalty. To test these hypotheses, we collected survey data from Goa's electric buses and used the SEM method to estimate the coefficients of the relationships. We assumed the null hypothesis, which states that none of the five factors has a significant effect on passenger satisfaction. As a result, we discovered that three factors, namely, service quality, comfort and convenience, and environmental performance, had a predictive effect on passenger satisfaction, and the relationship between these factors is significant, whereas the other two variables, operations, and network, do not affect passengers satisfaction, and the relationship between the factor passengers satisfaction is not significant. Furthermore, the findings show that service quality factors (standardized beta: 0.143, p-value: 0.000), comfort and convenience (standardized beta: 0.298, p-value: 0.00), and perceived environmental performance (standardized beta: 0.185, p-value: 0.000) of electric buses have an indirect positive effect on passengers' loyalty, which is mediated by passenger satisfaction. The network factor (standardized beta: 0.037, p-value: 0.406) and an operation (standardized beta: 0.046, p-value: 0.346) were found to have no positive effect on passenger loyalty, implying that there is no mediation effect on passenger loyalty by passenger satisfaction.

4.4 Managerial Implications:

In many cities, traditional fossil fuel-driven buses are being replaced by electric buses. Thus, we study passengers' satisfaction with electric buses in the assessment framework. We collect data from 450 passengers who travel in electric buses in Goa. A conceptual model is estimated using the covariance-based SEM, and also the PLS-SEM for robustness check of the estimates, and Jamovi for analyzing the demographic profile based on location. We found there is a significant effect of factors that affect the passenger's satisfaction and loyalty towards it, so we

rejected our hypothesis and stated that there is a significant effect of the factors. To conclude we found that networking of the buses and their operation that is reliability, timing bus stop availability, frequency, and speed doesn't have any significant effect on passenger satisfaction. The environmental performance of electric buses plays a major role in customer satisfaction. As per the survey, we found that passengers find electric buses a more efficient and eco-friendly option for public transportation.

4.5 Limitation Of The Study

Although the study provided promising results, there are some limitations to consider. While the study provides valuable insights into passenger satisfaction and passenger loyalty regarding electric buses in Goa, it is essential to acknowledge several limitations.

To begin with, the present investigation mainly gathered information from participants in Goa via an internet-based survey. The limits on the applicability of the results could be attributed to the sample size and respondent consistency. The reliability of the findings to the entire population could be compromised if the sample does not represent Goa's consumer base. Respondents' opinions served as the basis for data collection, which may alter over time. Reliance too much on a structured survey questionnaire can lead to response bias.

Second, measurement issues with the survey instrument's accuracy and reliability may impact data quality. Perplexing or poorly worded survey questions can lead to misinterpretation and reduce the validity of the findings.

Finally, the study may not take into account all of the factors that influence passenger satisfaction on electric buses, potentially leaving out important aspects that could affect overall satisfaction rates. External factors, such as economic conditions, regulatory changes, travel conditions, public policy, funding initiatives, and fare levels, may confound the study's findings. These external factors may introduce unanticipated variables that affect passenger satisfaction and loyalty to electric buses in Goa, limiting the study's ability to draw definitive conclusions.

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