CHAPTER I

Introduction

The Chennai Metro, inaugurated in 2015, represents a pivotal moment in the evolution of urban transportation in one of India’s largest cities, addressing critical challenges such as traffic congestion, a rapidly growing population, and environmental concerns that have plagued the region for years. As cities like Bangalore and Hyderabad successfully implement rapid transit systems, Chennai's introduction of metro rail serves as a proactive response to these pressing issues, aiming to enhance the urban mobility landscape. This research paper delves into the myriad benefits that the Chennai Metro offers to its passengers, with a particular focus on its impact on daily commuting patterns, travel efficiency, safety, and the overall quality of life for the city's residents. The metro network features a combination of elevated and underground lines, meticulously designed to improve connectivity across key areas in Chennai. It effectively links vibrant commercial centers, educational institutions, and residential neighborhoods, thereby providing a reliable alternative to traditional modes of transportation, such as buses and autorickshaws. By offering this efficient transit option, the Chennai Metro aims to significantly reduce travel times, making commutes less stressful and more manageable for daily passengers. The affordability and comfort of the metro system stand out as key attributes, ensuring that it remains accessible to a diverse range of passengers, from students to working professionals and families. This inclusivity is crucial in a city where transportation equity is essential for fostering economic growth and social interaction. In examining the effectiveness of the Chennai Metro, this paper explores various dimensions, including its operational performance, passenger satisfaction, and the socioeconomic benefits it brings to the city. The operational performance of the metro is evaluated through metrics such as punctuality, frequency of service, and the overall reliability of the system. High levels of passenger satisfaction are indicative of the metro's success in meeting the needs of commuters and enhancing their travel experience. Surveys and feedback mechanisms are instrumental in understanding passenger sentiments, allowing authorities to make necessary adjustments and improvements. Furthermore, the socioeconomic benefits of the Chennai Metro extend beyond mere convenience; the system has the potential to stimulate local economies by improving access to jobs and services, thereby contributing to the overall economic vitality of the city. Enhanced connectivity can lead to increased foot traffic in commercial areas, benefiting local businesses and promoting entrepreneurship.

However, alongside these positive aspects, the paper also addresses several challenges that could impact the longterm success of the Chennai Metro. Issues such as operational costs, maintenance of infrastructure, and the need for continuous investment in technology and services are critical factors that must be managed effectively to ensure sustainability. Additionally, public awareness and

acceptance of the metro as a primary mode of transportation are essential for maximizing ridership and achieving the desired impact on urban mobility. Through this comprehensive evaluation, we aim to underscore the importance of the Chennai Metro in shaping the future of urban transport in Chennai. By fostering a more connected and sustainable city, the metro not only addresses current transportation challenges but also sets the stage for a more efficient and environmentally friendly urban landscape in the years to come. Ultimately, the Chennai Metro stands as a testament to the city's commitment to improving public transport and enhancing the quality of life for all its residents, paving the way for a brighter, more connected future.

Objectives of study:

1. Assess Impact on Commuting Time

We aim to quantify how much time commuters save by using the Chennai Metro compared to their previous travel methods, focusing on both peak and off-peak hours to highlight the benefits of a smoother daily routine.

2. Analyze Traffic Congestion Reduction

This objective looks at how the Chennai Metro has reduced traffic congestion in crowded areas by comparing traffic patterns before and after its launch, illustrating its role in easing road travel for everyone.

3. Evaluate Environmental Benefits

We will explore the environmental benefits of the Chennai Metro, particularly its impact on air quality and reduced carbon emissions, emphasizing how it contributes to a healthier urban environment.

4. Examine Economic Implications

This study evaluates the economic impact of the Chennai Metro by analyzing commuter cost savings and increased foot traffic benefiting local businesses, highlighting its role in stimulating the economy.

5. Investigate Accessibility Improvements

We aim to assess how the Chennai Metro improves access to jobs, schools, and healthcare for underserved communities, demonstrating its importance in enhancing social equity and quality of life.

6. Measure Safety and Comfort Levels

Our focus is on commuter feelings of safety and comfort when using the Chennai Metro compared to other transport options, using surveys to identify areas for improvement.

7. Explore Real Estate Development

We will investigate how the Chennai Metro affects property values and real estate development near its stations, showcasing its role in revitalizing communities through improved accessibility.

8. Understand User Demographics and Patterns

This study examines the demographics of Chennai Metro users to better understand travel behaviors and needs, helping us determine how effectively the metro serves its diverse population.

9. Assess User Satisfaction

We will gather commuter feedback on satisfaction with the Chennai Metro, focusing on service quality and overall experience to identify strengths and areas for improvement.

10. Evaluate Integration with Other Transport Systems

Our objective is to analyze how well the Chennai Metro integrates with other forms of transport, assessing connectivity and ease of transfers to enhance the overall commuter experience.

Scope of the Study:

1. Operational Efficiency

Delving into Service Delivery: We'll take a close look at how well the metro operates on a daytoday basis. This includes assessing the frequency of train services and how reliably they adhere to schedules. Understanding these operational metrics will shed light on how well the metro meets the needs of the commuting public.

2. Infrastructure Quality

Investigating Infrastructure Standards: The study will thoroughly examine the quality of essential infrastructure, including tracks, stations, and signaling systems. We'll assess how regular maintenance and upgrades impact safety and overall travel experience for passengers, ensuring they have a smooth and reliable commute.

3. Passenger Experience

Exploring User Satisfaction: A vital aspect of our research is to understand what passengers think and feel about their commuting experience. Through surveys and interviews, we'll gather insights on comfort, safety, convenience, and accessibility, helping us paint a fuller picture of how the metro serves its users.

4. Economic Factors

Analyzing Fare Structures and Financial Viability: We will closely evaluate the pricing strategy for metro fares, considering how affordable it is for different segments of the population. Additionally, the study will explore the financial sustainability of the metro system, including sources of funding and operational costs, which are crucial for maintaining services longterm.

5. Connectivity with Other Transport Modes

Assessing Integrated Mobility: The effectiveness of the metro isn't just about its own operations; it's also about how well it connects with other public transport options like buses and suburban trains.

6. Demographics and Ridership Patterns

Understanding Who Uses the Metro: This part of the study will delve into the demographics of metro users looking at age, income, and travel behavior. By understanding who rides the metro and why, we can identify trends and opportunities for enhancing service to better meet community needs.

7. Safety and Security Measures

Evaluating Safety Protocols: Safety is paramount for any public transport system, and this study will assess the effectiveness of the existing safety measures. We'll analyze security protocols, emergency responses, and how these elements influence passengers' feelings of safety while using the metro.

8. Technological Integration

Embracing Innovation: We will explore how technology is being used to improve the metro experience for both operators and passengers. This includes looking at automated systems, realtime tracking, and innovative mobile apps, which can streamline operations and provide users with vital information at their fingertips.

9. Environmental Impact

Assessing Sustainability Efforts: The metro has the potential to significantly reduce traffic congestion and lower pollution levels. Our study will investigate the environmental benefits of the metro and evaluate how the construction and operation of the system affect local ecosystems, aiming to provide a clearer understanding of its ecological footprint.

10. Public Awareness and Communication

Connecting with the Community: An essential part of our research will focus on how well the metro is promoted and communicated to the public.

Effective marketing and educational initiatives are crucial for raising awareness about the metro’s benefits and encouraging its usage among residents.

Usefulness of the Chennai Metro:

1. Time Efficiency

Swift Journeys: One of the standout features of the Chennai Metro is its ability to whisk passengers across the city with remarkable speed. By operating on dedicated tracks, the metro bypasses the often frustrating traffic snarls that characterize Chennai's roads, allowing commuters to spend less time in transit and more time on what truly matters in their lives, whether that's work, family, or leisure activities.

2. Affordability

Budget Friendly Travel: The Chennai Metro is designed to accommodate everyone, offering an economical fare structure that ensures public transport remains accessible to all. This affordability is particularly helpful for students, daily workers, and families, making it a practical choice that encourages more people to leave their cars at home and opt for public transportation.

3. Enhanced Connectivity

Bridging Distances: The metro connects many of Chennai's key areas—from bustling business districts to educational institutions and cultural landmarks. This enhanced accessibility means that getting from one point to another is easier than ever, fostering a sense of community and connectivity within the city.

4. Comfort and Convenience

A Pleasant Travel Experience: Traveling on the Chennai Metro is a comfortable experience, thanks to welldesigned airco nditioned trains and spacious seating. Passengers can relax and enjoy their commute, whether they are reading, catching up on work, or simply taking a moment to unwind—especially during the hot and humid days typical of Chennai.

5. Safety and Security

Prioritizing Passenger Safety: Safety is a top priority for the Chennai Metro. With features like surveillance cameras, emergency communication systems, and trained personnel present throughout the stations and trains, passengers can travel with peace of mind, knowing that their security is being taken seriously.

6. Environmental Benefits

Championing Sustainability: By encouraging more residents to use public transportation rather than private vehicles, the Chennai Metro plays a vital role in reducing greenhouse gas emissions and easing traffic congestion. This shift not only improves air quality in the city but also contributes to Chennai's overall commitment to sustainable living.

7. Urban Development

Stimulating Growth: The establishment of metro stations often brings a flurry of economic activity to surrounding neighborhoods. As new businesses emerge and residential areas flourish, the metro becomes a catalyst for urban development that benefits the entire community, enhancing local economies and creating vibrant spaces for residents to enjoy.

8. Future Growth Potential

Looking Ahead: The Chennai Metro isn't just a static system; it's evolving. With plans for further expansion, there's a promising future ahead that will connect even more parts of the city. This growth means that the metro will become an increasingly valuable asset for passengers, enhancing mobility and convenience across Chennai.

Advantages:

1. Reduced Travel Time

Speedy Journeys: One of the most remarkable features of the Chennai Metro is how it significantly cuts down travel times. By operating on dedicated tracks, the metro allows passengers to glide past the oftencrawling road traffic. This means commuters can get to work, school, or social outings more quickly, freeing up valuable time for other activities and reducing daily stress.

2. Cost Effective Transportation

Affordable Fares for Everyone: The fare structure of the Chennai Metro is designed to be budget friendly, making it accessible for a wide range of passengers, from students on tight budgets to professionals and families. This affordability encourages more people to choose public transport, which ultimately helps reduce the number of cars on the road.

3. Increased Connectivity

Seamless Navigation: The Chennai Metro weaves together various key areas of the city, making it easier for passengers to reach commercial centers, educational institutions, and cultural hotspots. This expanded connectivity fosters a sense of community by allowing residents to engage more freely in all that Chennai has to offer.

4. Enhanced Comfort

A Pleasant Commuting Experience: Traveling on the Chennai Metro is a breath of fresh air compared to other forms of public transportation. With airconditioned trains, spacious seating, and wellmaintained stations, passengers can enjoy a comfortable ride—an especially welcome relief during the sweltering heat of Chennai.

5. Safety and Security

Prioritizing Passenger Protection: The metro places a strong emphasis on the safety of its passengers. With features such as surveillance cameras and emergency communication systems, as well as welltrained staff present at stations and on trains, riders can travel with peace of mind, knowing that their safety is being taken seriously.

6. Environmental Sustainability

Championing a Greener City: By encouraging the use of public transport and reducing reliance on personal vehicles, the Chennai Metro plays a crucial role in lowering greenhouse gas emissions and improving air quality. This commitment to sustainability helps create a cleaner, healthier environment for future generations.

7. Decreased Traffic Congestion

A Solution to Urban Gridlock: As more residents opt for the convenience of the metro, the overall number of vehicles on the road decreases. This reduction in traffic congestion not only makes the roads less chaotic but also enhances the overall quality of life in the city by minimizing travel frustrations and delays.

8. Stimulating Economic Growth

Boosting Local Economies: The presence of metro stations often acts as a magnet, attracting businesses and services to the surrounding areas. This influx can lead to job creation and increased economic activity, benefiting local residents and encouraging a thriving community.

9. Promoting Urban Development

Catalyst for Positive Change: The construction of metro lines often paves the way for improved urban planning and infrastructure development. As vibrant neighborhoods emerge around metro stations, they draw in new investments and contribute to a more dynamic urban landscape.

10. Future Expansion Opportunities

A Growing Network: The Chennai Metro is continuously expanding its reach to serve even more areas and passengers. This ongoing development not only enhances the metro's usability but also opens up new possibilities for urban mobility in Chennai.

Methodology:

a. Data collection

Primary data:

For data collection, we will employ Google Forms to design a structured questionnaire tailored to the commuting experiences of Chennai Metro users. This method enables us to efficiently reach a wide and diverse demographic of metro users while ensuring ease of participation. The questionnaire will focus on gathering quantitative and qualitative insights regarding commuters' travel patterns, satisfaction levels, and perceived benefits of utilizing the Chennai Metro Rail system. By leveraging this digital platform, we aim to facilitate a comprehensive assessment of commuter experiences and encourage participants to provide constructive feedback, ultimately contributing to the continuous improvement of public transportation in Chennai.

Secondary data:

To enhance our analysis, we will utilize secondary data obtained from Google Forms questionnaires that have been previously administered to Chennai Metro commuters. This approach allows us to leverage existing insights into commuting patterns and satisfaction levels, providing a solid foundation for our study. By analyzing this secondary data, we aim to identify key trends and themes that accurately reflect the experiences of metro users. This comprehensive understanding will enable us to draw informed conclusions and make relevant recommendations for future improvements to the Chennai Metro system.

b. Sample collection

Purposive sampling procedure is used for selecting the samples from the population, consisting of commuters who travel through metro rail service. The research project entitled developing a questionnaire and administering 133 questionnaires to the commuters who travel through metro rail service. A follow-up telephone communication was performed to randomly selected respondents to increase the response rate.

c. Data Analysis

The primary data collected from the samples are analyzed using the Jamovi Software. To analyze the perception of commutors who travel through metro rail service, various statistical tools such as Percentage analysis, Chi-square test, Correlation analysis, Regression Analysis and ANOVA are applied.

d. Hypothesis

Keeping in view the above objectives, this study proceeds to frame the following hypotheses and they were tested for its significance using appropriate statistical tools.

1. H_0: There is no significant relationship between the use of Chennai Metro Rail and the reduction in travel time for commuters.

2. H_0: There is no significant difference in commuter satisfaction levels between those using Chennai Metro Rail and those using traditional road transport.

Limitations of study:

1. High Initial Cost

A Heavy Price Tag: Building the Chennai Metro required a tremendous financial investment, and that initial cost can translate into higher fares for passengers. As the metro strives to recoup its expenses, some riders may find the ticket prices challenging to afford, which could deter lower income individuals from utilizing this transit option.

2. Construction Disruptions

Growing Pains: The process of constructing metro lines and stations can be a disruptive experience for the community. Roads may be closed, detours become necessary, and the noise and mess of construction can impact local businesses and daily life. While these changes are often essential for progress, they can temporarily inconvenience residents.

3. Limited Coverage

Not for Everyone Just Yet: Although the Chennai Metro connects many important areas, it doesn’t cover every part of the city comprehensively. For those living in neighborhoods that aren't serviced by the metro, relying on other forms of transportation can feel frustrating and timeconsuming, leading to a sense of exclusion.

4. Overcrowding During Peak Hours

The Rush Hour Crush: As more people discover the convenience of the Chennai Metro, trains can become crowded during peak commuting times. This overcrowding can turn an otherwise comfortable ride into a cramped experience, which might discourage some commuters from choosing the metro for their daily travels.

5. Operational Challenges

The Unexpected Hiccups: Like any transport system, the Chennai Metro can face operational challenges. Whether it’s technical issues or maintenance needs, service disruptions can occasionally happen, leading to delays and passenger frustration. A reliable system is crucial for keeping commuters happy and confident in their travel choices.

6. Dependence on Public Funding

Funding Woes: The metro's sustainability is often tied to public funding, which can be a doubleedged sword. Economic downturns or shifts in political priorities may impact financial support, raising concerns about service quality and future expansions.

7. Integration with Other Transport Systems

Navigating Transfers: Seamless travel often depends on smooth integration with other modes of transportation, like buses and suburban trains. If the connections between these systems aren't well coordinated, passengers may find it cumbersome to switch from the metro to other forms of transport, which can lead to unnecessary delays.

8. Vandalism and Safety Concerns

Safety on the Mind: Despite many safety measures in place, incidents of vandalism or petty crime can occur. Such occurrences can make passengers feel uneasy, impacting their willingness to use the metro, especially during offpeak hours or in less crowded areas.

9. Environmental Concerns During Construction

A Price for Progress: While the operation of the metro is aimed at promoting sustainability, the construction phase can disrupt local ecosystems. Construction activities may lead to temporary environmental degradation, raising concerns about the impact on flora and fauna in affected areas.

10. Limited Capacity for Future Demand

Planning for Tomorrow: As Chennai's population continues to grow, the demand for public transport is likely to increase. If the current capacity of the metro system isn't sufficient to accommodate future growth, it may lead to ov

CHAPTERISATION

The research has been organized and presented in five chapters as follows:

Chapter I - INTRODUCTION AND DESIGN OF THE STUDY

This chapter contains the introduction about Introduction about objectives of study, Scope of study, Methodology, and Limitations of study.

Chapter II - REVIEW OF LITERATURE

This chapter consists of past reviews at National and International level pertaining to the current study. The chapter has helped to identify the research gap from previous literatures.

Chapter III - A CONCEPTIONAL FRAMEWORK

This chapter contains the background of the topic, Analysis of the Chennai Urban rail system, Overview of the transit system, Key features, Dare structure, Ticketing machanisms, Operational management, Geographical and social economics context.

Chapter IV - ANALYSIS OF DATA FOR EVALUATION OF THE BENIFITIES OF THE CHENNAI METRO RAIL COMMUTERS.

This chapter encapsulates analyses and interpretations of the collected data with the help of simple percentage analysis and Factor analysis. The obtained frequencies are tabulated and are represented in a diagrammatic manner. Interpretation of each demographic variable and major factor influencing the evolution of metro rail system are also drafted in this chapter.

Chapter V - SUMMARY OF FINDINGS, SUGGESTIONS AND CONCLUSION

This chapter discuss the Findings, Suggestions and Conclusion of the present study based on the critical analysis of primary data. Conclusion drawn will be useful for the people who are engaged in evolution of metro rail system.

CHAPTER II

REVIEW OF LITERATURE

1. Sajanraj Thandassery, Jaison Mulerikkal (2024) did a study on "Operational Pattern Forecast Improvement with Outlier Detection in Metro Rail Transport System" which was published in Multimedia Tools and Applications. The objective was to enhance metro rail operational forecasting by identifying and mitigating outliers in data patterns. The study utilized advanced analytical techniques to improve accuracy in predicting metro rail operations and optimize performance.

2. Dong Lin, Zhipeng Zhou, Miaocheng Weng, Wout Broere, Jianqiang Cui (2024) did a study on "Metro Systems: Construction, Operation, and Impacts" which was published in Tunnelling and Underground Space Technology. The objective was to explore the construction, operation, and socio-economic impacts of metro systems. The study examined the construction methods, operational aspects, and urban development impacts of metro systems.

3. K. Shriram, M.M. Saadh (2024) did a study on *Chennai Commuters' Satisfaction Towards Chennai Metro Rail*, which was published in *The British Journal*. The objective was to assess commuter satisfaction with Chennai Metro Rail services. The findings showed that commuters were satisfied with service quality, punctuality, and comfort, contributing to overall satisfaction.

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6. R. Vaishali, H. Krupanandhan (2024) did a study on *Antecedents of Metro Passenger Gratification Among Public-With Special Reference to Chennai Metro Rail Limited*, which was published in *Quing: International Journal of Commerce and Management*. The objective was to identify factors influencing passenger satisfaction with Chennai Metro services. The study found that service quality, reliability, and convenience were key factors affecting satisfaction.

7. Priyanka Prabhakaran, S. Anandakumar, E.B. Priyanka, S. Thangavel (2023) did a study on "Development of Service Quality Model Computing Ridership of Metro Rail System Using Fuzzy System" which was published in Results in Engineering. The objective was to develop a fuzzy logic-based model for evaluating service quality and predicting metro rail ridership. The study utilized fuzzy systems to assess passenger perceptions of metro service quality, influencing ridership estimation and transit planning.

8. M. Selvakumar, D. Siddi Ramulu, K. Sankar (2023) did a study on *A Unique Metro Choice Behaviour of Suburban Rail Passengers in India*, which was published in *Urban Rail Transit*. The objective was to explore factors influencing metro usage among suburban rail passengers in India. The study found that convenience, cost, and travel time were significant factors influencing metro adoption.

9. Sruthilaya Dara, Aneetha Vilventhan (2022) did a study on "Identification and Analysis of Lean Techniques in Indian Metro Rail Projects" which was published in Indian Lean Construction Conference. The objective was to identify and analyze the implementation of lean construction techniques in Indian metro rail projects. The study examined the application of lean principles in metro rail construction, highlighting efficiencies, cost savings, and challenges in the Indian context.

10. A.R.S. Sivaneswari, D.R.D. Karthigeyan (2022) did a study on *Shift from Smart Mobility to Responsive Mobility for Metro Stations in Chennai, India*, which was published in *Transactions on Transport Sciences*. The objective was to explore responsive mobility solutions for enhancing last-mile connectivity at Chennai metro stations. The study identified challenges in last-mile connectivity and proposed responsive mobility strategies to improve the commuter experience.

11. D. Siddi Ramulu, K. Sankar, M. Selvakumar (2022) did a study on *Trip-based Modal Shift Behaviour of Mode Users along the Proposed Extension Metro Corridor in Chennai (India)*, which was published in *European Transport / Trasporti Europei*. The objective was to analyze factors influencing modal shift from suburban rail to the proposed metro extension in Chennai. The study revealed that fare differences and travel time were critical factors in modal shift decisions.

12. A. Appu (2022) did a study on *Factors and Motives of Usage of Public Transport Systems in Tamil Nadu: A Case of Chennai Metro Rail Services*, which was published in *The British Journal*. The objective was to identify the factors and motives influencing the usage of Chennai Metro Rail services. The study revealed that passenger behavior and preferences were influenced.

13. Andreas Benardos, Natalia Sourouvali, Athanassios Mavrikos (2021) did a study on "Measuring and Benchmarking the Benefits of Athens Metro Extension Using an Ex-Post Cost Benefit Analysis" which was published in Tunnelling and Underground Space Technology. The objective was to evaluate the economic benefits of the Athens metro extension using a post-implementation cost-benefit analysis. The study analyzed the impacts of the metro extension, assessing its effectiveness in terms of cost savings, environmental benefits, and ridership.

14. The study analyzed airborne pollutants in the metro Amit Passi, S.M. Shiva Nagendra, M.P. Maiya (2021) did a study on "Assessment of Exposure to Airborne Aerosol and Bio-Aerosol Particles and Their Deposition in the Respiratory Tract of Subway Metro Passengers and Workers" which was published in Atmospheric Pollution Research. The objective was to assess the exposure of metro passengers and workers to airborne aerosol and bio-aerosol particles and their potential deposition in the respiratory system. system, evaluating the levels of aerosol and bio-aerosol particles and their potential health impacts on individuals.

15. Madhu Bharti, Pavithra Velechettiar Bhaskaran (2021) did a study on *Impact of Metro-Rail Projects on Land Use and Land Value in Indian Cities—The Case of Chennai*, which was published in *Railway Transportation in South Asia: Infrastructure Planning, Regional Development and Economic Impacts*. The objective was to examine the impact of metro rail projects on land use and land values in Chennai. The study found that metro rail development significantly influenced land use patterns and real estate values.

16. R. Kanthavel, S.K.B. Sangeetha, K.P. Keerthana (2021) did a study on *Design of Smart Public Transport Assist System for Metropolitan City Chennai*, which was published in *International Journal of Intelligent Networks*. The objective was to design a smart assist system for improving public transport efficiency and passenger convenience in Chennai. The study proposed a technology-driven system integrating GPS, IoT, and real-time data to enhance public transport accessibility and reliability.

17. Sandeep Mathur, Johan Ninan, Lauri Vuorinen, Yongjian Ke, Shankar Sankaran (2021) did a study on *An Exploratory Study of the Use of Social Media to Assess Benefits Realization in Transport Infrastructure Projects*, which was published in *Project Leadership and Society*. The objective was to explore how social media can be used to evaluate benefits realization in transport infrastructure projects. The study found that social media, particularly tweets, helped gauge public sentiment and perceptions of metro rail projects.

18. Kasturi Gokhale, Divya Mishra, Siddesh Pai (2020) did a study on "Analyzing Critical Factors Causing Project Delays in Indian Metro Rail Projects" which was published by ALBOREAR (OPC) PVT. LTD. The objective was to identify and analyze the major factors contributing to project delays in Indian metro rail construction. The study investigated delays due to financial issues, regulatory approvals, land acquisition, and technical challenges, offering insights for improved project management.

19. Guangyue Nian, Fangxi Chen, Zhe Li, Yi Zhu, Daniel Sun (2019) did a study on "Evaluating the Alignment of New Metro Line Considering Network Vulnerability with Passenger Ridership" which was published in Transportmetrica A: Transport Science. The objective was to evaluate the optimal alignment for a new metro line by considering network vulnerability and its effect on passenger ridership. The study analyzed the trade-off between network vulnerability and ridership patterns to propose an efficient metro line alignment.

20. Yash Kumar Mittal, Virendra Kumar Paul, Anil Sawhney (2019) did a study on "Methodology for Estimating the Cost of Delay in Architectural Engineering Projects: Case of Metro Rails in India" which was published in Journal of the Institution of Engineers (India): Series A. The objective was to propose a methodology for estimating the cost of delays in metro rail projects in India. The study developed a framework to quantify the impact of delays on costs in metro rail construction projects, using case studies from India.

21. Aarthi Aishwarya Devendran, Gnanappazham Lakshmanan (2019) did a study on *Analysis and Prediction of Urban Growth Using Neural-Network-Coupled Agent-Based Cellular Automata Model for Chennai Metropolitan Area, Tamil Nadu, India*, which was published in *Journal of the Indian Society of Remote Sensing*. The objective was to predict urban growth patterns in Chennai using a neural-network-coupled agent-based model. The study applied a neural-network and cellular automata model to forecast urban expansion in Chennai.

22. Brus Butchibabu, Prosanta Kumar Khan, P.C. Jha (2019) did a study on *Foundation Evaluation of Underground Metro Rail Station Using Geophysical and Geotechnical Investigations*, which was published in *Engineering Geology*. The objective was to assess foundation stability of an underground metro station in Chennai. The study found that seismic surveys and resistivity tomography successfully identified weak zones and evaluated subsurface conditions.

23. .K. Babu (2018) did a study on "A Study of Satisfaction N Level of Passenger in Kochi Metro Train" which was published in Think India Journal. The objective was to assess passenger satisfaction levels in Kochi Metro based on various service quality parameters. The study analyzed factors such as comfort, safety, frequency, and affordability to evaluate overall passenger satisfaction with Kochi Metro services.

24. Ismail Haque, Priyank Pravin Patel (2018) did a study on *Growth of Metro Cities in India: Trends, Patterns and Determinants*, which was published in *Urban Research & Practice*. The objective was to examine the trends, patterns, and factors influencing the growth of metro cities in India. The study identified socio-economic, political, and infrastructural factors contributing to the growth and development of metro cities.

25. M. Selvakumar, M. Abishek Reddy, V. Sathish, R. Venkatesh (2018) did a study on *Potential Influence of Metro on Bus: A Case Study*, which was published in *Journal of The Institution of Engineers (India): Series A*. The objective was to estimate the modal shift from bus to metro in Chennai, India, and identify factors influencing the shift. The study found that fare, age, and income were significant factors influencing the shift from bus to metro.

26. S. Nandakumar, A. Roselin Raja (2017) did a study on *ICT and Youth: A Study on the Use of Smart Phone Apps among Youth in Chennai Metropolitan City*, which was published in *International Journal of Research in Social Sciences*. The objective was to analyze smartphone app usage patterns and their impact among youth in Chennai. The findings showed that youth frequently used social media and entertainment apps.

27. R. Manaikandan, S. Lakshmi, P. Bakiya (2016) did a study on "Safety of Women Passengers in Share Autos—A Case Study of Chennai" which was published in International Journal for Innovative Research in Science & Technology. The objective was to assess the safety perceptions and challenges faced by women passengers using share autos in Chennai. The study conducted a questionnaire survey in two corridors of south Chennai, revealing that while share autos are preferred for their convenience, women passengers experience safety concerns, particularly during late evenings and in poorly lit areas.

28. Banti Deori (2016) did a study on "Case of Single Female Labour Migrants Working in the Low-End Service Jobs from North-Eastern Region to the Metropolitan City Chennai, India" which was published in IOSR Journal of Humanities and Social Science. The objective was to explore the experiences of single female migrants from the North-Eastern region working in low-end service jobs in Chennai. The study investigated the challenges faced by single female migrants in Chennai, focusing on their socio-economic conditions and work-related issues.

29. Christopher D. Gore, Govind Gopakumar (2015) did a study on "Infrastructure and Metropolitan Reorganization: An Exploration of the Relationship in Africa and India" which was published in Journal of Urban Affairs. The objective was to explore the relationship between infrastructure development and metropolitan reorganization in African and Indian cities. The study analyzed how infrastructure investments drive urban restructuring and governance changes in metropolitan areas.

30. Loraine Kennedy, Aurélie Varrel, Eric Denis, Véronique Dupont, R. Dhanalakshmi, Samuel Roumeau, Isa Baud, Karin Pfeffer, N. Sridharan, M. Vijayabaskar, M. Suresh Babu, Aicha Seifelislam, Hortense Rouanet, Tara Saharan (2014) did a study on *Engaging with Sustainability Issues in Metropolitan Chennai*, which was published in *City Report Series*. The objective was to explore sustainability challenges in Chennai, focusing on urbanization, environmental concerns, and social inequalities. The study analyzed the impacts of rapid urban growth on sustainability and proposed strategies for more sustainable development.

31. K.C. Sivaramakrishnan (2013) did a study on "Revisiting the 74th Constitutional Amendment for Better Metropolitan Governance" which was published in Economic and Political Weekly. The objective was to evaluate and propose improvements to the 74th Constitutional Amendment for better metropolitan governance in India. The study critiqued the limitations of the amendment and suggested reforms for more effective urban governance in metropolitan areas.

32. Pritpal Randhawa (2012) did a study on "Delhi Metro Rail: Beyond Mass Transit" which was published in Economic and Political Weekly. The objective was to examine the broader impact of the Delhi Metro beyond its role as a mass transit system. The study analyzed the metro's influence on urban development, environmental sustainability, and socio-economic changes in Delhi.

33. Annapurna Shaw (2012) did a study on "Metropolitan City Growth and Management in Post-Liberalized India" which was published in Eurasian Geography and Economics. The objective was to analyze the growth and management of metropolitan cities in India after liberalization. The study explored the effects of economic reforms on metropolitan growth, urban management challenges, and the need for policy adaptation in post-liberalized India.

34. Kurian Joseph, S. Rajendiran, R. Senthilnathan, M. Rakesh (2012) did a study on "Integrated Approach to Solid Waste Management in Chennai: An Indian Metro City" which was published in the Journal of Material Cycles and Waste Management. The objective was to evaluate and propose an integrated approach for solid waste management in Chennai. The study analyzed the current waste management system and suggested an integrated approach involving waste segregation, collection, recycling, and disposal.

35. J.Chadchan, R. Shankar (2012) did a study on *An Analysis of Urban Growth Trends in the Post-Economic Reforms Period in India*, which was published in *International Journal of Sustainable Built Environment*. The objective was to examine the impact of liberalization, privatization, and globalization on urban growth in India. The study suggested the need for sustainable development strategies to manage urban sprawl, zoning, and regulatory frameworks post-1991 provided insights into planning, financing, and infrastructure development.

36. M. Ramachandran (2011) did a study on "Metro Rail Projects in India: A Study in Project Planning" which was published by Oxford University Press. The objective was to examine the planning processes involved in metro rail projects in India, focusing on challenges and solutions. The study analyzed key aspects of metro rail project planning, including financial, technical, and organizational challenges faced during implementation in Indian cities.

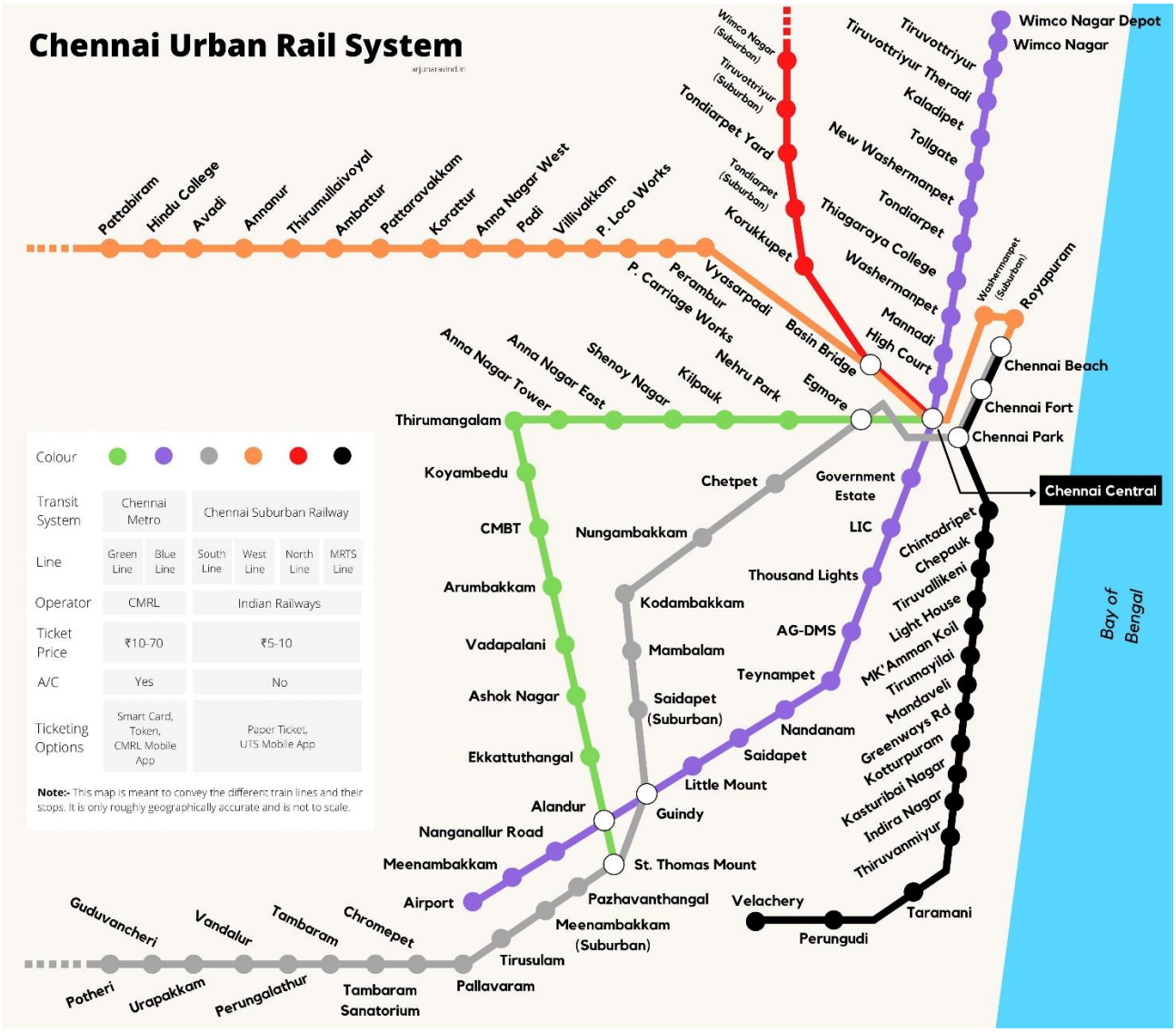
37. V. Sampathkumar, M. Helen Santhi (2010) did a study on *Land Price Model for Sholinganallur Town in Chennai Metropolitan Area*, which was published in *Indian Journal of Marketing*. The objective was to forecast land prices and analyze factors influencing land prices in Sholinganallur, Chennai. The study developed a predictive model using empirical data and statistical methods to identify factors affecting land prices.

38. Dinesh Mohan (2008) did a study on *Mythologies, Metro Rail Systems and Future Urban Transport*, which was published in *Economic and Political Weekly*. The objective was to explore the myths surrounding metro rail systems and their role in shaping the future of urban transport in India. The study critically analyzed common misconceptions about metro systems and examined their effectiveness in addressing urban mobility challenges.

39. Annapurna Shaw, M.K. Satish (2007) did a study on "Metropolitan Restructuring in Post-Liberalized India: Separating the Global and the Local" which was published in Cities. The objective was to examine the restructuring of metropolitan cities in India following liberalization, focusing on the global-local divide. The study analyzed how post-liberalization urban development in India reflects the intersection of global influences and local conditions, leading to urban restructuring.

40. David E. Dowall, Paavo Monkkonen (2007) did a study on *Urban Development and Land Markets in Chennai, India*, which was published in *International Real Estate Review*. The objective was to examine the spatial development, land use, and land markets in Chennai. The study analyzed the city's land market dynamics, focusing on the impact of urban growth, density, and policy on land values and development patterns.

CHAPETER III



https://i.redd.it/0yn0zd37gcn81.jpg

Analysis of the Chennai Urban Rail System:

The Chennai Urban Rail System is a critical infrastructure component designed to enhance public transportation accessibility within the city of Chennai, India. The accompanying map illustrates the various transit lines that comprise this urban rail network, which includes both the Chennai Metro and the Chennai Suburban Railway.

Overview of the Transit System:

Integrated Network: The system is delineated through a colorcoded scheme representing different rail lines, including:

Chennai Metro: Identified by multiple colors (green, blue, purple, orange, and red).

Chennai Suburban Railway: Represented in gray, highlighting its significance for suburban connectivity.

Key Features:

Station Infrastructure: The map enumerates key stations, such as:

Chennai Central

Chennai Beach

Various other important terminals that enhance commuter mobility.

Fare Structure:

Chennai Metro: Ticket prices range from ₹10 to ₹70, based on distance traveled.

Chennai Suburban Railway: Generally maintains a fare structure below ₹5, making it an economical option for daily commuters.

Ticketing Mechanisms: Multiple ticketing options are available, including:

Smart Cards

Mobile applications

Traditional paper tickets, which cater to diverse user preferences.

Operational Management:

The operations of the Chennai Metro are overseen by Chennai Metro Rail Limited (CMRL), while the Suburban Railway services are administered by Indian Railways. This bifurcation allows for specialized management tailored to the operational needs of urban versus suburban transit.

Geographic and Socioeconomic Context:

Urban Coverage: The rail network supports a broad geographic range, catering to both urban and suburban populations, thus facilitating mobility to major districts as well as critical transit points, such as the city's international airport.

Economic Implications: The efficient transportation provided by this system is integral to urban economic dynamics, affecting commuting patterns, local business development, and real estate trends.

Facilities:

1. Accessibility for Everyone:

Elevators and Escalators: You'll often find escalators and elevators at stations, making it easier for those with mobility challenges or parents with strollers to navigate.

Braille Signage: For our visually impaired friends, Braille signage ensures they can move around confidently.

2. Comfort While Waiting:

Seating: Many stations have comfortable benches where you can sit and relax while you wait for your train.

Weather Protection: Platforms are usually covered, keeping you sheltered from the rain or sun

3. Safety Comes First:

CCTV Cameras: These are installed for everyone's security, giving peace of mind as you travel.

Emergency Alarms: In case of any issues, you can easily access emergency alarms or intercoms for help.

4. Clean and Welcoming:

Regular Cleaning: Stations and trains are regularly cleaned to ensure a pleasant environment.

Waste Bins: You'll find bins around to keep the place tidy and encourage everyone to dispose of trash properly.

5. Stay Informed:

RealTime Displays: Electronic boards show live updates on train schedules, so you know exactly when your ride is arriving.

Clear Signage: Easytoread signs throughout the station help you find your way without confusion.

Features That Make Travel Smooth:

1. Comfortable Trains:

Modern Designs: Trains are built with comfort in mind, featuring cozy seating and even air conditioning to keep you comfortable in any season.

2. Easy Ticketing:

Contactless Payments: Forget about digging for change! Many systems allow you to pay with smart cards or even your phone for a quick, hasslefree experience.

UserFriendly Ticket Machines: These machines make buying or recharging tickets a breeze.

3. Frequent and Reliable Service:

Quick Trains: During busy times, trains often run every few minutes, so you won't have to wait long.

Wide Coverage: Metro networks typically span across the city, giving you access to all the key spots.

4. Connecting You to More:

Easy Transfers: Many stations connect you directly to buses, trams, or other metro lines, simplifying your journey.

MultiModal Options: You can also find options for bikesharing or ridesharing nearby, making it even easier to get around.

Positive for Our Planet:

Less Traffic: By encouraging more people to use public transport, metro trains help ease congestion on the roads, which is better for everyone.

EcoFriendly Technology: Many trains use energyefficient technologies, helping to reduce our carbon footprint.

https://chennaimetrorail.org/wpcontent/uploads/2024/03/cmrlbanner.jpg

In today's bustling urban landscape, metro systems are not just a mode of travel; they embody the heartbeat of the city, connecting diverse communities and making daily commutes smoother and more enjoyable. Picture this: you arrive at an elevated station just as a sleek, modern metro train approaches, its doors gliding open with a welcoming whoosh. The anticipation builds as you step onto the platform, ready to embark on your journey.

These metro services offer much more than just transportation. With extensive networks that link vibrant neighborhoods to business hubs, cultural hotspots, and essential amenities, they weave the fabric of city life together. As you ride, you not only avoid traffic headaches but also contribute to a greener environment by reducing reliance on personal vehicles.

One of the standout features of many metro systems is their realtime tracking capabilities. Through userfriendly apps and digital displays, you can easily check arrival times, track delays, and stay informed throughout your journey. Ticketing has also evolved imagine breezing through gates with contactless payment options, eliminating the need for cash or long lines.

Accessibility is a key priority in these systems. Meticulously designed stations boast elevators and ramps, ensuring everyone especially those with disabilities can navigate the transit landscape with ease.

Moreover, bike facilities, like bike racks and policies allowing bicycles on trains during offpeak hours, encourage sustainable commuting and promote a healthier lifestyle.

While you wait, you can enjoy complimentary WiFi, seamlessly connecting you to the digital world. Security is another cornerstone of metro services, with comprehensive surveillance and dedicated personnel providing peace of mind to all travelers. Customer support representatives are always on hand to assist, ready to answer questions and provide guidance.

In the bustling heart of the city, the metro system is like a lifeline, connecting us all and making daily travel a bit easier. Picture yourself waiting on the elevated platform as the sun sets, casting a warm glow over everything. The gentle rumble of the train draws near, and the doors slide open, inviting you to hop on board. In that moment, you're not just boarding a train; you're stepping into an adventure, ready to explore the city around you.

As the train pulls away, you feel a sense of freedom no more navigating through traffic or hunting for parking. Instead, you're cruising along smooth tracks, the city unfolding outside your window. The metro makes it easy to connect with your favorite spots, whether you're heading to work, meeting friends for coffee, or exploring a new gallery.

One of the best parts of today's metro systems is the realtime tracking. With just a glance at your phone or the digital displays at the station, you know exactly when your train will arrive. It's a little thing, but it takes away the stress of waiting and lets you plan your journey with confidence.

At the heart of it all, metro systems foster a sense of community. With loyalty programs that reward frequent riders and partnerships with local businesses, you feel like you're part of something bigger. Each ride brings encounters small chats with fellow commuters, shared smiles, and moments of connection.

https://chennaimetrorail.org/wp-content/themes/CMRL%20-%20English/cmrl-assets/images/whatsapp.png

Booking Facilitites:

1. SBI Cards: A Smart Travel Companion

If you hold an SBI card, you're in for a treat when it comes to metro travel! Using your SBI debit or credit card is a breeze. Imagine walking up to a ticket vending machine and simply tapping your card to get through the gates. No fumbling for cash or worrying about exact change just straightforward and quick access to your journey.

Plus, if you prefer booking your tickets from the comfort of your home, you can easily do that online through the metro's website or app. Don't forget to keep an eye out for special offers; sometimes, SBI cardholders enjoy exclusive discounts or cashback offers on their metro rides!

2. WhatsApp: Your Travel Chat Buddy

What if you could book your metro tickets while chatting with a friend? With some metro services offering ticketing through WhatsApp, that's the reality! By simply sending a message to the official metro number, you can book your tickets, check train schedules, and even get realtime updates.

It's not just about ticketing; if you have questions or need assistance, you can ask right there in the chat. Whether you're curious about routes or facing issues, your travel buddy is just a message away!

3. Paytm: Your OneStop Ticket Shop

With Paytm, metro travel becomes even more convenient! You can easily book your metro tickets right from the app. Just a few taps, and you're done! After purchasing, you'll receive a QR code that opens the gates for you, making entry smooth and hasslefree.

Paytm also lets you add funds to your wallet, so future transactions are quicker. And keep an eye out for offers sometimes you can snag discounts or cashback deals on your metro tickets during special promotions. It's like a little gift for choosing to travel smart!

4. PhonePe: Quick and Easy Transactions

PhonePe is another fantastic option for booking your metro tickets. If you love the idea of using UPI to pay quickly, you'll appreciate how easy it is to purchase your tickets through the PhonePe app. A few clicks are all it takes, and you're set to travel!

You can even track your ticket purchases and keep an eye on your transaction history right in the app. Plus, PhonePe often rolls out promotions, so look out for cashback offers that make your journeys even more affordable.

CHAPTER IV

DATA ANALYSIS FOR EVALUATING THE BENEFITS OF THE CHENNAI METRO RAIL COMMUTERS

PERCENTAGE ANALYSIS FOR GENDER OF RESPONDENTS

Descriptives

Descriptives	
	Gender
N	133
Missing	1
Mean	1.56
Median	2
Standard deviation	0.632
Minimum	1
Maximum	4

TABLE 4.1

Frequencies

Frequencies of Gender			
Gender	**Counts**	**% of Total**	**Cumulative %**
Prefer not to say	2	1.5%	1.5%
Others	4	3.0%	4.5%
Female	61	45.9%	50.4%
Male	66	49.6%	100.0%

TABLE 4.2

Plots

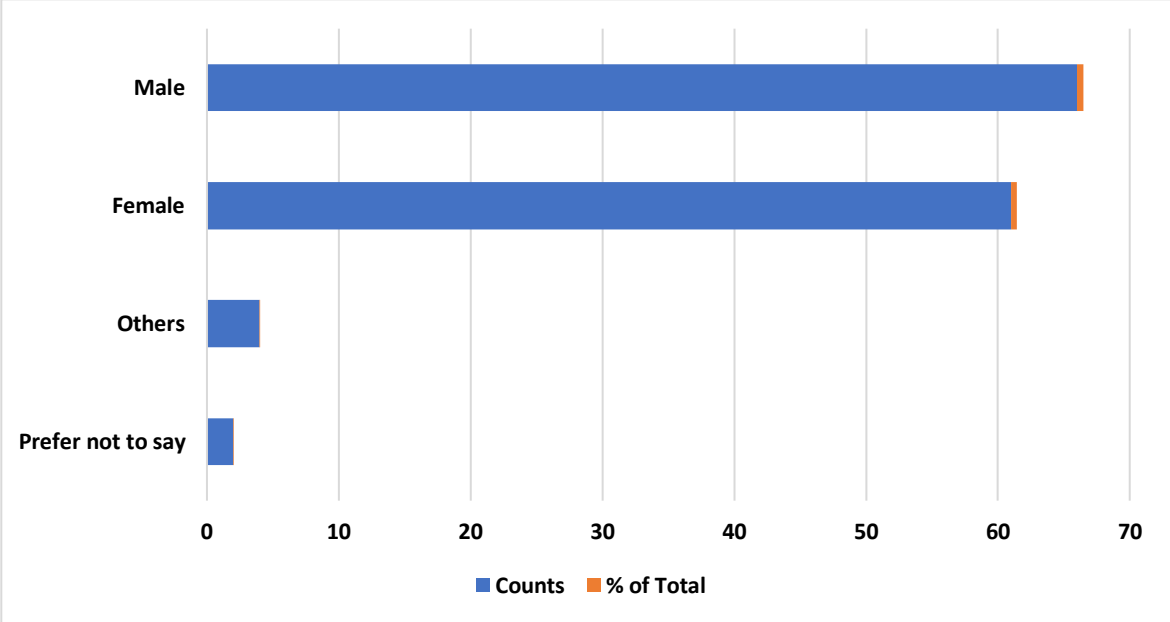


CHART 4.1

Interpretation

The above table shows that the majority of the gender who travel through metro rail are male (49.6%) , which is followed by female (45.9%). We can infer that the Prefer not to say (1.5%) of the commuters are the least frequency.

PERCENTAGE ANALYSIS FOR AGE OF RESPONDENTS

Descriptives

Descriptives	
	Age
N	133
Missing	1
Mean	1.49
Median	1
Standard deviation	0.545
Minimum	1
Maximum	3

TABLE 4.3

Frequencies

Frequencies of Age			
Age	**Counts**	**% of Total**	**Cumulative %**
20 - 40	71	53.4%	53.4%
40-60	59	44.4%	97.7%
Above 60	3	2.3%	100.0%

TABLE 4.4

Plots

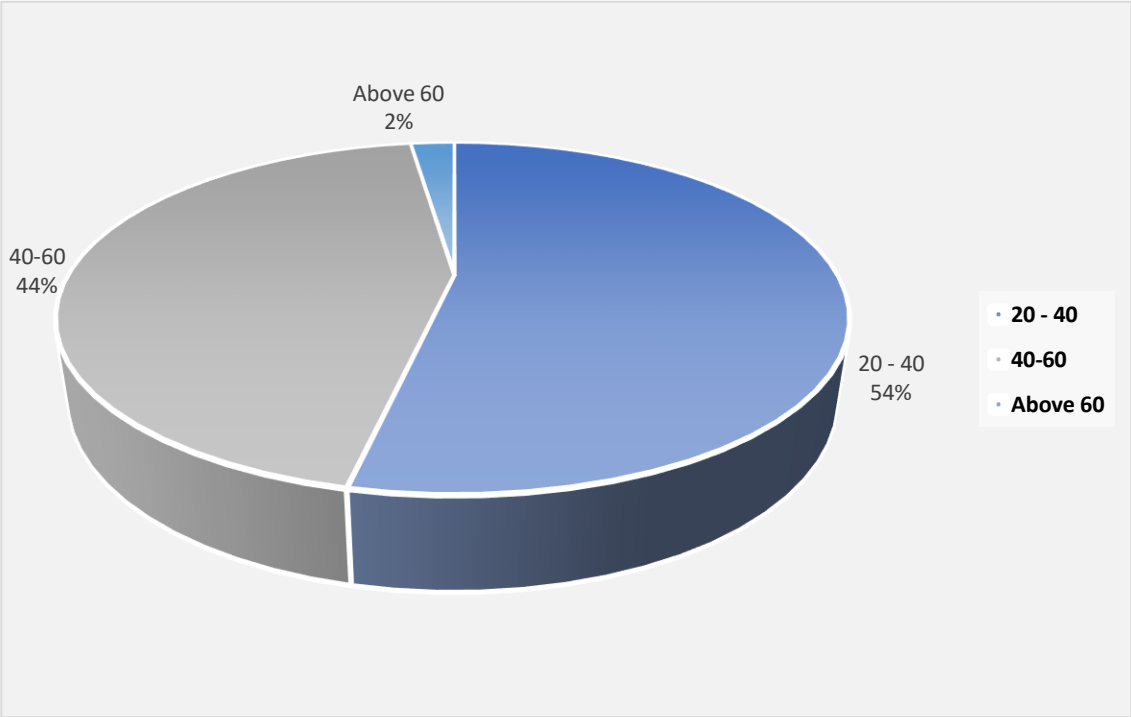


CHART 4.2

Interpretation

As shown in the table, the 20–40 age group (53.4%), while the 40–60 age group (44.4%). Together, these two categories make up the majority of respondents, accounting for 97.7% of the total sample.

PERCENTAGE ANALYSIS FOR OCCUPTION FROM WHICH THE RESPONDENTS BELONG

Descriptives

Descriptives	
	Occupation
N	133
Missing	1
Mean	2.17
Median	2
Standard deviation	0.963
Minimum	1
Maximum	5

TABLE 4.5

Frequencies

Frequencies of Occupation			
Occupation	**Counts**	**% of Total**	**Cumulative %**
Student	31	23.3%	23.3%
Employed	67	50.4%	73.7%
Self-employed	20	15.0%	88.7%
Unemployed	12	9.0%	97.7%
Retired	3	2.3%	100.0%

TABLE 4.6

Plots

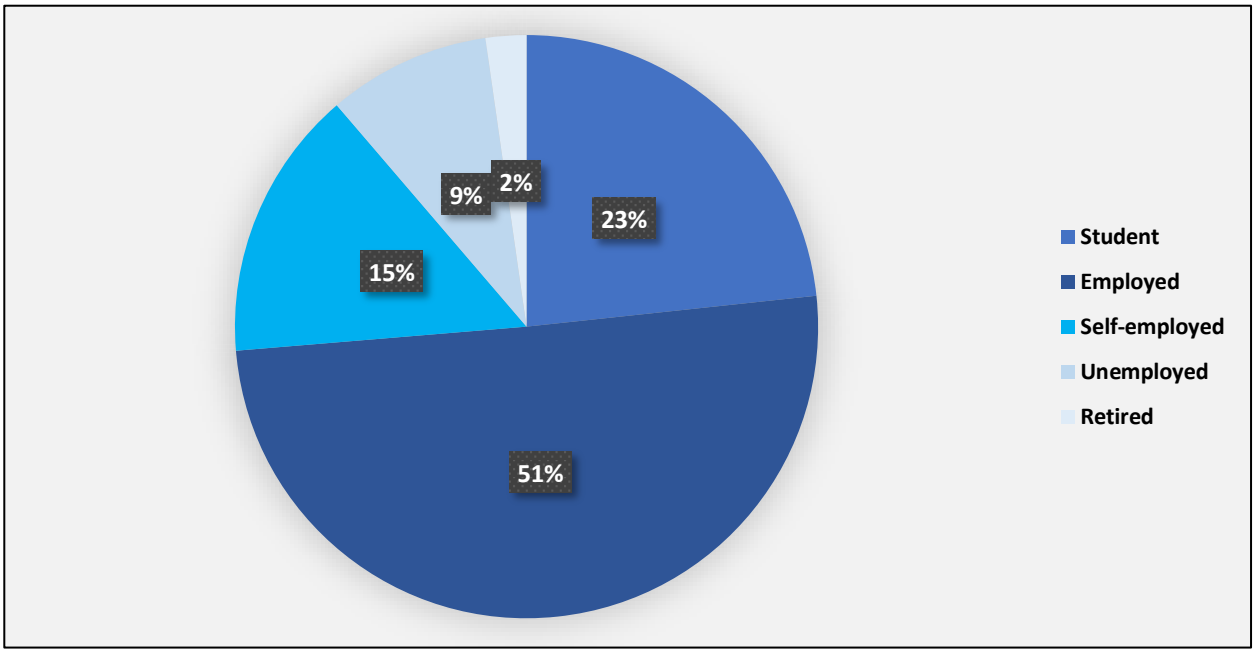


CHART 4.3

Interpretation

As shown in the table, the employed (50.4%), while the student (23.3%). Together, these two categories make up the majority of respondents, accounting for 73.7% of the total sample.

PERCENTAGE ANALYSIS FOR MONTHLY INCOME OF RESPONDENTS

Descriptives

Descriptives	
	Income
N	133
Missing	1
Mean	2.55
Median	2
Standard deviation	1.37
Minimum	1
Maximum	6

TABLE 4.7

Frequencies

Frequencies of Income			
Income	**Counts**	**% of Total**	**Cumulative %**
Below 25,000	37	27.8%	27.8%
25,000 - 30,000	32	24.1%	51.9%
30,000 - 35,000	37	27.8%	79.7%
35,000 - 40,000	14	10.5%	90.2%
40,000 - 45,000	7	5.3%	95.5%
50,000 Above	6	4.5%	100.0%

TABLE 4.8

Plots

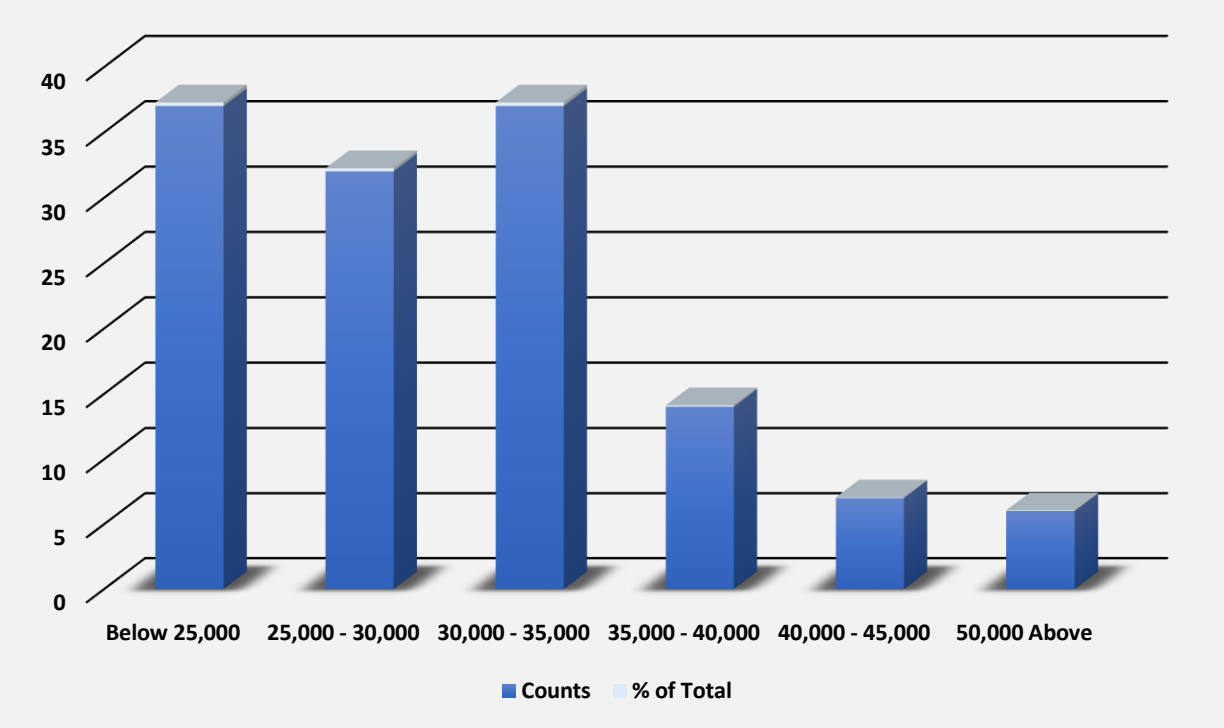


CHART 4.4

Interpretation

As shown in the table, the Below 25,000 income group (27.8%), while the 30,000–35,000 income group (27.8%). Together, these two categories make up the majority of respondents, accounting for 55.6% of the total sample.

CHI-SQUARE TEST ANALYSIS FOR GENDER AND AGE OF RESPONDENTS

Contingency Tables

Contingency Tables				
	Age			
Gender	**20 - 40**	**40-60**	**Above 60**	**Total**
Prefer not to say	1	0	1	2
Others	2	2	0	4
Female	28	32	1	61
Male	40	25	1	66
Total	71	59	3	133

TABLE 4.9

Chi square Tests			
	Value	**df**	**p**
χ^2	24.3	6	<.001
N	133		

TABLE 4.10

Interpretation

We can understand from the above table that the P=<.001 which is not significant associate between gender of the metro rail and the age level of the metro rail.

CHI-SQUARE TEST ANALYSIS FOR GENDER AND OCCUPATION OF RESPONDENTS

Contingency Tables

Contingency Tables						
	Occupation					
Gender	**Student**	**Employed**	**Self-employed**	**Unemployed**	**Retired**	**Total**
Prefer not to say	0	0	0	1	1	2
Others	0	1	1	2	0	4
Female	11	32	11	6	1	61
Male	20	34	8	3	1	66
Total	31	67	20	12	3	133

TABLE 4.11

Chi square Tests			
	Value	**df**	**p**
χ^2	39.6	12	<.001
N	133		

TABLE 4.12

Interpretation

The above table shares that P=<.001 which means there is no significant associate difference between gender and the occupation of the metro rail.

CHI-SQUARE TEST ANALYSIS FOR GENDER AND MONTHLY INCOME OF RESPONDENTS

Contingency Tables

Contingency Tables							
	Income						
Gender	**Below 25,000**	**25,000 - 30,000**	**30,000 - 35,000**	**35,000 - 40,000**	**40,000 - 45,000**	**50,000 Above**	**Total**
Prefer not to say	1	0	0	0	0	1	2
Others	1	0	1	2	0	0	4
Female	12	10	22	10	4	3	61
Male	23	22	14	2	3	2	66
Total	37	32	37	14	7	6	133

TABLE 4.13

Chi square Tests			
	Value	**df**	**p**
χ^2	33.3	15	0.004
N	133		

TABLE 4.14

Interpretation

The table reveals that P=0.004 which has significant associate between the gender and the income earned by the metro rail.

CHI-SQUARE TEST ANALYSIS FOR GENDER AND SATISFACTION OF RESPONDENTS

Contingency Tables

Contingency Tables						
	How satisfied are you with your overall experience on the metro					
Gender	**Very satisfied**	**Neutral**	**Satisfied**	**Dissatisfied**	**Very dissatisfied**	**Total**
Prefer not to say	1	1	0	0	0	2
Others	0	1	1	2	0	4
Female	10	28	21	2	0	61
Male	18	23	23	1	1	66
Total	29	53	45	5	1	133

TABLE 4.15

Chi square Tests			
	Value	**df**	**p**
χ^2	30.1	12	0.003
N	133		

TABLE 4.16

Interpretation

As shown in the table, the P=0.003 which means there is no significant associate difference between satisfaction with your overall experience on the metro with gender.

CHI-SQUARE TEST ANALYSIS FOR AGE AND SATISFACTION OF RESPONDENTS

Contingency Tables

Contingency Tables						
	How satisfied are you with your overall experience on the metro					
Age	**Very satisfied**	**Neutral**	**Satisfied**	**Dissatisfied**	**Very dissatisfied**	**Total**
20 - 40	23	18	26	3	1	71
40-60	5	33	19	2	0	59
Above 60	1	2	0	0	0	3
Total	29	53	45	5	1	133

TABLE 4.17

Chi square Tests			
	Value	**df**	**p**
χ^2	19.0	8	0.015
N	133		

TABLE 4.18

Interpretation

As shown in the table, P=0.015 which means there is no significant associate difference between satisfaction with your overall experience on the metro with age.

CORRELATION ANALYSIS FOR ACCESSIBILITY FOR PEOPLE WITH DISABILITY AND AVAILABILITY OF THE SEATING

Correlation Matrix

Correlation Matrix			
		Accessibility for people with disability	**Availability of the seating**
Accessibility for people with disability	**Pearson's r**	—	
	df	—	
	p-value	—	
	Spearman's rho	—	
	df	—	
	p-value	—	
Availability of the seating	**Pearson's r**	**0.385**	—
	df	**131**	—
	p-value	**<.001**	—
	Spearman's rho	**0.254**	—
	df	**131**	—
	p-value	**0.003**	—

TABLE 4.19

Interpretation

We are able to infer that the above table Pearson's r = 0.385. this help us to come to a conclusion that there is a moderate relationship between Availability of the seating and Accessibility for people with disability.

CORRELATION ANALYSIS FOR FREQUENCY OF THE TRAIN IN WEEKENDS AND SAFETY AND SECURITY MEASURES

Correlation Matrix

Correlation Matrix			
		Frequency of the train in weekends	**Safety and security measures**
Frequency of the train in weekends	**Pearson's r**	—	
	df	—	
	p-value	—	
	Spearman's rho	—	
	df	—	
	p-value	—	
Safety and security measures	**Pearson's r**	**0.287**	—
	df	**131**	—
	p-value	**<.001**	—
	Spearman's rho	**0.115**	—
	df	**131**	—
	p-value	**0.189**	—

TABLE 4.20

Interpretation

From the about table, we are able to find out the Pearson's r =0. 287 which we consider as a moderate relationship between Safety and security measures with Frequency of the train in weekends.

CORRELATION ANALYSIS FOR FREQUENCY OF THE TRAIN AND PUNCTUALITY

Correlation Matrix

Correlation Matrix			
		Punctuality	**Frequency of the train**
Punctuality	**Pearson's r**	—	
	df	—	
	p-value	—	
	Spearman's rho	—	
	df	—	
	p-value	—	
Frequency of the train	**Pearson's r**	**0.521**	—
	df	**131**	—
	p-value	**<.001**	—
	Spearman's rho	**0.451**	—
	df	**131**	—
	p-value	**<.001**	—

TABLE 4.21

Interpretation

The table shows that Pearson's r =0. 521 which is a moderate relationship between the Frequency of the train and Punctuality.

CORRELATION ANALYSIS FOR PUNCTUALITY AND SPEED OF THE SERVICE

Correlation Matrix

Correlation Matrix			
		Punctuality	**Speed of the service**
Punctuality	**Pearson's r**	**—**	
	df	**—**	
	p-value	**—**	
	Spearman's rho	**—**	
	df	**—**	
	p-value	**—**	
Speed of the service	**Pearson's r**	**-0.036**	**—**
	df	**131**	**—**
	p-value	**0.683**	**—**
	Spearman's rho	**-0.050**	**—**
	df	**131**	**—**
	p-value	**0.570**	**—**

TABLE 4.22

Interpretation

The above table shows that Pearson's r =-0.036 which means there is no relationship. This religious between Speed of the service and Punctuality.

CORRELATION ANALYSIS FOR ACCESSIBILITY FOR PEOPLE WITH DISABILITY AND SAFETY AND SECURITY MEASURES

Correlation Matrix

Correlation Matrix			
		Accessibility for people with disability	**Safety and security measures**
Accessibility for people with disability	**Pearson's r**	—	
	df	—	
	p-value	—	
	Spearman's rho	—	
	df	—	
	p-value	—	
Safety and security measures	**Pearson's r**	**0.318**	—
	df	**131**	—
	p-value	**<.001**	—
	Spearman's rho	**0.157**	—
	df	**131**	—
	p-value	**0.071**	—

TABLE 4.23

Interpretation

The table reviews that Pearson's r =0.318 which is a moderate relationship between the Safety and security measures and Accessibility for people with disability.

ANOVA FOR AGE AND COMFORTABILITY THAT LEAD TO IMPULSIVE DECISIONS IN EVALUATING THE BENEFITS OF THE CHENNAI METRO RAIL COMMUTERS

ANOVA

ANOVA – Age

	Sum of Squares	**df**	**Mean Square**	**F**	**p**
Comfortability	1.58	4	0.395	1.34	0.257
Residuals	37.65	128	0.294		

TABLE 4.24

Interpretation

The above ANOVA table shows P=0.257 between the age and the comfortability. Hence, we can conclude that there is no association between the age of the individual and their comfortability.

ANOVA FOR OCCUPATION AND PUNCTUALITY THAT LEAD TO IMPULSIVE DECISIONS IN EVALUATING THE BENEFITS OF THE CHENNAI METRO RAIL COMMUTERS

ANOVA

ANOVA – Occupation					
	Sum of Squares	**df**	**Mean Square**	**F**	**p**
Punctuality	4.72	4	1.180	1.28	0.280
Residuals	117.64	128	0.919		

TABLE 4.25

Interpretation

It is shown that P=0.280 in the ANOVA table. There is no association option between Occupation and Punctuality of the trains.

ANOVA FOR GENDER AND SAFETY THAT LEAD TO IMPULSIVE DECISIONS IN EVALUATING THE BENEFITS OF THE CHENNAI METRO RAIL COMMUTERS

ANOVA

ANOVA – Gender

	Sum of Squares	**df**	**Mean Square**	**F**	**p**
Safety	2.39	4	0.598	1.52	0.200
Residuals	50.32	128	0.393		

TABLE 4.26

Interpretation

We can see that the P=0.200 which is not associated with the Safety and Gender of the commuters.

ANOVA FOR AGE AND HELPFULLNESS OF THE STAFF THAT LEAD TO IMPULSIVE DECISIONS IN EVALUATING THE BENEFITS OF THE CHENNAI METRO RAIL COMMUTERS

ANOVA

ANOVA – Age

	Sum of Squares	**df**	**Mean Square**	**F**	**p**
Helpfulness of staff	0.417	4	0.104	0.343	0.848
Residuals	38.817	128	0.303		

TABLE 4.27

Interpretation

The ANOVA table shows that P=0.848 between Helpfulness of staff and age of the commuters. But it is concluded that there is no association between Helpfulness of staff and age.

CHAPTER V

FINDINGS:

1. Gender Distribution: The majority of metro rail commuters are male (49.6%), followed by female (45.9%), with 1.5% preferring not to say.

2. Age Group Composition: The 20–40 age group comprises 53.4%, and the 40–60 age group accounts for 44.4%, together making up 97.7% of respondents.

3. Employment Status: Employed individuals (50.4%) and students (23.3%) represent 73.7% of the total respondents.

4. Income Levels: The below 25,000 and 30,000–35,000 income groups each account for 27.8%, totaling 55.6% of respondents.

5. Gender and Age Association: A p-value of <0.001 indicates no significant association between gender and age demographics.

6. Gender and Occupation Association: A p-value of <0.001 shows no significant difference between gender and occupation.

7. Gender and Income Association: A significant association exists with a p-value of 0.004 between gender and income.

8. Overall Satisfaction and Age: A p-value of 0.015 indicates no significant association between satisfaction and age.

9. Seating and Accessibility: Pearson's r = 0.385 indicates a moderate relationship between seating availability and accessibility for people with disabilities.

10. Safety and Frequency: Pearson's r = 0.287 suggests a moderate relationship between safety/security measures and train frequency on weekends.

11. Train Frequency and Punctuality: Pearson's r = 0.521 shows a moderate relationship between train frequency and punctuality.

12. Speed of Service and Punctuality: Pearson's r = -0.036 indicates no relationship between speed of service and punctuality.

13. Age and Comfortability: A p-value of 0.257 concludes no significant association between age and comfortability.

14. Occupation and Punctuality: A p-value of 0.280 indicates no association between occupation and train punctuality.

15. Safety and Gender: A p-value of 0.200 shows no association between safety measures and gender.

16. Helpfulness of Staff and Age: A p-value of 0.848 indicates no association between staff helpfulness and age.

SUGGESTIONS:

1. The Chennai Metro Rail needs to expand its network to cover more areas of the city and connect to more residential and commercial hubs, making it a more viable transportation option for a wider range of commuters.
2. Improving connectivity between the Chennai Metro Rail and other modes of transportation.
3. Address the time delays through improved maintenance, better scheduling, and real-time information systems is crucial.
4. Improving the quality of passenger facilities, such as waiting areas, restrooms, and information displays.

CONCLUSION:

The evaluation of the benefits of metro rail systems for commuters provides compelling insights into how these networks impact urban life. As cities continue to grow, the role of efficient public transportation becomes increasingly crucial for promoting sustainable development and enhancing the quality of life for residents. This research has illuminated the multifaceted advantages that metro systems offer, revealing not only their effectiveness in moving people but also their broader socio-economic and environmental benefits. At the heart of metro rail systems is their capacity to improve mobility for millions of commuters each day. By significantly reducing travel times compared to other modes of transportation, metros help individuals reach their destinations more efficiently. For many, this means getting to work, school, or appointments on time, which can be a significant source of stress in today's fast-paced world. The convenience of a reliable metro service can transform daily commutes from a tedious ordeal into a manageable part of life, allowing passengers to reclaim precious time that can be spent on family, leisure, or self-care.

Furthermore, metro systems enhance accessibility for marginalized communities, providing crucial connections to jobs and services that might otherwise be out of reach. In cities where public transport is lacking, some residents may find it challenging to access employment opportunities, education, and healthcare. Metro rail networks can bridge these gaps, ensuring that everyone has a fair chance to participate in the urban economy and enjoy the benefits of city life. Another significant advantage of metro rail systems is their contribution to environmental sustainability.

With growing concerns about climate change and air quality, the shift from personal vehicles to public transportation becomes urgent. Metro systems provide a cleaner alternative, reducing the number of cars on the road and, consequently, lowering greenhouse gas emissions and fossil fuel consumption. This shift not only promotes a healthier environment but also leads to improved air quality in urban areas, benefiting the health of all residents. By investing in metro infrastructure, cities can take significant strides toward achieving their climate goals. Each rider on a metro train represents a step towards a greener future, with fewer pollutants being released into the atmosphere. The promotion of public transport, particularly through metro systems, aligns with global efforts to combat climate change and develop sustainable urban environments.

The socio-economic impacts of metro rail systems extend well beyond transportation. The presence of a metro line can lead to increased property values in surrounding areas, as accessibility often makes neighborhoods more desirable. This increase can contribute to wealth generation for homeowners and stimulate local economies, with businesses benefiting from the increased foot traffic that metro stations bring. Additionally, metro rail projects create jobs during their construction and operational phases, providing economic boosts to local communities.

They also encourage urban development and densification, leading to more vibrant city centers. This infill development promotes a sense of community, as more people live and work within close proximity to one another, fostering social interactions and a sense of belonging. Despite these benefits, it is essential to recognize the challenges that metro rail systems face. Issues such as funding, maintenance, and efficient service delivery are paramount. As cities grapple with budget constraints, ensuring that metro systems remain reliable and well-maintained is crucial for sustaining ridership and public trust. Engaging with the community to understand their needs and preferences can lead to targeted improvements, ensuring that these systems evolve alongside the populations they serve.

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QUESTONORE

Evaluation of the benefits of the Chennai Metro rail commuters

1. **Gender**

Mark only one oval.

- ◯ Male
- ◯ Female
- ◯ Others
- ◯ Prefer not to say

2. **Age**

Mark only one oval.

- ◯ 20 - 40
- ◯ 40-60
- ◯ Above 60

3. **Occupation**

Mark only one oval.

- ◯ Student
- ◯ Employed
- ◯ Self-employed
- ◯ Unemployed
- ◯ Retired

4. **Income**

Mark only one oval.

- Below 25,000
- 25,000 - 30,000
- 30,000 - 35,000
- 35,000 - 40,000
- 40,000 - 45,000
- 50,000 Above

5. **How do you usually travel to the nearest Metro station?**

Mark only one oval.

- Walking
- Bicycle
- Auto-rickshaw
- Taxi
- Public Bus
- Other

Influence of Metro Trains on passengers:

6. **How frequently do you use metro trains?**

Mark only one oval.

- ◯ Daily
- ◯ 2-3 times a week
- ◯ Weekly
- ◯ Occasionally
- ◯ Never

7. **In your view, does the metro service contribute to a more sustainable urban transport system?**

Mark only one oval.

- ◯ Yes
- ◯ Some What
- ◯ No
- ◯ Unsure

8. **Do you think the metro system has made public transport more accessible for people with disabilities?**

Mark only one oval.

- ◯ Yes, significantly
- ◯ Yes, somewhat
- ◯ No
- ◯ Unsure

9. **In your opinion, how has the introduction of the metro train affected overall public transport in your city?**

Mark only one oval.

- ◯ Significantly improved
- ◯ Slightly improved
- ◯ No change
- ◯ Slightly worsened
- ◯ Significantly worsened

10. **What impact do you think the metro has on traffic congestion in your area?**

Mark only one oval.

- ◯ Greatly reduced
- ◯ Somewhat reduced
- ◯ No impact
- ◯ Somewhat increased
- ◯ Greatly increased

Service Performance and Passenger Satisfaction:

11. **How would you rate the crowd management in metro stations during peak hours?**

Mark only one oval.

- ◯ Very poor
- ◯ Poor
- ◯ Average
- ◯ Good
- ◯ Excellent

12. **How satisfied are you with your overall experience on the metro?**

Mark only one oval.

- ◯ Very satisfied
- ◯ Satisfied
- ◯ Neutral
- ◯ Dissatisfied
- ◯ Very dissatisfied

13. **What improvements would significantly enhance your satisfaction with the metro?** (Select all that apply)

- ☐ Increased train frequency
- ☐ Better cleanliness
- ☐ Improved safety measures
- ☐ Enhanced customer service
- ☐ Other:

14. **Rate the following aspects of metro service performance on a scale from 1 (Poor) to 5 (Excellent):**

	1	2	3	4	5
Punctuality	◯	◯	◯	◯	◯
Frequency of trains	◯	◯	◯	◯	◯
Cleanliness of trains and stations	◯	◯	◯	◯	◯
Comforts during travel	◯	◯	◯	◯	◯
Helpfulness of staff	◯	◯	◯	◯	◯

Technology and Innovation in Metro Systems:

15. **Are you familiar with the mobile apps related to the metro system?**

Mark only one oval.

◯ Yes

◯ No

16. **If yes, how would you rate the usability of these mobile apps?**

Mark only one oval.

- ◯ Very poor
- ◯ Poor
- ◯ Average
- ◯ Good
- ◯ Excellent

17. **What technological features do you consider most beneficial?** (Select all that apply)

- ☐ Real-time tracking of trains
- ☐ Mobile ticketing
- ☐ Automated announcements
- ☐ Wi-Fi availability in stations
- ☐ Other: _____

18. **How do you feel about the use of technology for enhanced safety measures (e.g., surveillance cameras, emergency alarms)?**

Mark only one oval.

- Very supportive
- Supportive
- Neutral
- Unsupportive
- Very unsupportive

19. **How likely are you to use apps that provide rewards or incentives for sustainable travel choices (e.g., metro usage instead of cars)?**

Mark only one oval.

- Very likely
- Likely
- Neutral
- Unlikely
- Very unlikely

20. **SUGESSTION**

21. **How important are the following features in a metro train system for you?**

Rate it on a scale from 1 (Poor) to 5 (Excellent):

Mark only one oval per row.

	1	2	3	4	5
Accessibility for people with disabilities	⬭	⬭	⬭	⬭	⬭
Frequency of trains on weekends	⬭	⬭	⬭	⬭	⬭
Safety and security measures	⬭	⬭	⬭	⬭	⬭
Speed of service	⬭	⬭	⬭	⬭	⬭
Availability of seating	⬭	⬭	⬭	⬭	⬭