

Analysing factors influencing usage of Metro Services in Bengaluru, India

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Introduction

National Ambient Air quality test, November 20, 2020 to November 20, 2021



- PM 2.5 exceeding the WHO guidelines by 6-7 times
- PM 10 levels exceeded the limit 3 to 4 times
- Industrial and commercial areas in the city are critically polluted
- Pollution from transportation the major contributors, with ever-increasing traffic congestion, worsening the scenario.
- Air pollution alone was responsible for **12000 deaths** in the Silicon Valley of India.





Introduction



- Therefore, sustainable and responsible travel in the current scenario, is the need of the hour.
- Bengaluru metro, also called as "Namma metro" has 51 metro stations.
- Being the key mass rapid transit system (MRTS) in the city, understanding its service quality and factors influencing the same is important from the perspective of passengers.



Reference	Study context	Transit type	Methodology	SQ factors	Research gap /limitation
Parida, M et al (2020).	Delhi, India SQ of metro	Metro	Structural Equation Modelling	Service availability, passenger ease, passenger information, amenities. Safety and security, seamless connectivity, environmental impact, service quality	Absence of gender perception on SQ
Parida, M et al (2021)	Delhi, India SQ of metro, based on gender perception	Metro	Structural Equation Modelling	Service availability, passenger ease, passenger information, amenities. Safety and security, seamless connectivity, environmental impact, service quality	All factors are positively influencing.
Díez-Mesa et al (2018)	Seville, Spain Developing SQ models	Metro light rail	Structural Equation Modelling	Accessibility, Availability, Customer Service, Environmental Pollution, Individual Space, Information, Security, Tangibles	Absence of gender perception on SQ
Noriel et al (2018)	Manila , Philippines Perception of SQ	Paratransit bus	Structural Equation Modelling	Vehicle condition, reliability, stop' condition, customer care, information, convenience, availability	Absence of service indicators that takes into account of both the users and operators perspective
Anjali Sharma (2020)	Delhi, India Perception of SQ	Metro	Factor analysis	Reliability, responsiveness, Tangibility, Empathy, Assurance, Security	Absence of gender perception on SQ
Lierop et al (2016)	Cananda , The relationship between service quality, customer satisfaction, and behavioral intentions in public transit	Bus	Structural Equation Modelling	Reliability, Safety, Information, Cleanliness	comfort, accessibility, and affordability were poorly measured in the survey
Verma.M et al (2020)	Bengaluru, Ahmedabad Young Women's Perception of Safety		Factor analysis Logistic Regression;	Safety, Trust, Anxiety while travelling in bus, Bus stop facilities	Extracted only 3 factors, therefore not a robust model
Saikat et al (2022)	Guwahati Service quality estimation and improvement plan of bus Service	Bus	Structural Equation Modelling	Vehicle condition & hygiene , Comfort, Reliability & Convenience, Information availability , Safety, Travel Expenses	temporal variation in the users' satisfaction during peak and non-peak hours is not included in this article



❑ To study the factors that influence the usage of metro services in Bengaluru by assessing the service quality satisfaction and loyalty intention (SQLI) of metro commuters in the current scenario and developing a regression model.





Survey design





Data analysis

Connective mode of travel to metro station in Bengaluru



- The data depicts that a higher rate of passengers transit to metro through public modes (i.e., by foot-48%, 25.9% by auto rickshaws, 8.74% by bus).
- Therefore use of public transit systems led road users to choose sustainable modes.
- This fewer rate in the modal shift of individuals owing vehicles can also be the lack of parking facilities in the metro station.

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- The authorities like Bengaluru Metro Rail Corporation Limited (BMRCL) must take effective measures in all the on-going construction activities (Yellow, Pink and Blue lines) and future (Orange) Metro lines to provide proper parking facilities that can attract all personal vehicle users (cars, two-wheelers) and in turn increase the percentage of modal shift from private to Metro transit.
- Thus, providing better last mile connectivity with easy and safe access to the commuters who walk or cycle to Metro station will also result in more usage of

Metro services.







Factor analysis

Exploratory factor analysis

- The indicators were subjected to Exploratory factor analysis applying Principal Component Analysis (PCA) with Varimax rotation using IBM SPSS Statistics 26 software.
- The Kaiser-Meyer-Olkin (KMO) measures 0.96 therefore the sample size has good sampling adequacy.
- ➢ The Bartlett test of sphericity is 0.000, therefore significant and indicates that the data set is suitable for FA.
- The scree plot and total variance were also checked parallelly to fix the factors.
- Seven factors were extracted with a factor loading of 0.7 and above.
- Total variance = 66.52%
- > The reliability of correlation between the variables to factors are measured using the Cronbach α .

No.	Extracted Factors	Cronbach alpha	
1	Passenger Ease(PE)	.920	
2	Overall service quality satisfaction and Loyalty Intention(SQLI)	.910 .840	
3	Smooth transition(ST)		
4	Metro Operations and Safety (MOS)	.839	
5	Anxiety(A)	.899	
6	Amenities(AMT)	.729	
7	Service available(SA)	0.681	



Factor discussion

Fear of slipping or falling at Metro doors and escalators, fear of harassment in Metro, fear of aggression (violence) inside Metro stations while boarding a Metro due to crowd.

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Prior alerts, a good landscape, disabled-friendly infrastructure, good connectivity to the destination

Metro services are time saving, Willingness to make most of the trips by Metro, Recommend, Affordability & Convenience to using Metro, Satisfaction of Metro trips



Reliable and clear travel information, ease of access to smart card facilities, safe environment from theft and robbery provision of support systems like use of handrails

Attitudeofthestaffpersonnel, ease of purchase oftickets,comfortlevelinsideMetro,witheffectiveMetrolineinterchangestodestination

 Availability of wheelchairs, Proper parking facilities, Proper lighting facility available

 Network connectivity of Metro across the city, Convenience in the scheduled timings, Waiting time.





Model development

Regression

Model		Coefficien	t test	Sig		
		Factors name	В	Std. Error	1-1631	Sig.
1	Factor No.	(Constant)	0.625	0.126	4.963	0
	F1	Mean of Passenger Ease (PE)	0.234	0.036	6.454	0
	F2	Mean of Smooth transition (ST)	0.106	0.033	3.259	0.001
	F3	Mean of Metro Operation and safety (MOS)	0.243	0.037	6.624	0
	F4	Mean Anxiety (A)	-0.072	0.016	-4.625	0
	F5	Mean of Amenities (AMT)	0.184	0.035	5.331	0
	F6	Mean of Service available (SA)	0.172	0.029	5.939	0

a. Dependent Variable: Mean_Service Quality satisfaction and Loyalty Intention (SQLI)

- A regression model developed using IBM SPSS
 26 with :
 - > Dependent variable : SQLI factor
 - Independent variable: remaining 6 factors (PE, ST, MOS, A, AMT, SA)
- The summated scale is estimated by taking the mean of all the variables that loads in the same factor.
- This process is done for simplicity and reducing the complexity of the model.
- The developed model has R-square value as
 0.588

YSQLI = 0.625+ 0.243*MOS+ 0.234*PE + 0.184*AMT + 0.172*SA +0.106*ST - 0.072*A + 0.385





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- The regression model depicts that Metro operation and safety along with passenger ease to be the most dominating factor as the coefficient is the highest amongst the other attributes.
- Amenities and service available are the subsequent attributes that positively influence overall satisfaction towards the service quality satisfaction and loyalty intention.
- The smooth transition attribute has the lowest coefficient, therefore less dominant compared to the other attributes impacting SQLI.
- However, the results depict that the attribute anxiety have a negative impact on SQLI amongst the Metro users.



- The **novelty** of this study was found in the **factor anxiety** which was extracted separately, having a **negative coefficient.**
- Therefore, satisfaction reduces if fear is infused while traveling
- The commuter will not just be reluctant to go for repeat use of the services but will not recommend others also to use Metro services. Such commuters may give a negative word of mouth to others.
- The authorities like Bengaluru Metro Rail Corporation Limited (BMRCL) need to pay attention in addressing the passenger's concerns related to this factor.
- Implementing open spaces, more security, personnel and user-friendly infrastructures while planning can defuse such fears and anxieties that will in turn, increase the ridership of Metro.



- The model developed with the factors influencing the usage of Metro services in terms of SQLI can bridge the service gaps of Bengaluru Metro to attract commuters.
- Further, this model can also be used to assess the commuter's service quality satisfaction and their loyalty to use the metro in the future, for other Metro systems in India.
- The sample size is restricted to 700 only, a study with larger data can give a more robust model for the measure of satisfaction and loyalty intention towards Metro services.
- The gender perception on the satisfaction level of service quality for Metro transits are not studied, this can be a future scope of work.



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