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AN EMPIRICAL STUDY ON VARIABLES INFLUENCING CHENNAI'S DECISION TO SELECT AMONG TWO FORMS OF PASSENGER RAIL: CHENNAI SUBURBAN RAILWAY AND CHENNAI METRO RAIL LIMITED

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Abstract

People in Chennai depend heavily on the railways to commute locally from one part of the city to another, which plays a significant role in their daily lives. However, it is quite challenging to obtain when opting between Chennai's two main passenger railways because there are a number of variables that influence their choices. The Chennai Suburban Railway and the Chennai Metro Rail Limited (CMRL) are the two most often used passenger rail networks in Chennai. The Chennai Suburban Railway has four distinct rail lines, and the CMRL has two metro lines that span the city. These two kinds of passenger railways are exploited not merely by residents of Chennai but also by tourists, visitors from bordering states, merchants, and other individuals. The main objective of the survey is to assess the key variables that influence people's decisions among the two passenger railways, the Chennai Suburban Railway and the CMRL. The purpose of this research is to establish the challenges that travelers on passenger trains encounter while also examining the disparities seen between two passenger railways. Despite the differences between the two, it is possible to address the issues and achieve superior management on both passenger railways with the help of this research. With the sample of 240 passengers the outcome will assist in identifying the key factors influencing Chennai's decision between the two passenger rail options, and along with that, a comparative study between CMRL and Chennai Suburban Railway is made.

Keywords – Chennai Metro Rail Limited (CMRL), Chennai Suburban Railway (CSR), Mass Rapid Transit System (MRTS), Indian Railways (IR), Southern Railways (SR), Questionnaire, Influence of variables, Passenger Railways, Chennai.

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INTRODUCTION

Indians heavily rely on the Indian Railways on a daily basis to go from one town to another and to visit friends and relatives who live in different states throughout the country. Indian Railways is governed by the Railway Ministry of India, and the Indian Government is in charge of the entire national rail system of the nation. The Southern Railway has grown to become India's fourth-largest zone, and its trains are regarded as the best-kept and cleanest trains in the country.

The Chennai Suburban Railway, a commuter rail system in Chennai, Tamil Nadu, India, is run by the Southern Railway division of Indian Railways. The Chennai Metro provides accelerated transportation. India's fourth-longest metro system is the Chennai Metro. The Chennai Metro Rail Limited (CMRL), a partnership between the governments of Tamil Nadu and India, built and operates the Chennai Metro. There is a combination of elevated and underground stops in the commuter rail system.



Figure 1: Chennai Suburban Railway

(Source: CSR Train: <https://www.youtube.com>)
<https://www.metrotrainnews.in/>)



Figure 2: Chennai Metro Rail Limited

(Source: CMRL Train: <https://www.metrotrainnews.in/>)

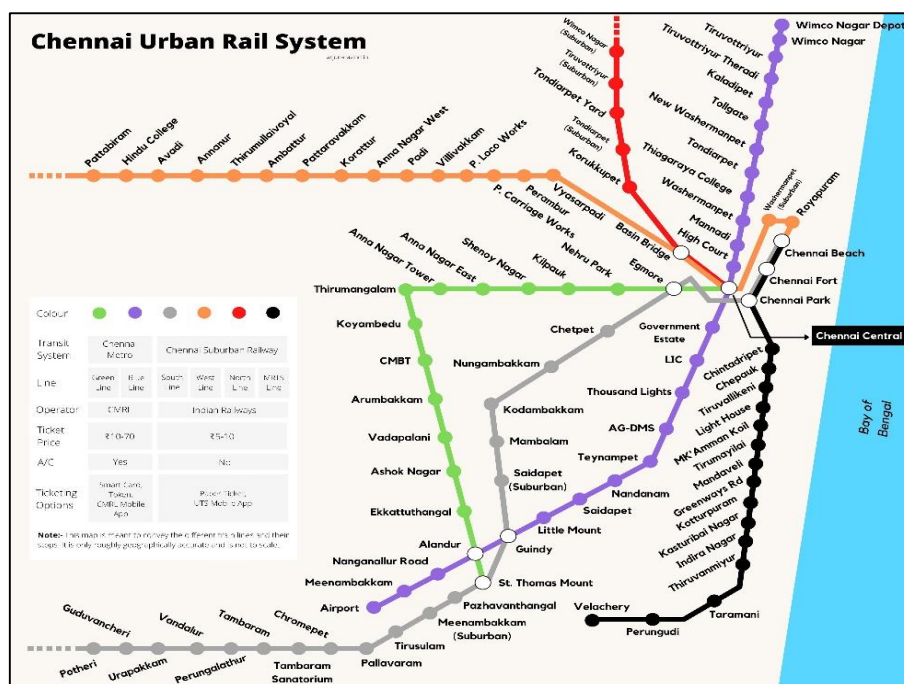


Figure 3: Chennai Urban Rail System

(Source: Map of Urban Rail System in Chennai: <https://www.reddit.com>)

The Chennai Suburban Railway and the Chennai Metro Rail Ltd., are the two main commuter locomotives that are extensively used for mobility in Chennai. Every area of Chennai is accessible by these two passenger rails. Four suburban rail lines and two metro lines make up Chennai's Urban Rail System. The North Line, West Line, South Line, and MRTS Line are the capital's four suburban railway lines. The West North, West South, and South West lines are basically truncated versions of the aforementioned suburban lines. The Green Line and the Blue Line are Chennai's two metro rail lines.

The Chennai Suburban Railway's ticket ranges from ₹5 to ₹10. The cost of a CMRL ticket fluctuates from ₹10 to ₹70. CMRL has the air conditioning feature, while CSR does not. Paper tickets and online ticket purchases via the UTS Mobile Application are the two ticketing alternatives offered to customers of the Chennai Suburban Railway. The CMRL offers smart cards (Metro Cards), tokens, and the CMRL mobile application as ticketing choices to customers. At less than market rates, the government is providing season passes that let users go anywhere on the Chennai Suburban Railway. On the Chennai Metro Rail Limited, the government has also implemented the Metro Card, which enables users to travel to multiple locations for 10% cheaper than the going rate.

The major goal of this study is to identify the critical factors that affect the passenger's decision to use these passenger railways. This study explains the variations between the two passenger rails and study passenger satisfaction among CSR and CMRL. As a conclusion of this study, commuters will gain knowledge of the features offered by both passenger rails as well as the distinctions of the service offered between the two railways.

REVIEW OF LITERATURE

The use of public transportation is advantageous for several purposes, including getting to and from work, enjoying leisure time, and making purchases [1,20]. With the help of Chennai Metro Rail Limited, transportation in Chennai has entirely changed from being uncomfortable to being enjoyable. In addition to providing secure and comfortable transportation, it also saves tourists' valuable time and money by getting them to their destination on time [2-4,20]. In public transportation, the time and prices are quite important factors and they are inversely proportional. As time varies, so does the price, and vice versa. Socioeconomic characteristics like income and gender are taken into consideration to identify who uses public transit the most. While selecting a form of public transportation, age and gender are important considerations [1,5,6]. The rights to social engagement and independence for elderly persons and individuals with impairments are growing [1]. The effectiveness and standards of public transportation have a significant impact on people's decision-making [5,6,20].

The impact of the route coverage is mitigated with the least amount of delay and highest level of production [2,6,16]. To determine the commuter's degree of satisfaction while commuting in CMRL, infrastructural facility variables like ticket prices, parking options, and air conditioning are taken into consideration. Service-ascent factors like smart cards, security, and hygiene are also considered [6,20,24]. The ticket price, daily parking cost, journey duration, service quality, and availability are the main factors that influence whether consumers prefer to use their own automobiles or public transportation [5].

The CMRL project can be made practical with the help of a cost-benefit analysis since the net present value under various scenarios results in a good outcome [7,18].

With the substitution of electricity for gasoline and diesel fuel and traffic rerouting, its implementation would shorten travel times, lower accident rates, and lessen pollution ^[1,2,4,7,9,10,11,21,25]. Internal rate of return (IRR), which is another result of the financial analysis, is 9.885% ^[7].

The reliability and safety of passengers will improve as CMRL continues to develop ^[8,20]. The city's suburban railway line has unquestionably contributed to a rise in rail corridor development in Chennai. However, it took some time before the impact could be seen ^[10,18].

Para-transit systems are required that can gather traffic and be conveniently accessed from all parts of the city. They also make public transportation simple. As a result, more people will be able to work effectively and live healthier lives ^[11]. In populated cities around the world, metro rail has proven to be one of the most effective and environmentally friendly transportation systems ^[2-4,6,11,12,15]. In Chennai, the state capital of Tamil Nadu in southern India, a few of the design and construction techniques employed for the Chennai Central Metro station are studied, including station planning, suitable structural design, architectural design that honours the city's past, multimodal traffic integration, and a strategy for diverting traffic during construction ^[12].

Econometric demand models were used to examine how sensitive suburban rail customers were to fare adjustments ^[6,13,16,22]. The models were built using data from a 30-year time series of demand and fares for suburban rail services in Chennai, Kolkata, and Mumbai, three of India's largest cities ^[13]. The elasticities were calculated using a direct-demand model. Panel data, dynamic timeseries, and static timeseries were all used and was found that Kolkata and Chennai have high fare flexibility ^[13,20].

The recent metro growth corridor in India was causing suburban train passengers to

alter their behavior ^[6,16,20,21]. Regardless of the reason for the travel, suburban train customers gave cost difference more weight than time savings when estimating their chance to move ^[14,22]. To make suburban railways a clean method of transportation, it is essential to use more renewable energy, lighten coach bodies, extend the lifespan and renewability of rails and fastenings, and increase train occupancy ^[16,24]. The fact that the vendors are engaged in a wide range of suburban activities, including the sale of children's books, vegetables, and accessories as well as snacks and flowers, suggests that there is kid labor participating in this industry and that age is not a barrier to work.

The reality that suburban railroad sellers have kept their children in this line of employment despite having earned the knowledge necessary to land a more stable career demonstrates their fatalistic mindset ^[17]. Even individuals who live in remote regions far from the city have access to employment attributable to commuting ^[17-20]. The number of trains is increased to accommodate the large number of commuters ^[19,21,25]. The locations, stations, and rail lines are constant, while the things, people, and trains are constantly shifting. These two elements work in perfect harmony and are closely related ^[19]. Thus, city's traffic will be managed via a rail-based urban transportation system. This will establish in the population a sense of security and cleanliness, changing the way society thinks ^[6,8,10,14,20,21,24,25]. It is simple to identify platforms and facilities present in that specific city using Geographical Information Systems (GIS), which serves as a guide for commuters who travel to an unfamiliar location. In this study, GIS is used to create the information system for each station. Regarding the facilities available, passenger usage, station utilization, and track utilization, recommendations were given to enhance the operation of railway stations ^[23]. Due to the exceptionally low public transportation charges and huge

passenger volumes, even slight increases could result in significant financial gains for system development, modernization, and maintenance [6,7,16,18,24,25]. Fares cannot be increased too much, even among middle-class passengers, as this could lead to a shift towards private transportation, which is the source of the majority of urban transportation issues [17].

More public sector subsidies will therefore be necessary. Public transportation in India will continue to be overcrowded, dangerous, unreliable, and unpleasant without the necessary funding from all levels of government. As a result, more Indians will choose to drive their own cars and motorcycles, which will worsen the traffic and pollution issues in Indian cities [6,13,16,22,25].

The **research gap** identified after examining all the articles is that the two passenger rails utilized by people in Chennai are not differentiated based on the variables extracted by the researcher. In order to determine which affects both passenger rails more, the 14 variables under the four factors (Outlay Factor, Purity, Protection Factor, Railway Utility Factor, Aid, Aliment, Amenity Factor) are considered. The differences between the two passenger railways are also stated, and the conclusion indicates which of the two passenger railways is more preferred based on the factors identified. Identification of factors helps to prioritize their areas of importance, increase loyal passengers, meet regulatory requirements and provide quality service to passengers.

OBJECTIVE OF THE STUDY

Based on the above literature review and the identified research gap the following objectives were framed for the present study.

- **01** – To identify the factors that influence the Chennai's decision on choosing between passenger rails CSR and CMRL through available literature review.
- **02** – To understand the influence of direct variables on passenger satisfaction of Chennai Suburban Railway and Chennai Metro Rail Limited using paired T – test.
- **03** – To analyze the influence of the variables on CSR and CMRL pre score and post score using paired T – test.
- **04** – To analyze the role of CSR and CMRL factors on passenger satisfaction using factor analysis, regression analysis and structural equation model. To study the factors affecting the passenger satisfaction of Chennai Suburban Railway and Chennai Metro Rail Limited.

Based on the above objectives the researcher has devised a model to study the passenger satisfaction among the Chennai Passenger rails CSR and CMRL under the four factors. This model will form a base for future passenger rails can be designed to meet passenger satisfaction.

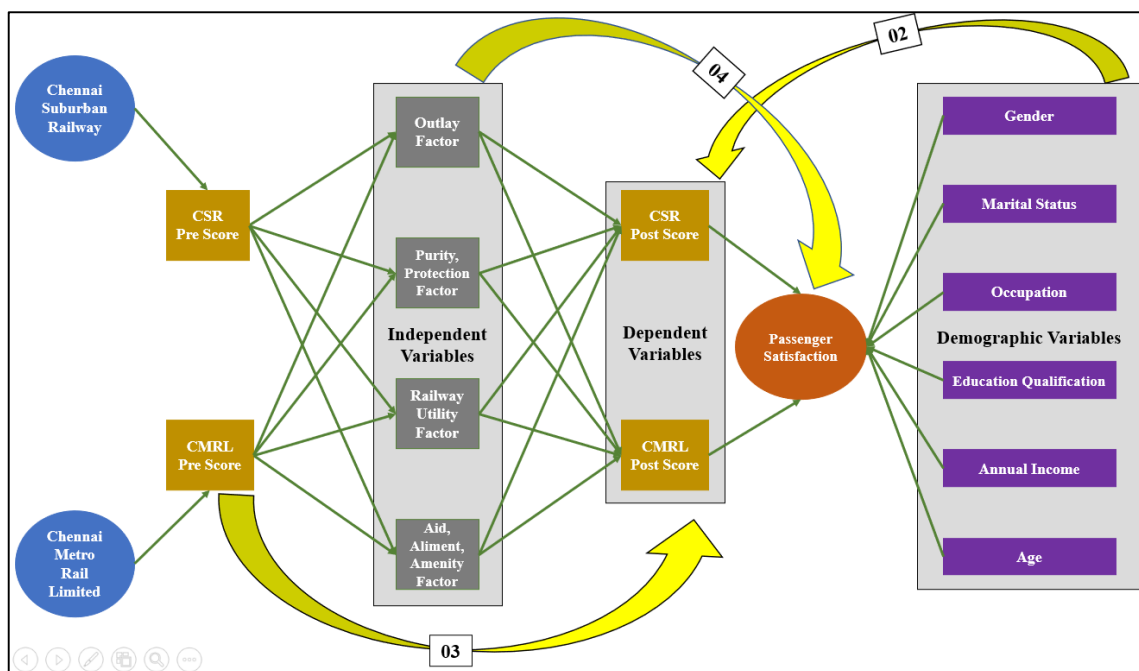


Figure 4: Model fitness to study passenger satisfaction among the Chennai Passenger Rail, Chennai Suburban Railway (CSR), and Chennai Metro Rail Limited (CMRL)

RESEARCH METHODOLOGY

The major **objective** of this research is to determine the differences in viewpoints between Chennai Suburban Railway (CSR) and Chennai Metro Rail Limited (CMRL) on passenger rails. 240 passengers who went on both the CSR and CMRL were surveyed using a structured questionnaire in order to discover their relative preferences for each rail. This was done in order to learn the passenger perspectives on these passenger rails.

The demographic profile of the respondents included age where 52% of the population is from below 18-24 yrs, gender (58% were female), marital status (70% were singles and not married), occupation (39% Salaried and 34% students), educational qualifications, and annual income (40 % non-salaried, 27% were above 4 Lakhs per annum). In the analysis, all these were considered to bring out the preferences among choosing the Chennai passenger rails using the Paired T-test method.

Table 1: Preference among Passenger rails with demographic variables using Paired T – test

Preference among Passenger rails with demographic variables n = 240		Paired Differences		
		Mean	t	Sig. (2tailed)
Pair 1	Gender - PreferenceAmongChennaiPassengerRails	-0.395 -0.909	-6.748	.000
Pair 2	MaritalStatus - PreferenceAmongChennaiPassengerRails	-0.6625 -0.989	-10.38	.000
Pair 3	Occupation - PreferenceAmongChennaiPassengerRails	1.775 -1.312	20.948	.000
Pair 4	EducationalQualification - PreferenceAmongChennaiPassengerRails	2.1625 -1.221	27.424	.000
Pair 5	AnnualIncome - PreferenceAmongChennaiPassengerRails	2.58333 -1.785	22.408	.000
Pair 6	Age - PreferenceAmongChennaiPassengerRails	0.6875 -1.362	7.818	.000

It was found that all the demographic variables of the respondents were found to be highly significant with their preference among Chennai Passenger Rails.

The samples were asked to evaluate and rate the passenger rails before and after

introducing the 14 variables chosen for the study which is grouped under (Outlay Factor, Purity, Protection Factor, Railway Utility Factor, Aid, Aliment, Amenity Factor) and tabulated using paired T-test method.

Table 2: Paired Samples Test

		Paired Differences			Correlation	Sig.
		Mean	t	Sig. (2-tailed)		
Pair 1	CSR PRE Score - CSR POST SCORE	0.35 -1.095	4.951	0	0.456	0
Pair 2	CMRL PRE Score - CMRL POST SCORE	0.546 (1.576)	5.366	0	0.161	0.012

From the above table it is evident that there is a significant difference between the Pre and Post Score. The introduction of the 14 variables has drastically changed the mindset of the 240 passengers which is evident with the t values. There is also a strong correlation between the CSR and CMRL Pre and Post Score.

Reliability analysis for all the items were done which resulted in Cronbach alpha value of 0.940 and 0.970 for CSR and CMRL respectively which confirmed that all the items – total correlation is above the acceptable minimum and hence accepted.

Table 3: Reliability analysis for CSR and CMRL

Reliability Statistics - CSR			Reliability Statistics - CMRL		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.939	.940	14	.970	.970	14

KMO and Bartlett's Test of Sphericity for all the 14 variables that influences the preference of CSR and CMRL were

performed for the items. The following table shows the result of the analysis.

Table 4: Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity for Chennai Suburban Railway (CSR) and Chennai Metro Rail Limited (CMRL)

KMO and Bartlett's Test		CSR	CMRL
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.922	.956
Bartlett's Test of Sphericity	Approx. Chi-Square	2937.972	4165.003
	df	91	91
	Sig.	0.000	0.000

KMO Bartlett's Test for sphericity was performed and the measure was found to be 0.922 and 0.956 for CSR and CRML respectively which is above the obligatory minimum of 0.5. Hence confirming the sampling adequacy. This test was found to be significant at (P<0.01) with the Chi-

square value of 2937.972 and 4165.003 for CSR and CMRL respectively confirming the stability of the data set for factor analysis. The principal component analysis with varimax rotation resulted in the extraction of 4 factors for CSR and CMRL and the factor loading of 0.5 or above was

taken as significant loadings. The factor structure explains 81.623 and 87.642 variance for the 4 factors (cost factor, hygiene safety and security factor, core

railway service factor and food, services and amenities factor) Thus the percentage of variance explained by the factor structure is acceptable.

Table 5: Descriptive statistics of 14 variables and its communalities

Factors	CSR Factors	Extraction	CMRL Factors	Extraction
OUTLAY FACTOR	CSRTicketFare	0.868	CMRLTicketFare	0.898
	CSRSeasonPass	0.859	CMRLMetroCard	0.873
	CSRVehicleParkingFare	0.858	CMRLVehicleParkingFare	0.937
PURITY, PROTECTION FACTOR	CSRHygiene	0.802	CMRLHygiene	0.916
	CSRSecurity	0.833	CMRLSecurity	0.88
RAILWAY UTILITY FACTOR	CSROnlineTicketPurchase	0.686	CMRLOnlineTicketPurchase	0.872
	CSRTrainSpeed	0.808	CMRLTrainSpeed	0.86
	CSRPlatformIdentification	0.797	CMRLPlatformIdentification	0.807
	CSRConvenientduringtravel	0.808	CMRLConvenientduringtravel	0.898
	CSRJourney	0.797	CMRLJourney	0.9
	CSRRouteCoverage	0.822	CMRLRouteCoverage	0.702
AID, ALIMENT, AMENITY FACTOR	CSRVehicleParkingFacility	0.856	CMRLVehicleParkingFacility	0.869
	CSRFood	0.818	CMRLFood	0.966
	CSRService	0.817	CMRLService	0.891

All the 14 variables under the 4 factors had communalities greater than 0.5. Higher communalities indicate that larger amount of variance in the variables that has been

extracted by the factor solution. This indicates that all the 14 variables were considered for the study and no variable was eliminated.

Table 6: Factor loading for key variables of Chennai Suburban Railway (CSR)

Key Attributes of CSR	FACTOR LOADING		Initial Eigen values		
			Total	% of Variance	Cumulative %
CSRTicketFare	.869	OUTLAY FACTOR	7.985	57.036	57.036
CSRSeasonPass	.852				
CSRVehicleParkingFare	0.819				
CSRHygiene	.846	PURITY, PROTECTION FACTOR	2.106	15.046	72.081
CSRSecurity	.842				
CSROnlineTicketPurchase	.692 .826 .793 .523 0.724 0.647	RAILWAY UTILITY FACTOR	.836	5.968	78.050
CSRTrainSpeed					
CSRPlatformIdentification					
CSRConvenientduringtravel					
CSRJourney					
CSRRouteCoverage					
CSRVehicleParkingFacility	.791	AID, ALIMENT, AMENITY FACTOR	.500	3.573	81.623
CSRFood	.827				
CSRService	0.58				

All 14 variables of CSR have significant factor loading under four factors. The factor loading must be greater than 0.5 and here the factor loading of CSR ranges from 0.526 (CSR Convenient during travel) to 0.869 (CSR Ticket Fare). Percentage of the total variance is explained by all the factors.

Factor 1 explained 57.036% of total variance. Principal component analysis of extraction method was employed with the varimax rotation method converged in four iterations.

Table 7: Factor loading for key variables of Chennai Metro Rail Limited

Key Attributes of CMRL	FACTOR LOADING		Initial Eigen values		
			Total	% of Variance	Cumulative %
CMRLTicketFare	0.874	OUTLAY FACTOR	10.149	72.495	72.495
CMRLMetroCard	0.705				
CMRLVehicleParkingFare	0.786				
CMRLHygiene	0.887	PURITY, PROTECTION FACTOR	1.140	8.144	80.639
CMRLSecurity	0.826				
CMRLOnlineTicketPurchase	.539	0.739	.539	3.848	84.487
CMRLTrainSpeed		0.845			
CMRLPlatformIdentification		0.714			
CMRLConvenientduringtravel		0.871			
CMRLJourney		0.883			
CMRLRouteCoverage		0.705			
CMRLVehicleParkingFacility		0.707			
CMRIFood	.442	0.863	.442	3.154	87.642
CMRLService		0.846			

All 14 variables of CMRL have significant factor loading under four factors. The factor loading must be greater than 0.5 and here the factor loading of CMRL ranges from 0.705 (CMRL Metro Card and CMRL Route Coverage) to 0.887 (CMRL Hygiene). Percentage of the total variance is explained by all the factors. Factor 1 explained 72.495% of total variance. Principal component analysis of extraction method was employed with the varimax rotation method converged in four iterations.

In this study the regression analysis was used to derive an appropriate mathematical expression for finding values of dependent variable (Passenger Satisfaction) on the basis of the independent 14 variables (4 factors: Outlay Factor, Purity, Protection

Factor, Railway Utility Factor and Aid, Aliment, Amenities Factor). The modal summary for key metrics of CSR and CMRL and passenger satisfaction on each passenger rails was studied. The model fit output consists of “Modal Summary” and “ANOVA”. The modal summary includes multiple correlation coefficient R and R – Square and also the adjusted version of this coefficient has summary measures of the model fit. As per the table the linear regression coefficient R = 0.715 and R = 0.710 for CSR and CMRL, R Square = 0.511 and R Square = 0.504 for CSR and CMRL indicating that 51.1% and 50.4% of variation respectively in the key metrics of CSR and CMRL explained by 14 variables.

Table 8: Model for key attributes of influencing variables of Chennai Suburban Railway (CSR) and Chennai Metro Rail Limited (CMRL) on passenger satisfaction

Category	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
CSR	1	.715 ^a	.511	.481	.83783	2.016
CMRL	2	.710 ^a	.504	.473	1.07832	2.019

a. Predictors: (Constant), CSR 14 FACTORS, CMRL 14 FACTORS

b. Dependent Variable: PASSENGER_Score

Setting the confidence intervals at 95% the results of ANOVA test provide a F-test Value where F=16.814 and F = 16.313 for with P<0.001 for CSR and CMRL reflected significant relation with

passenger satisfaction. This means that the prediction of passenger satisfaction by the 14 variables under CSR and CMRL was found to be linear.

Table 9: ANOVA for key attributes of influencing variables of Chennai Suburban Railway (CSR) and Chennai Metro Rail Limited (CMRL) on passenger satisfaction

Category	Model	Sum of Squares	Df	Mean Square	F	Sig.	
CSR	1	Regression	165.241	14	11.803	16.814	.000 ^b
		Residual	157.942	225	.702		
		Total	323.183	239			
CMRL	2	Regression	265.560	14	18.969	16.313	.000 ^b
		Residual	261.623	225	1.163		
		Total	527.183	239			

a. Dependent Variable: CSR-PASSENGER_SCORE & CMRL-PASSENGER SCORE

b. Predictors: (Constant), CSR 14 FACTORS AND CMRL 14 FACTORS

The key metrics of 14 variables in CSR viz., CSR Ticket Fare, CSR Hygiene, CSR Vehicle Parking Fare, CSR Service were all found to be significant at P<0.001. While CSR Ticket Fare (X1), CSR Hygiene (X2), CSR Service (X4) had positive relationship, CSR Vehicle Parking Fare (X3) had negative relationship with passenger satisfaction.

$$Y = 0.480 + 0.187X1 + 0.293X2 - 0.132X3 + 0.176X4$$

CMRL Vehicle Parking Facility, CMRL Train Speed, CMRL Journey were all found to be significant at P<0.001. While CMRL Security (X2), CMRL Vehicle Parking Facility (X3), CMRL Train Speed (X4), CMRL Journey (X5) had positive relationship, CSR Hygiene (X1) had negative relationship with passenger satisfaction.

$$Y = 0.497 - 0.308X1 + 0.288X2 + 0.333X3 + 0.296X4 + 0.374X5$$

The key metrics of 14 variables in CMRL viz., CMRL Hygiene, CMRL Security,

Table 10: T- test for key attributes of influencing variables of Chennai Suburban Railway (CSR) and Chennai Metro Rail Limited (CMRL) on passenger satisfaction

Category	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
		B	Std. Error	Beta			
CSR	1	(Constant)	.480	.178		2.706	.007
		CSRTicketFare	.187	.087	.242	2.142	.033
		CSRHygiene	.293	.077	.312	3.812	.000
		CSRVehicleParkingFare	-.132	.074	-.139	-1.797	.074
		CSRService	.176	.082	.178	2.146	.033
CMRL	2	(Constant)	.497	.208		2.386	.018
		CMRLHygiene	-.308	.163	-.291	-1.892	.060
		CMRLSecurity	.288	.141	.273	2.045	.042
		CMRLVehicleParkingFacility	.333	.124	.287	2.680	.008
		CMRLTrainSpeed	.296	.123	.291	2.398	.017
	CMRLJourney	.374	.136	.365	2.748	.006	

Based on the standardized coefficients CSR Hygiene (0.312) for CSR and CMRL Journey (0.365) for CMRL of the passengers are the most important variables to extract importance for passenger satisfaction followed by other

variables explained above. This means that if these variables are taken care of it results in attaining better passenger satisfaction.

Structural Equation Modelling on Influencing factors leading to passenger satisfaction: SEM was carried out to find the fit of the developed conceptual model. The variables used for the analysis includes: The post scores of CSR and CMRL were considered as the observed, endogenous variables and the factors influencing passenger satisfaction was considered as observed, exogenous

variables. The number of variables in the SEM for the model is 26, number of observed variables is 11, number of unobserved variables is 15, number of exogenous variables is 13 and number of endogenous variables is 13. The factors that are used for the study are found to be significant. The C.R. represents construct reliability.

Table 11: Influencing Factors in SEM Analysis on PS

			Estimate	S.E.	C.R.	P	Label
CSRService	<---	F1	1				
CSRVehicleParkingFare	<---	F1	0.841	0.08	10.561	***	P<0.001
CSRHygiene	<---	F1	0.817	0.081	10.077	***	P<0.001
CSRTicketFare	<---	F1	0.821	0.1	8.19	***	P<0.001
CMRLTrainSpeed	<---	F2	1				
CMRLVehicleParkingFacility	<---	F2	0.837	0.041	20.381	***	P<0.001
CMRLSecurity	<---	F2	0.999	0.04	25.209	***	P<0.001
CMRLHygiene	<---	F2	1.03	0.037	28.109	***	P<0.001
CMRLJourney	<---	F2	1.01	0.042	23.929	***	P<0.001
CSTPOSTSCORE	<---	F1	0.57	0.058	9.81	***	P<0.001
CMRLPOSTSCORE	<---	F2	0.157	0.04	3.96	***	P<0.001

Fig 5: SEM on Influencing factors on PS

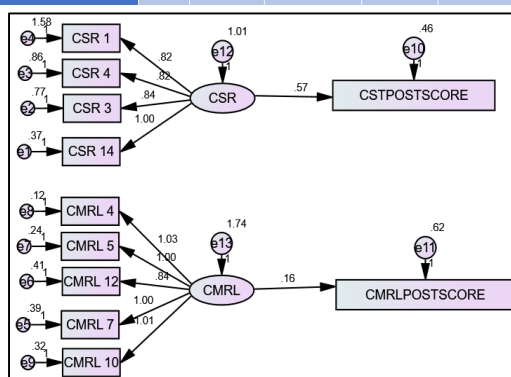


Table 12: Goodness of Fit Indices of Influencing Factors on Passenger Satisfaction

Goodness of Fit Statistics CSR & CMRL on PS		Values	Desired range of values of a good fit
Chi - Square Test	CMIN	298.75	P < 0.001
Absolute Fit measure			
Degrees of Freedom	DF	55	> = 0
Chi - Square Test / DF Ratio	CMIN / DF	5.431	
Goodness of Fit Index	GF I	0.845	> 0.90
Root mean square error of approximation	RMSEA	0.106	< 0.08
Incremental Fit measure			
Adjusted good of fit index	AGFI	0.766	> 0.90
Tucker - Lewis Index	TLI	0.85	> 0.90
Comparative Fit Index	CFI	0.88	> 0.95
Normed Fit Index	NFI	0.863	> 0.90

The SEM on Passenger Satisfaction is depicted in Fig 2. The Confirmatory Factor Analysis, reliability and validity analysis were performed to assess the adequacy of

the measurement model. More than one goodness of fit index was used to evaluate the model fit of the proposed model. The variables identified fit well with the

influencing factors on passenger Satisfaction. Among the 14 factors the most important factors that decides the passenger satisfaction is what that makes the difference in the choice made by the passengers.

FINDINGS & CONCLUSION:

1. Demographic profile of the passengers and its influence on passenger satisfaction was studied using paired T – test. The results indicate It was found that all the demographic variables of the respondents were found to be highly significant with their preference among Chennai Passenger Rails.
2. The paired T – test was done to understand whether there was a difference in the passenger satisfaction before and after introduction of 14 variables. The results indicated that there is a significant difference between the pre-score and post-score of Chennai Suburban Railway (CSR) and Chennai Metro Rail Limited (CMRL), respectively. The introduction of the 14 variables has drastically changed the mindset of the 240 passengers which is evident with the t values. There is also a strong correlation between the Chennai Suburban Railway (CSR) and Chennai Metro Rail Limited (CMRL) pre-score and post-score.
3. Reliability analysis with Cronbach's alpha value revealed that the entire item total correlation for both Chennai Suburban Railway (CSR) and Chennai Metro Rail Limited (CMRL) are above acceptable minimum >0.7 and the KMO measure also being above the obligatory minimum of 0.5. Hence the sampling adequacy is well confirmed.
4. Bartlett's test of sphericity is significant at 1% level of significance ($P < 0.01$). Therefore, the stability of the dataset of factor analysis is confirmed.
5. In correlation of the key metrics of the Chennai Suburban Railway (CSR) and Chennai Metro Rail Limited (CMRL) variables, a positive relationship was found to be strongly prevalent with the passenger scores.
6. Principal component analysis of extraction method was employed with varimax rotation method converged in four iterations which are grouped to contribute the influencing factors loading to passenger satisfaction.
7. Multiple regression between the 14 variables on passenger satisfaction established a linear relationship between with positive the positive and negative effects between the overall passenger's satisfaction and key metrics of influencing factors for SEM a partial effect exists both Chennai Suburban Railway (CSR) and Chennai Metro Rail Limited (CMRL) factors on passenger satisfaction with a good fit.
8. The above findings were observed to correlate with the objectives of the research and thereby address the research intent of the study. The key metrics of Chennai Suburban Railway (CSR) and Chennai Metro Rail Limited (CMRL) responsible for passenger satisfaction was identified and the study reveals that Chennai Metro Rail Limited (CMRL) had better satisfaction than Chennai Suburban Railway (CSR) with 72.495% of total variance Chennai Metro Rail Limited (CMRL) as against 57.036% of total variance of Chennai Suburban Railway (CSR). These confirming the preference of Chennai Metro Rail Limited (CMRL) over Chennai Suburban Railway (CSR).

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