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AN ANALYTICAL INVESTIGATION ON PASSENGER SATISFACTION: A PERCEPTUAL STUDY ON INDIAN RAILWAY

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ABSTRACT

The present study aims to identify the most significant Service Quality Dimensions influencing Railway Passenger Satisfaction, to investigate their influencing level, and to find out the rank of those aforesaid factors in terms of their importance, width and height of their zone of tolerance in terms of Railway Passenger Satisfaction. Further, it aspires to develop a framework which may lead to policy implementation in satisfying Railway Passengers. To understand the perception and attitude of the Railway Passenger towards Railway Passenger Satisfaction a structured questionnaire is developed with 45 attributes on the basis of standard measuring instrument RAILQUAL. 362 usable responses (88.29%) are analyzed with the help of SPSS, R and Hugin lite software. Logistic regression is applied to check the accuracy and goodness of fit of the model. Principal component analysis and Multiple Regression Analysis have been used to investigate the most substantial Railway Passenger Service Quality Factors and their influencing level on Railway Passenger Satisfaction. Logistic regression is applied to check the accuracy and goodness of fit of the model. The rank analysis is used to identify the rank of those aforesaid factors in terms of their importance, width and height of their zone of tolerance in terms of Railway Passenger Satisfaction and Bayesian Probabilistic Network are applied to frame a model for Indian Railways to implement policy on the basis of the different scenario and causal analysis.

KEYWORDS: *Service Quality Dimensions, Passenger Satisfaction, Scenario and Causal Analysis*

Article History

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INTRODUCTION

Theoretical Background

According to research conducted by the International Railway Research Board (IRRB) and the International Union of Railways (IUR), with the rapid development of transport market and the rapid development of three-dimensional traffic, railways, civil aviation and road competition is becoming increasingly fierce. The Gallup Organization, Hungary (2011) surveyed the EU rail passengers' satisfaction level with various features of the rail services, including the trains, railway stations and the rail network prevailing in various countries. From the study, the largest number the largest proportions of respondents who mostly used the train to go to work or school were seen in Portugal, Denmark and Belgium. The largest proportions of persons who are business travelers were in Sweden, Italy and Greece.

Spain, Lithuania and Luxembourg were among the countries with the highest proportions of satisfied rail passengers and Poland among the most dissatisfied. Gomatheeswaran M., Sivakumar B. (2014) analyzed the important factors that led to customer satisfaction, problems faced by the passengers, the benefits the passengers get from Coimbatore to other places. The facilities of reservation, cancellation satisfied the passengers. The pantry car system, entry of beggars, unauthorized vendors led to major dissatisfaction. In this light Rajeswari V et al (2014) conducted a survey to access the quality of service provided for the passengers frequently travelling between Kerala to Delhi and Mumbai to Delhi. A modified SERVQUAL questionnaire was used and found out that the service provided by Indian railways is not satisfactory. Next year, Vimal. K.P., Jitin P. (2015) studied the factors affecting passenger satisfaction, passenger satisfaction level in Coimbatore junction and the problems faced by the passengers. It was observed that overcrowding is a major problem faced by the passengers, but in spite of that they prefer travelling by train as that is the cheapest mode of transportation.

OBJECTIVES & METHODOLOGY

The present study aims to identify the most significant Service Quality Dimensions influencing Railway Passenger Satisfaction, to investigate their influencing level, to find out the rank of those aforesaid factors in terms of their importance, width and height of their zone of tolerance in terms of Railway Passenger Satisfaction. Further, it aspires to develop a framework which may lead to policy implementation in satisfying Railway Passengers.

To understand the perception and attitude of the Railway Passenger towards Railway service quality a structured questionnaire is developed with 45 attributes on the basis of standard measuring instrument RAILQUAL. Out of 500 distributed questionnaires 410 is returned and finally 362 usable questionnaires (88.29%) are analyzed with the help of SPSS and Hugin lite software. Principal component analysis and Multiple Regression Analysis have been used to investigate the most substantial Railway Passenger Service Quality Factors and their influencing level on Passenger Satisfaction. Logistic regression is applied to check the accuracy and goodness of fit of the model. Rank analysis is used to identify the rank of those aforesaid factors in terms of their importance, width and height of their zone of tolerance in terms of Railway Passenger Satisfaction and Bayesian Probabilistic Network is applied to frame a model for Indian Railways to implement policy on the basis of different scenario and causal analysis.

ANALYSIS AND DISCUSSIONS

Interpretation of Principle Component Analysis using SPSS

Here, from the perspective of Barlett's test of spericity, factor analysis is significant and feasible as p value is.001 i.e. less than. 05. As the Bartlett's test is significant, a more discriminating index of factor analyzability is the KMO. For this data set, KMO value is. 845 (very close to 1.0), which is very high, so the KMO also supports factor analysis.

Reliability Testing

The reliability is tested using coefficient alpha. On analysis, the alpha values are found greater than (0.7). Hence the reliability analysis predicted the trustworthiness of the data obtained from the questionnaire and the data was used for further analysis.

Factor Identification

Determination Based on Eigen Values

In this approach, only those factors with Eigenvalues greater than 1 are considered. Other factors are not included in this model. Here, from the SCREE PLOT and the table TOTAL VARIANCE EXPLAINED, 2 factors can be identified whose Eigenvalues are more than 1.

Determination Based on Percentage of Variance

The number of factors extracted can also be determined in a way so that the cumulative percentage of variance extracted by the factors reaches a satisfactory level. Here according to the analysis, the cumulative percentage of variance extracted by the 2 factors is 87.500 %(from the table TOTAL VARIANCE EXPLAINED), which is quite satisfactory.

Factor Interpretation

Factor interpretation is facilitated by identifying the variables that have large load on the same factor. That factor can be interpreted in terms of variables that load high on it.

In the ROTATED COMPONENT MATRIX, Component 1 has high coefficients. 891 and. 742 for variables *Punctuality and Personal safety on the train; whereas* Component 2 has high coefficients. 813 and. 719 for varying conditions of *Lighting, seat &condition of toilet and Cleanliness of the train & station.* Component 1 may be renamed as Reliability and Component 2 may be renamed as Tangibles. As Component 1 is treated as the principal components, so, in this case, to enhance passenger satisfaction *Reliability is* the most significant factor followed by tangibles with respect to *Railway Passenger Service Quality.*

INTERPRETATION OF MULTIPLE REGRESSION ANALYSIS USING SPSS:

Table 1: Model Summary

Model		R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
						R Square Change	F Change	df1	df2	Sig. F Change
	1	**.794**[a]	**.693**	**.614**	.152	.101	221.14	3	361	.00001
a. Predictors: (Constant), *Punctuality, Personal safety on train, Lighting, seats &condition of toilet and Cleanliness of the train & station*										

The above table represents the value of R, the multiple correlation coefficients. Here the value of "R", 0.794 indicates a high level of prediction. From the R square value of 0.693, it can be depicted that our independent variables explain 69.3% of the variance of our dependent variable. Here dependent variable is Railway Passenger Satisfaction and the 4 independent variables are categorized under 4 parameters, namely – *Punctuality, Personal safety on train, Lighting, seat &condition of toilet and Cleanliness of the train & station*

Unstandardized coefficients indicate how much the dependent variable varies with an independent variable when all other independent variables are held constant. Consider the effect of on Railway Passenger Satisfaction, the unstandardized coefficient, for *Punctuality* is equal to 0.342. This means that for each one scale increase in the Average value of Approach *towards Punctuality*, there is an increase in Railway Passenger Satisfaction of 0.3142 i.e. *Punctuality* has 31.2% influence on Railway Passenger Satisfaction. Similarly, influence level of *Personal safety on train, Lighting, seats & condition of toilet and Cleanliness of the train & station* is 28.4%, 20.7% and 17.1% on Railway Passenger Satisfaction. Here for 4 independent variables $p < .05$, so this explained that these coefficients are statistically significantly

different to 0 (zero).

So, the equation from the regression output is as follows:

Railway Passenger Customer Satisfaction = 1.005 + (31.4×*Punctuality* + 28.4× *Personal Safety on Train* + 20.7 × *Lighting, Seats & Condition of Toilet* + 17.1 × *Cleanliness of the Train & Station)*

Figure 1: Factors Influencing Railway Passenger Satisfaction

INTERPRETATION OF LOGISTIC REGRESSION USING R PROGRAMMING

Sensitivity and Specificity are statistical measures of the performance of a binary classification test, also known in statistics as classification function. Sensitivity (true positive rate) measures the proportion of positives that are correctly identified as such (e.g. The percentage of sick people who are correctly identified as having the condition). Specificity (true negative rate) measures the proportion of negatives that are correctly identified as such.

Receiver Operating Characteristic curve (ROC curve) is a plot of the true positive rate against the false positive rate for the different possible cutpoints of a diagnostic test. A ROC curve demonstrates the tradeoff between sensitivity and specificity (any increase in sensitivity will be accompanied by a decrease in specificity).

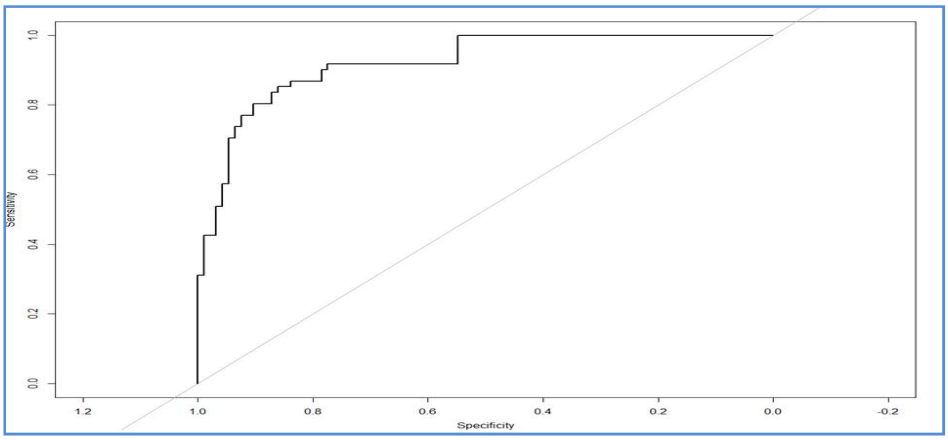


Figure 2: ROC Curve of Railway Passenger Satisfaction with Respect to Passenger Service Quality

The closer the curve follows the left-hand border and then the top border of the ROC space, the more accurate the test. The area under the curve is 0.931, this specifies test accuracy. This area measures discrimination which is the ability of the test to correctly classify respondents agreed or disagreed to the importance of this service quality factor. Thus, the test of satisfaction model is an accurate one with a good fit.

INTERPRETAION OF RANK ANALYSIS USING SPSS:

Table 2: Comparison of the Rankings Obtained by the Three Measurements

Attribute	Importance	Rank	Width of Zone	Rank	Height of Zone	Rank
Punctuality	9.75	1	1.12	1	8.74	1
Safety	9.56	2	1.18	2	8.72	2
Tangibles	9.01	3	1.57	3	8.69	3

According to Rank Analysis, *Punctuality has been perceived as the highest rank in terms of important service quality factor, followed by the Personal safety on train, and Tangibles.* This result importance of attributes supports the rank of the width of tolerance zone as well as the height of the zone.

INTERPRETATION OF BAYESIAN PROBABILISTIC NETWORK

Further, the Bayesian probabilistic Network may be established on the basis of the above analysis. Hug in lite soft -ware is used in this regard and following framework has been framed:

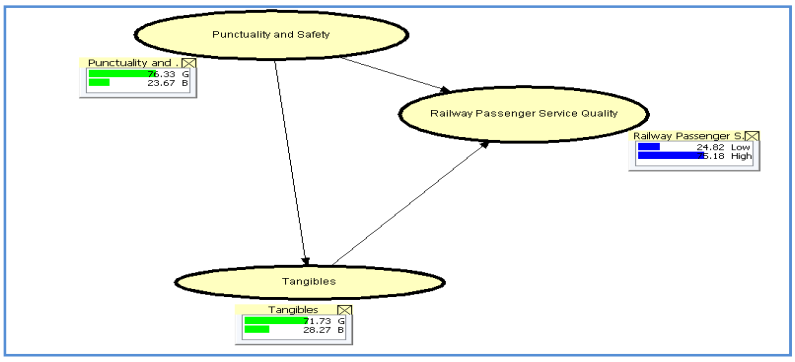


Figure 3: Bayesian Probabilistic Networks

As part of the initiative to further research, the empirical analysis has been recast in terms of Bayesian Probabilistic Framework. The independent service quality dimensions – *Punctuality, Safety, and Tangibles* – have binary measures from the available evidence and a probability distribution of the dependent variable- Railway Passenger Customer Satisfaction – occupies and completes the Bayesian framework. As its well known, Bayesian Probabilistic frameworks provide an elegant solution, particularly in cases of limited data and when qualitative and/or a mix of qualitative and quantitative data need to be used. This is precisely the case in the current investigation. The basic framework is given in the following diagram. A spectrum of scenario and causal analyses follows.

Scenario Analysis 1

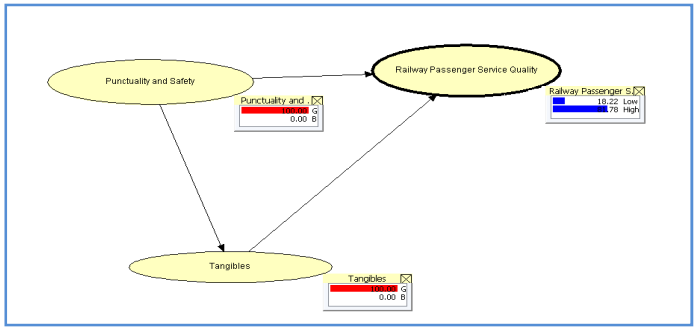


Figure 4

Scenario Analysis 2

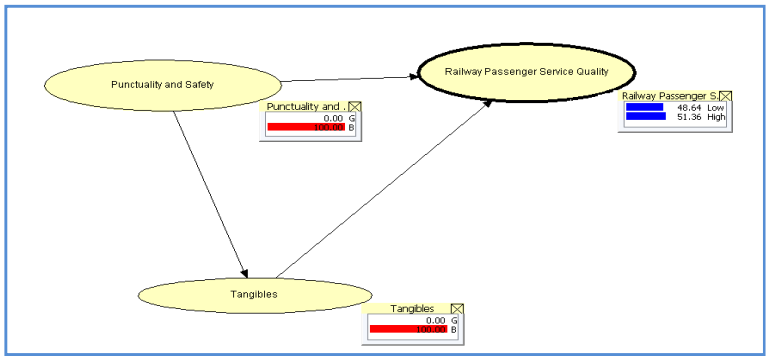


Figure 5

Causal Analysis 1

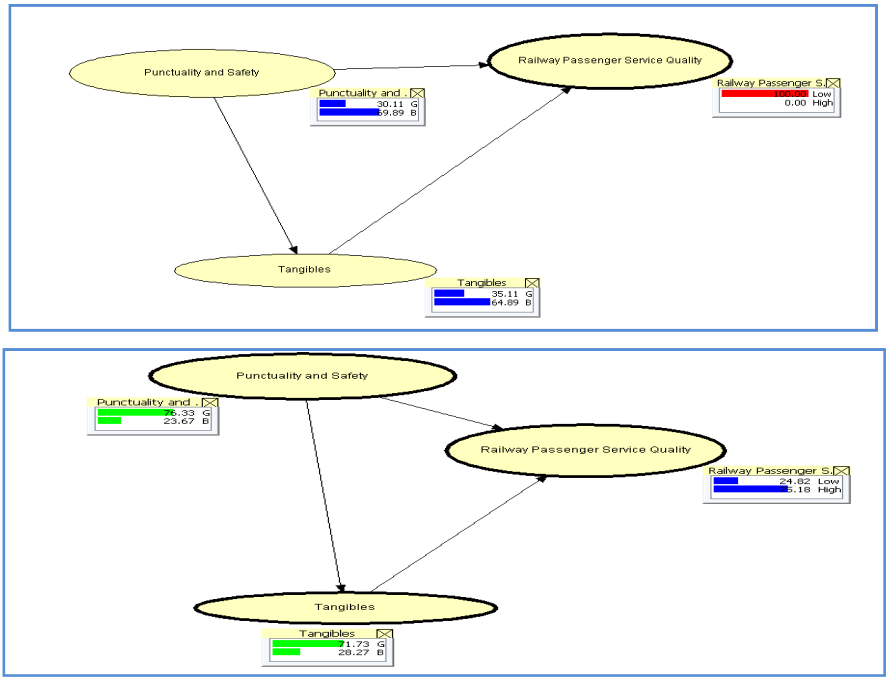
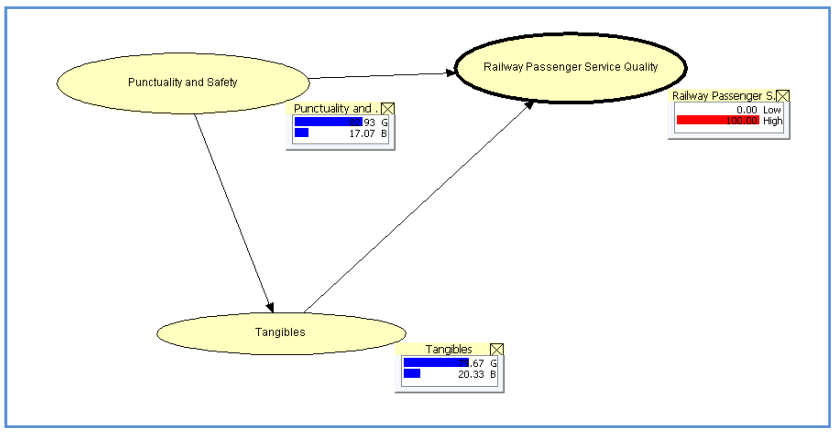


Figure 6

Causal Analysis 2



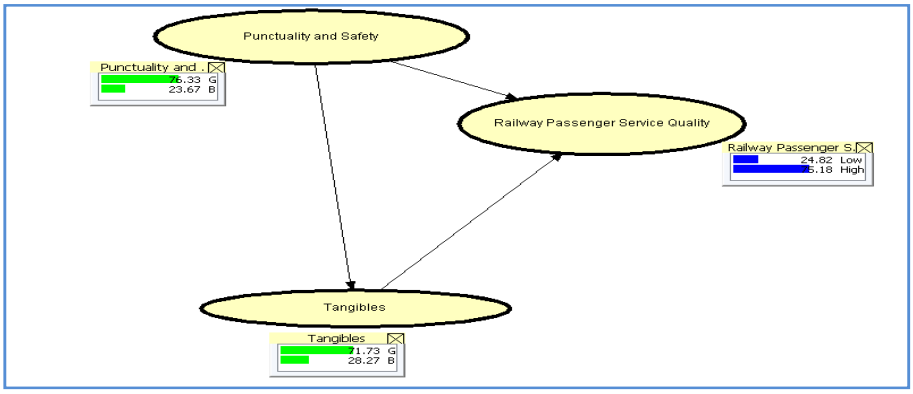


Figure 7

Scenario Analysis and Causal Analysis help analyze and make policy intervention regarding leadership effectiveness.

Scenario Analysis**:** If, for example, when 100 percent high Punctuality and Safety is there, it shows positive changes in other variable tangibles as well as capture changes in the dependent variable of *Railway Passenger Satisfaction* simultaneity. On the contrary 100 percent low Punctuality and Safety results in low tangibles and ultimately low Leadership Effectiveness. Similarly, there is the direct impact of high and low independent variables on the dependent variable. This is just a framework on *Railway Passenger Satisfaction* with respect to service quality dimensions.

Causal Analysis: Causal analysis is evidence-based. It reverses the whole thing. If it is evident that Railway Passenger Satisfaction is high, this information is propagated to the causal variables. Similar evidence would be depicted in case of low *Railway Passenger Satisfaction.*

CONCLUSIONS

The principal component analysis depicts two significant service quality dimensions- Reliability (*Punctuality* and *Personal safety on the train*) and Tangibles (*Lighting, seats & condition of toilet and Cleanliness of the train & station*) in terms of *Railway Passenger Satisfaction.* Multiple Regression Analysis portrays 4 independent variables *Punctuality* and *Personal safety on the train*) and Tangibles (*Lighting, seats & condition of toilet and Cleanliness of the train & station mostly influencing the dependent variable Railway Passenger Satisfaction* which *corroborates with the result of the* principal component analysis. Again from Rank Analysis, *the* importance of attributes supports the rank of the width of tolerance zone as well as the height of the zone. Logistic Regression specifies test accuracy; the ROC curve signifies the test model is an accurate one with a good fit.

Scenario Analysis develops a Bayesian Probability Network to model ` on the causal variables extracted from the first phase, whereas Causal Analysis calculates updated probabilities of all the causal factors and as such gives us information on likely values of these causal opinions/perception variables that may generate desired *Railway Passenger Satisfaction* with respect to significant service quality dimensions. The causal variable has, definitely, taken on the value which has resulted in low/high Punctuality and Safety or Tangibles which capture changes in the dependent variable. The model combines independent or causal variables, leading to this outcome. It can also be utilized to construct some kind of policy intervention or conjecture. This means if the industry wants high *Railway Passenger Satisfaction* then it must be ensured that the causal variables take on appropriate values or if a marketer wants to know the consequences of low *Railway Passenger Satisfaction* then it must be ensured that the causal variables similarly take on appropriate values.

Thus, this research lays the foundation for future investigation in a very promising International Railways. One probable step may be to enhance the scope of research by expanding the target area through including international market of Railways industry to evaluate and benchmark their *Railway Passenger Satisfaction* with the help of multivariate analysis (i.e. Confirmatory Factor Analysis, Discriminant and Cluster Analysis) and Efficiency- Productivity study.

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