



Factors affecting road users' satisfaction: The case of Agra Lucknow Expressway

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Abstract: This study proposes to evaluate and identify the significant factors influencing road users' satisfaction levels. This study primarily investigates the related factors that may contribute to the satisfaction level of all road users on the Agra-Lucknow Expressway. The questionnaires are designed and divided into two major sections: respondent profiles, measurement of the level of satisfaction toward each indicator, and overall satisfaction of Agra-Lucknow Expressway travellers. According to the findings of the study, highway conditions are the most important factor influencing road users' satisfaction. Various aspects of road services have an impact on road user satisfaction. Some of these variables have a significant impact on user satisfaction, such as comfort, emergency services, and safety.

Keywords: Road user satisfaction, Agra Lucknow expressway, highway conditions, travellers

1. Introduction:

Land transportation is one of the most important ways of transportation as it covers most areas and modes. The expansion of transportation infrastructure in any country is mostly the responsibility of government agencies. Roads are necessary components of any transportation infrastructure. They are utilised by pedestrians, cyclists, and vehicles. As large investments are made to improve road networks, it is critical to investigate how satisfied are road users with these large investments. The objective of this study is to investigate and evaluate the satisfaction level of road users of Agra-Lucknow Expressway with certain factors related to their perception of the conditions of roads.

The Agra-Lucknow Expressway is a 302.222 km long 6 lane (expandable to 08 lanes) access controlled (greenfield) expressway with 08-lane wide structures for future expressway expansion to 08 lanes. The prestigious Expressway, a flagship project of the Government of Uttar Pradesh undertaken by "Uttar Pradesh Expressways Industrial Development Authority" (UPEIDA), was completed in record time. The expressway runs from Agra's inner ring road to Firozabad, Mainpuri, Etawah, Auraiya, Kannauj, Kanpur Nagar, Hardoi, and Unnao district. and concludes on SH-40 in Lucknow It has facilitated a high-speed corridor connecting the state capital Lucknow to Agra in western Uttar Pradesh, and then to the National Capital, New Delhi, via the Yamuna Expressway. Expressways are roads that are constructed to support high speed traffic flows of 100 to 120 km/h without traffic lights and junctions. They are designed to avoid city towns and are concerned with safety and traffic congestions by having full control of access with fences along the road. Road users must pay a toll of at least Rs.500 and can expect a higher level of serviceability than when travelling on a free public highway.

Satisfaction surveys have been widely used in many different areas of infrastructure and transportation (He et al., 2020; Kanwal et al., 2020; Kwon et al., 2019; Sabella & Bezyak, 2019; Shaaban, 2020). These surveys are popular because they provide a platform for customers' preferences. Customers are more informed than ever before, making it more difficult for service providers to meet their needs or desires. Previously, private companies were generally concerned with customer satisfaction in order to increase sales, but many public agencies are now concerned with customer satisfaction. This interest stems not only from governments' desire to determine whether the investment is worthwhile, but also from a desire to improve service quality in the future. The goal of this study is to identify the factors that influence road users' satisfaction levels and to determine how satisfied they are with the given factors. The collected data will be analysed statistically using factor analysis.

The paper is structured as follows. The next section reviews literature relevant to the aim of this study. The third section introduces questionnaire for collecting drivers survey data. The results are presented and discussed in the fourth section. The final section concludes and delineates future research needs.

2. Literature Review

The state of a road network's infrastructure has an impact on its efficiency (Lyu, 2018; Wang, 2020; Wang et al., 2018). Road improvements improve connectivity and mobility in cities, as well as the quality and security of access to work, businesses, and services, and free up scarce resources for consumption and production (Cantwell et al., 2009; Eboli & Mazzulla, 2008). In particular, India, one of the world's fastest-growing economies, is spending over 1.21 trillion Indian rupees on transportation projects to improve its road network during the fiscal year 2022. As part of these massive plans, government agencies must consider road users' satisfaction with the services provided and identify any shortcomings.

A survey was on The Karnataka State Highway Improvement Project (2004) s conducted by the asking respondents to rate their level of satisfaction for various attributes based on a Likert Scale of 5 points. As a result, the overall average score, the level of satisfaction was highest in terms of road quality. There were few surface and road-side signs satisfaction with regard to air and noise pollution. Some factors such as damaged roads, a lack of signage, and so on potholes and poor construction quality can affect road users' dissatisfaction.

Several important factors influence road users' satisfaction, including the value of time and money, convenience, and safety. According to (Himachal Pradesh Public Works Department, 2007), respondents believe that parking and public restrooms are the most important issues that can affect their satisfaction. Another critical factor was the type of road. The Road Users' Satisfaction Index (RUSI) score or ranking of road usage satisfaction from HPPWD (Himachal Pradesh Public Works Department) revealed that the highest level of satisfaction was on national highways, which was higher than for rural roads, due to better road infrastructure development.

Few studies have looked into how satisfied users are with the road network. In England, a study looked into road users' satisfaction with pavement conditions. The study's goal was to raise public awareness of the process of prioritising service levels based on public expectations for the road surface, cycle lanes, and sidewalks. To investigate the factors that influence road users' perspectives, group discussions and face-to-face interviews were conducted. Furthermore, road users were asked to share their opinions about different levels of road conditions as well as their maintenance priorities with a category of pedestrians, cyclists, motorcyclists, motorists, and commercial vehicle drivers. The findings revealed that the condition of the pavement surface, media reports, experience in other parts of the country or other countries, and contextual factors all have an impact on road users (e.g., congestion and traffic management measures such as speed humps). According to the study, the most important factors influencing satisfaction are safety and ride comfort (Ramdas, 2007). Another study in England used household interviews to examine driver satisfaction across the country. The findings revealed that their overall satisfaction was high (nearly 90% or higher) in the majority of categories. The most important factors affecting road users' satisfaction are traffic congestion, traffic safety, roadworks management, the rise of road litter, and a lack of notification about traffic delays. (Mello, 2014)

The Wisconsin Department of Transportation conducted a survey to determine how satisfied road users were with the department's performance. The survey was presented as a way to improve future programmes and

services for road users. Although user satisfaction was high, several areas for improvement were identified, including making highways smooth and free of potholes, increasing snow removal efficiency, and ensuring proper striping visibility at night and during wet weather (Fulton & Michelson, 2004).

In general, the literature has paid little attention to user satisfaction with road networks and infrastructure facilities, particularly in developing countries. This paper presents the results of a user satisfaction survey conducted for Agra-Lucknow Expressway located in Uttar Pradesh, India. To the best of our knowledge, this is one of the first attempts to provide a detailed picture of user satisfaction with this expressway. Previous studies, reviewed in this research, have successfully used this method to deliver significant factors affecting overall satisfactions. The following categories comprise all items that affect road users' satisfaction based on this study of Agra Lucknow characteristics and previous research: respondent profiles, value for time and money, comfort, safety, amenities, distance signs and road markers, and conditions. Gender, age, vehicle category, and respondent category are used to categorise respondent profiles. Travel time, fuel consumption, maintenance costs, and accessibility to settlement all contribute to the value of time and money. Components of comfort include road width, road infrastructure, and traffic congestion. Feeling safe, safety designs, accident management, police posts, and emergency phones are all components of safety. Public toilets/bathrooms, foods/drink, drinking water, medical facilities, rain shelters/bus stops, mechanics availability, and parking facilities are examples of amenities. Amenities include public toilets/bathrooms, food/drink, drinking water, medical facilities, rain shelters/bus stops, mechanics availability, and parking facilities. Distance signs and road markers include adequacy and visibility. Conditions include the behaviour of other drivers as well as the characteristics of the Agra Lucknow expressway. Overall satisfaction is evaluated using the final factor. Let us now compare the research papers on the basis of variables they are considering.



Main Factors Research/ papers ↓	Respondent profile	Value for time and money	Comfort	Safety	Amenities	Distance Signs and road markers	Conditions
<i>road users' satisfaction: the case of Motorway Route 7</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Road User satisfaction survey in the state of Himachal Pradesh	Yes	Yes	Yes	Yes	Yes	Yes	No
Customer satisfaction and Service quality in Malaysian Highway	Yes	No	Yes	Yes	No	Yes	No
The road of satisfaction: Measuring Dutch car driver satisfaction with travel	Yes	No	Yes	Yes	No	No	Yes
Measuring users' satisfaction of the road network using structural equation Modeling	Yes	No	Yes	Yes	No	No	Yes
Road Satisfaction continues to go downhill	No	No	Yes	Yes	No	No	No
Second Road user satisfaction in Kerela	Yes	No	Yes	Yes	Yes	No	Yes

3. Methodology

3.1 Method of approach and data collection

Two research methods were used in this study. First, it is documentary research based on journal articles and case studies about the satisfaction of road users. The second method is a survey study, which collects data by distributing questionnaires and asking respondents to indicate their level of satisfaction with each of the

expressway-related items. The questions are graded on a 5-point Likert scale, with "most satisfied" being the highest and "most dissatisfied" being the lowest. Table 2 provides a summary of each item. Questionnaires are distributed at random to people who have travelled on Agra Lucknow Expressway. The Survey was conducted from July 20, 2022 to September 20, 2022.

3.2 Analysis of factors affecting the satisfactions

In this study, principal component analysis is used to reduce the dimensions of related independent variables. This technique has two main uses: (1) to understand the structure of a set of variables, (2) to construct a questionnaire to measure an underlying variable, and (3) to reduce a data set to a more manageable size while retaining as much of the original information as possible (Field, 2009). After that, multiple regression is employed to predict the outcome of factor affecting road users' satisfaction level; the correctness of prediction has been proved from variety methods.

According to Field (2009), regression analysis enables us to predict future based on values of predictive variables. It is also an efficient means of gathering data without introducing threats to reliability that can occur with other data collection means. Generally, if the variance inflation factor (VIF) values < 5 for a particular independent variable, multicollinearity is not considered a problem for that variable. VIF values > 5 implies that the correlation between the independent variables is too extreme and should be dealt with by dropping variables from the models (Groebner et al., 2011). The level of significance is set at $p < 0.05$, as that is the customary level used when working on significance (Krathwohl, 2010).

The correlation coefficient squared (R^2) is a measure of the amount of variability in one variable that is shared by the others. The adjusted R^2 value indicates the loss of predictive power, which tells us how much variance in independent variable would be accounted for if the model had been derived from the population from which the sample was taken (Field, 2009). In addition, the study analyzed data from the examination of predictive variables and the dependent variable. The analysis model of factors affecting road users' satisfaction is described in Figure 1.

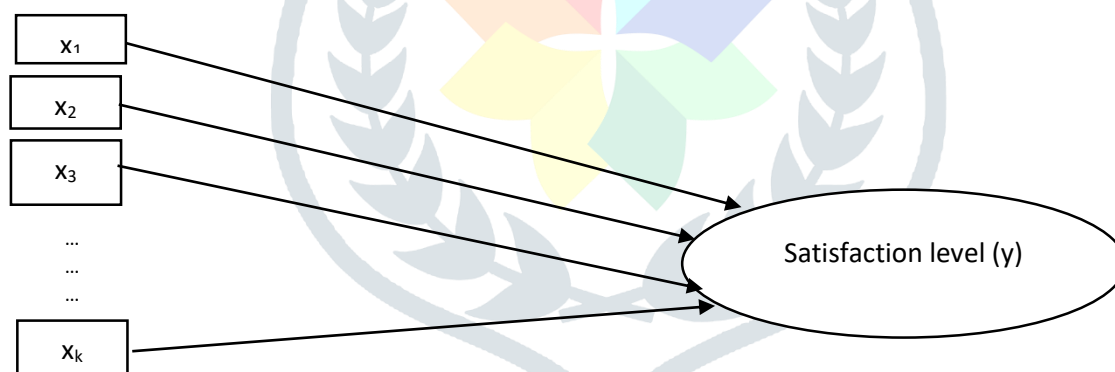


Figure-1 Conceptual Model Of Road User satisfaction Level (k is the number of independent variables)

4. The Results

The total number of samples collected was 100. The alpha value was calculated to check the reliability of the questionnaire. The alpha value came out to be **0.780**

Prior to multiple regression analysis, the Principal Component Analysis was conducted from 20 determinants with orthogonal rotation (varimax) in order to identify the structure of determinants related to road user satisfaction. The value of Kaiser-Meyer-Olkin (KMO) value is 0.765 out of 1, this indicates that samples are appropriate to proceed on. On the Bartlett's test of Sphericity, the approximation of Chi-square and the significance is 755 from 210 df and 0.000, respectively. These indicated that correlations between items are sufficiently large for a Principal Component Analysis (PCA). The likelihood increases that the null hypothesis can be rejected and the alternative hypothesis accepted and the variables are related.

Multiple regression analysis

Out of seven independent variables, six of them are significantly affecting road users' satisfaction. They are distance signs and road markers, convenience, amenities, value of time and money, conditions and safety.

According to Krathwohl's, about the customary level used when working on significance, the level of significance is to set at $p < 0.05$. Conditions factor appeared to be the most important factor with 0.253, the highest number of standardized coefficient value followed by distance signs and road markers (0.173), convenience (0.172), valuation for time and money (0.137), safety (0.085) and amenities (0.082). However, speed of safety staff, is not a significant factor affecting the over road users' satisfaction of Agra Lucknow Expressway since the significance value is 0.087 which is greater than 0.05 can be concluded that the effect was too small to be detected. The overall regression results 75.30% of adjusted R square and 75.5% of R^2 of the variance are almost equal. Hence, this is a model of 'no relationship' at all between the variables (Fiels, 2009). The Durbin-Watson statistics was at the value of 1.767, which lies between the range of 1.5 and 2.5; this means the residuals are uncorrelated (Field, 2009). Groebner et al. (2011) stated that if VIF values lower than 5 for a particular independent variable, multicollinearity is not considered a problem for that variable. In addition, tolerance below 0.2 indicates a potential problem (Menard, 1995; Field, 2009). From the studied, the VIF values are all below 5 and the tolerance statistics all above 0.2. Hence, we can conclude that there is no collinearity within our data.

5. Discussion and Conclusions

This study empirically investigated road users' satisfaction on Agra Lucknow Expressway by using of at least 100 samples of questionnaire in order to survey road users' satisfaction users' expectation and reach the road users' satisfaction on Agra Lucknow Expressway. As the multiple regression results suggested, the significant factors that most affected road users' satisfaction were conditions which are traffic volume, cleanliness of road surface, characteristics of the Agra Lucknow Expressway, and legality of other drivers. The second most significant factor that affected road users' satisfaction was signs/traffic/warning and road marking. Convenience is the third that affected to road users' satisfaction, followed by value for time and money, amenities, safety equipment and environment, and speed of safety staff. The study revealed that safety equipment and environment factors are concerns to road users.

6. Recommendations

Currently, there are several projects and action plans of UPEIDA which are related to the development of expressway infrastructure to support logistics of regional transport and a closed motorway tollgate system to solve the problem of safety and expensive toll fees. These projects are supported by the government through UPEIDA. Based on this study, these projects should include routine maintenance management in order to keep the road conditions such as surface roughness at the acceptable standard; Emphasis should be place on projects that are aimed to solve the problems of indistinctness of signs, traffic, and warnings to increase safety while using the motorway. Additionally, repairing of the road surface is also important for higher convenience and decreasing travel time of the road users. According to the large amount of the vehicles that travel via this road, fast tag has already been implemented by the highway authorities to improve traffic flow and decrease traffic problems.

7. References

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