Analysis and Modeling of Commuters' Perception to Radio Traffic Information in Lahore, Pakistan

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Abstract: Rapid development in technology and growing demand to make efficient transportation infrastructure has increased the interest of transportation planners in Road Transport Informatics. In this context, policy measures such as real-time traffic information has become an important tool for the solution of congestions oriented problems by influencing the route choice and departure time behavior of travelers. Lahore Traffic police has initiated RASTA (Road and Street Traffic Awareness) Program with Private-Public Partnership and has FM 88.80 traffic radio which provides with real time traffic information to road users regarding congestion, accidents, restrictions and regulations, constructions and so forth. The objective of this study is to investigate the commuter's perception to traffic radio and their level of satisfaction and future preferences with traffic radio. An e-mail based questionnaire survey has conducted and findings of statistical analysis reveals that the non-drivers have slightly more exposure and response to radio information as compare to drivers which means non-drivers also change their behavior based on perceived information. The students are more frequent listener of FM 88.80 traffic radio as compared to others because it is an infotainment channel which makes students more attractive as compare to other groups. Another important finding is that most of the respondents who have experienced to radio traffic information prefer to change route as compare to departure time. The findings of structural equation modeling diagnose that future preferences of road users with traffic radio is related to level of satisfaction with performance and service attributes of traffic radio. It can be concluded that improvement in level of service attributes would be the key parameters in improving efficiency of traffic radio information service and commuters satisfaction.

Key Words: *Traffic management, Traffic information, Travel behavior, Route choice, Departure time choice,*

1. INTRODUCTION

Traditionally, transportation strategies to solve transportation problems and traffic management issues are the "supply side" measures which address simply increasing the capacity of transportation infrastructure. According to the "predict and provide" philosophy the transportation planners simply predict the demand based on demographic changes and vehicle ownership and then provide the transportation facilities in order to meet this demand[1)]. Methods to reduce congestion by using demand side measures have gained much attention recently instead of putting more efforts on supply side measures. Travel demand management (TDM) measures such as education and behavior change initiatives are also called psychological strategies aim to influence individual's travel behavior and increase their knowledge about the more sustainable travel options. In this context rapid developments in technology and the growing demand to make efficient use of existing transportation infrastructure have increased the interest of transportation and urban planners in 'Road Transport Informatics' (RTI). Since traffic flow is

simply the aggregation of individuals decisions, road users behavior determine whether these new technologies are able to meet their objectives of using limited road space in a more efficient manner. The main objective of these initiatives has to minimize the congestion by providing real-time traffic information to the commuters.

Advance traveler information system (ATIS) provides important information to the traveler at home or office, in vehicle and at station. ATIS includes all those systems that use information technology to inform, monitor control and even charge travelers for using the roads, usually implemented as part of ITS initiatives[2]. This type of information can be very helpful for making decisions regarding mode, route choice and as well as departure time. The main question has been dealing with the ways in which information provided to commuters could relieve morning peak congestion. Early works attempting to assess potential system impacts concentrated mainly on choice of departure time whereas later studies included also choice of route information[3]. Travelers can expect to reduce their journey times and as a result an increase in service performance in the existing transportation system[4,5]. Some other researchers have also been pointed that other than relieving recurrent congestions during peak hours, the benefits of improving uncertainty in road traffic during non-recurrent congestion are even more significant[6, 7].

In this paper, statistical analysis of commuter's behavior and preferences in response to real-time radio traffic information is conducted whereas in the later stage, a Structural Equation Modeling (SEM) technique is used to evaluate the commuter's perception and preferences with radio traffic information. This model elaborates the conceptual diagram of commuter's satisfaction with traffic radio and future preferences with it in case of improvement.

The organization of this paper is as follows. Chapter 2 will briefly describe the characteristics of Lahore city, traffic problems and features of traffic information service. Chapter 3 is of data collection and variables. Chapter 4 provides an overview of data analysis and discussion is given in chapter 4, whereas chapter 5 consists of structural equation modeling of commuter's perception to traffic radio and level of satisfaction with traffic radio. Chapter 6 recapitulates the key findings and discusses the policy implications of the results.

2. FEATURES OF LAHORE CITY

(1) Geographical Characteristics

Lahore is a metropolitan city with the administrative status of a provincial seat of Pakistan. The present extents of Lahore Metropolitan Area (LMA) cover 1772 Km^2 and its population approximately 6.3 million as estimated by government in 1998 census. It is the most advance district in Punjab and with almost 81.17 % urban population[8]. The administration structure has been changed after promulgation of Local Government Ordinance (2001) and Districts, city Districts, Towns and Union Councils Administrations have been created. Lahore declared as City District Government Lahore (CDGL) in 2001 and divided into six towns. In 2005, three more towns were added to CDGL. It is the most advance district in Punjab and with almost 81.17 % urban population[8].

(2) Traffic Situation

Traffic in Lahore is becoming chaotic, unruly and the roads remain often jam packed with the traffic of all type of traffic. This rapid increase in traffic poses a big challenge for all groups responsible for planning, designing and implementing transport policies. Besides people's behavior on the roads and during driving, there are other multiple issues which are adding up and pointing towards a public policy failure. Number of vehicles is increasing at alarming rate but the development rate of road infrastructure is very low and other major reason for the increase is the absence of an efficient public transport system. Such congestion related problems tend to increase travel cost and environmental impacts by increasing the travel time and fuel consumption. Under these circumstances, transportation planners can help decision makers to incorporate appropriate TDM measures like real-time traffic information services and promotion of commuter's behavioral change approaches to meet the needs of transportation.

(3) Traffic Information Services

Above stated traffic problems and issues can be addressed effectively with the help of real-time traffic information by changing attributes of traveling, including departure time, route, or mode. In this context, Lahore traffic police has initiated RASTA (Road and Street Traffic Awareness) Program through Public-Private-Partnership (PPP) in Lahore and main objective is to ensure road safety, improvement in traffic management systems through effective awareness among the public traveling on roads and streets.

Currently, RASTA includes traffic helpline 1915, website hosting, FM 88.8 traffic radio and variable message signs (VMS). Traffic information is broadcasted mainly through RASTA website and FM 88.80 radio channel. Under the objective of this program, FM 88.80 Traffic Radio was initiated on July 18, 2009 and is working with Traffic Police. It

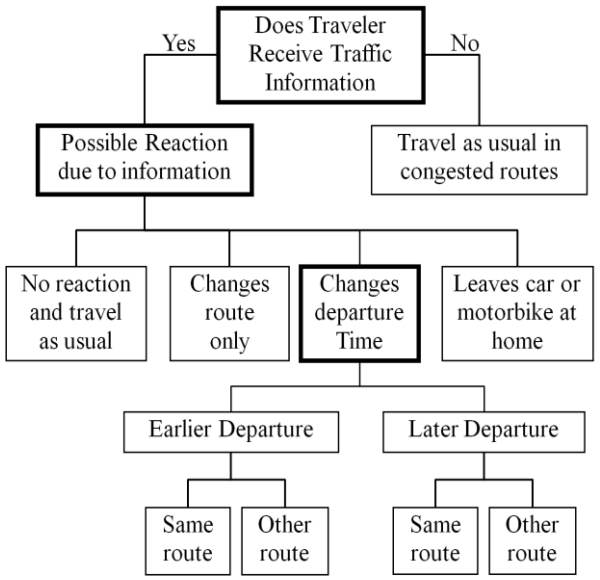

Fig. 1: Effect of pre-trip Information on trip attributes

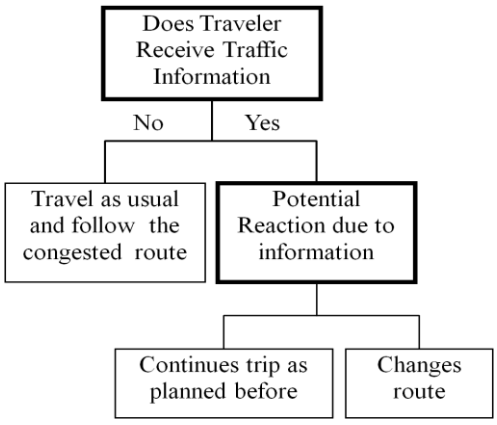

Fig. 2: Effect of En-route Information on trip attributes

is an infotainment channel and updates the road users after every 5 minutes about traffic conditions in peak hours. Road users can get latest traffic information's about different routes by listening FM 88.80 through their cell phones or by tuning on-board radio in the vehicle and by visiting website of RASTA (www.rasta.pk). Based on the perceived information a traveler can change his departure time and route. The schematic flow of information and expected reactions to perceived pre-trip and en-route information is given in Fig. 1-2.

3. DATA COLLECTION

An email based questionnaire consisting of 40 questions was designed in this study with the following four parts: (a) Personal characteristics: age, gender, occupation, vehicle ownership; (b) Trip characteristics: mode and frequency of most usual daily trip, average trip length and travel time, availability of alternative route and arrival time flexibility in morning trip; (c) Listening tendency of traffic radio information: pre-trip and en-route listening tendency on three point scale e.g. what is your pre-trip or at-home listening tendency of traffic radio (1= never, 2= frequently, 3= regularly); influence on trip attributes like route choice, departure time and mode; and main purpose of listening traffic radio e.g. routes conditions, weather information, train information, entertainment. (d) Performance and service attributes of traffic radio: satisfaction with accessibility level of radio information (easiness in getting required signal for listening or access to sources of listening), satisfaction with broadcasting frequency (after every 5 minutes), satisfaction with routes coverage (geographical coverage), efficiency level of traffic radio information (effectiveness in creating awareness about traffic problems and their solutions), overall performance of traffic radio and future preferences with traffic radio were also asked. The perceptions to service and performance attributes of traffic radio are asked on a five point Likert scale. E.g. what do you think about broadcasting frequency of latest routes information 1= very unsatisfied, 2 = unsatisfied, 3 = Neutral, 4 = Satisfied, 5=very satisfied. The listening of traffic radio in future in case of improvement in service attributes is evaluated on four point scale i.e. will not use, will start to use, will use as present, and will use more frequently.

An e-mail based survey was conducted and only 56 questionnaires were sent back out of 120 i.e. a response rate of 46.67%. The targeted group of survey was mainly university undergraduate and post graduate students, faculty members, technical staff, and employees of different private organizations. The respondents were requested to send back the questionnaire after filling and after two weeks a reminder was also sent to the requested respondents. A summary of some personal and trip characteristics of respondents are presented in table 1.

4. DATA ANALYSIS AND DISCUSSION

The data analyzed based on perception of traveler's to the given preferences in the questionnaire. Statistical analysis shows that a total of 48.2% respondents have flexibility of arrival time in morning trip; 75% of the respondents have alternative routes in their most usual daily trip. A total of 37.5% have frequent, 21.4% regular exposure to radio information and almost 85% trips are influenced due to traffic information as given in Fig. 3-4. Most of the respondents prefer to change route as compare to departure time and those who change departure time prefer to leave earlier following the same route after receiving the traffic information. A total of 47.3% respondents have exposure to radio information

Table 1: Personal and trip characteristics

Sex	Male (66.1%), Female (33.9%)
Occupation	Student (44.6%), Academic civil servant (16.1%), Technical civil servant (14.3%), Employed in private sector (17.9%), Others (7.2%)
Vehicle ownership	Did not own any vehicle (41%), Car (26.8%), Motorcycle (32.2%)
Mode of usual daily trip	Car (26.8%), Motor bicycle (30.4%), Public Transport (8.9%), Campus Bus (19.6%), Others (14.3%)
Frequency of trip	≤ 3-4 days a week (10.7%), 5-6 days a week (46.4%), Almost every day a week (42.9%)
Avg. Trip length (km)	< 5 (8.9%); 6 - 15 (35.7%); 16–25 (32.1%); 26–40 (16.1%); > 40 (7.1%)
Travel time (mints)	< 10 (5.4%); 10 – 25 (26.8%); 26–40 (25%); 41– 60 (23.2%); > 60 (19.6%)

during traveling and out of this 72.7% prefer to change route as given in Fig. 5-6. This analysis reveal that radio traffic information about route conditions has influence on travelers' preferences in making trips. The cross analysis of socio-economic and trip characteristics with listening propensity of radio information reveals that non-drivers have more exposure to traffic information as compared to drivers which means non-drivers also change trip attributes in response to information. The students are more frequent listener of FM 88.80 traffic radio as compare to academic civil servant because it is an infotainment channel which makes student more attractive as compare to others. The commuters have more listening propensity of traffic radio on increases with the length of trip and similar results have been reported by Richard[9]. The comparative distribution of

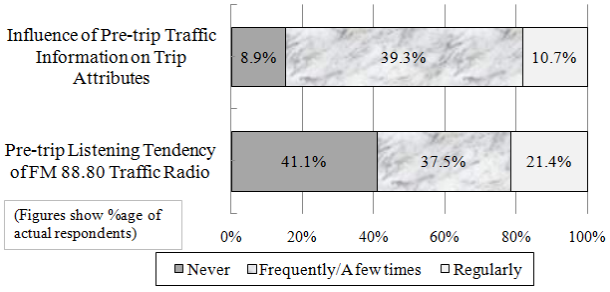

Fig. 3: Pre-trip listening propensity and influence on trip attributes

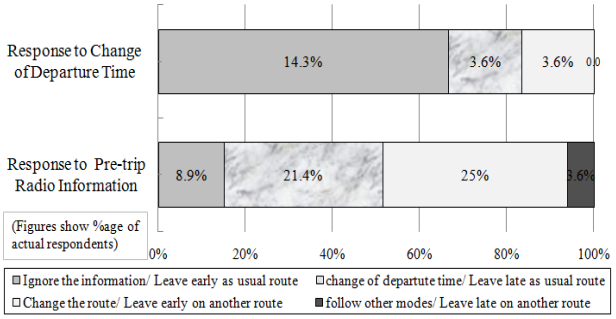

Fig. 4: Effect of pre-trip information on trip attributes

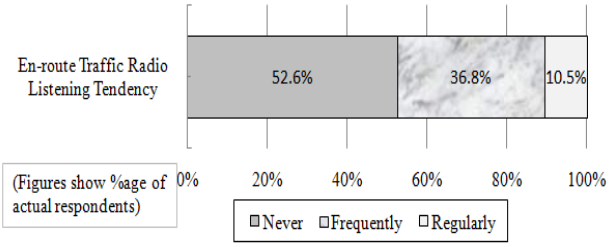

Fig. 5: En-route listening tendency

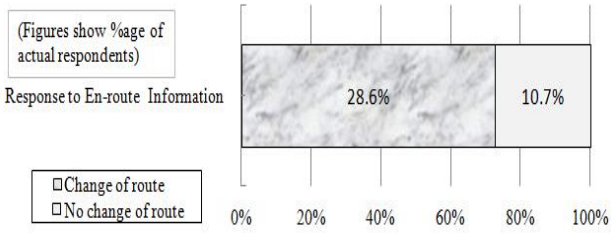

Fig. 6: Effect of en-route information on route choice

socio-economic and trip characteristics is given in Fig. 7. Similarly cross-analysis of personal and trip characteristics with influence of pre-trip information's on trip attributes diagnose that trips of technical civil servant are influenced more frequently as compare to others whereas trips of drivers are influenced more frequently as compare to drivers as

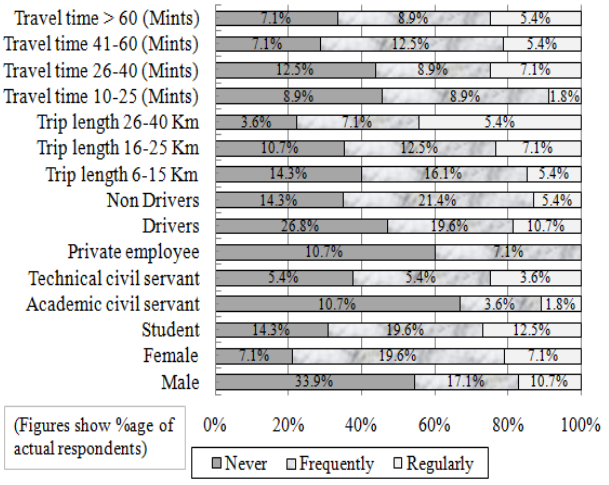

Fig. 7: Comparative distribution of personal and trip attributes to pre-trip listening tendency

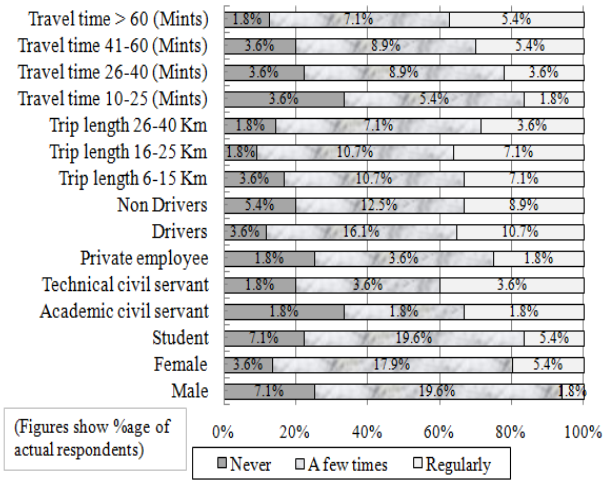

Fig. 8: Comparative distribution of personal and trip attributes to influence of pre-trip information on trip attributes

given in Fig. 8 which reveals that such kind of advance information are important to change driver behavior. Commuters with longer travel time are more keen to change their departure time and route based on scenario of traffic information.

5. STRUCTURAL EQUATION MODELING

(1) Overview

Commuters traveling behavior is mainly dependent on his/her preferences on the various travel factors referred as latent variables. These latent travel factors also depend on some other indicator variables. Similarly commuters' level of perception to radio traffic information or other traffic information initiatives is also dependent on observed variables. Moreover, commuters' satisfaction with the quality of traffic information depends on their perception to the attributes of quality of service such as reliability, accessibility, efficiency, broadcasting frequency etc.

It is possible to analyze these factors using Structural Equation Modeling (SEM) [10]. The SEM techniques have been widely used for behavioral research and different software packages are available for this purpose such as Amos[10]. The Amos software tools are used for the modeling of relationship of the observed variables that interpret the conditions of latent or unobserved variables.

The main objective of this section is to evaluate the relationship among current commuters' perceptions to traffic radio, service and performance attributes of traffic radio and then explore the level of future preferences with traffic radio.

(2) Commuters Level of Satisfaction and Future Preferences with Traffic Radio

This model tests the following two hypotheses; (i) commuters level of satisfaction with performance and service attributes is co-related with the attributes of listening tendency, (ii) commuters future preferences with traffic radio is dependent on current listening tendency and satisfaction with the quality of service of traffic radio.

The observed, endogenous variables are defined as follows: pre-trip listening tendency of traffic radio, influence of pre-trip information on trip attributes, route condition as main purpose of listening (dummy variable), accessibility level of radio information (easiness in getting required signal for listening or access to sources of listening), satisfaction with broadcasting frequency (after every 5 minutes), sa tisfaction with routes coverage (geographical coverage), efficiency level of traffic radio information (effectiveness in creating awareness), overall performance of traffic radio. The observed variables of service and performance attributes were evaluated on a five point scale (1 = very unsatisfied to 5 = very satisfied).

Three unobserved, exogenous variables or latent variables have been defined in the model i.e. (i) commuters perception to traffic radio, (ii) perception to performance attributes of traffic radio, (iii) perception to service attributes of traffic radio. In the development of this model co-variances are allowed to differ between latent variables. The standardized estimates of measurement model indicate that only variables of pre-trip listening tendency, response to pre-rip information's and route conditions as main purpose of listing are significant at 1% level of significance whereas variables related to en-route listening propensity are not significant. All the variables of performance attributes and service attributes of traffic radio are significant at 1% level of significance. From the structural equation model as shown in Fig. 9, all the coefficients of commuters' perception to performance and service attributes are positive which indicate that commuters' satisfaction increase with the increase in level of performance attributes and service attributes.

Standardized estimates of performance attributes and service attributes variables are within the range of 0.58 to 0.83 which argue that all variables are approximately equally evaluated by users. Variables of commuter perception to traffic radio having standard estimate are within range of 0.68 to 0.77 which indicate that user's perception regarding listening tendency, influence on trip attributes and purpose to listen is consistent. Negative co-variances between perception to traffic radio and performance attributes, service attributes reveal that commuter's perception to traffic radio and its performance and service attributes are not consistent with each other. The model parameters of goodness of fit are also in

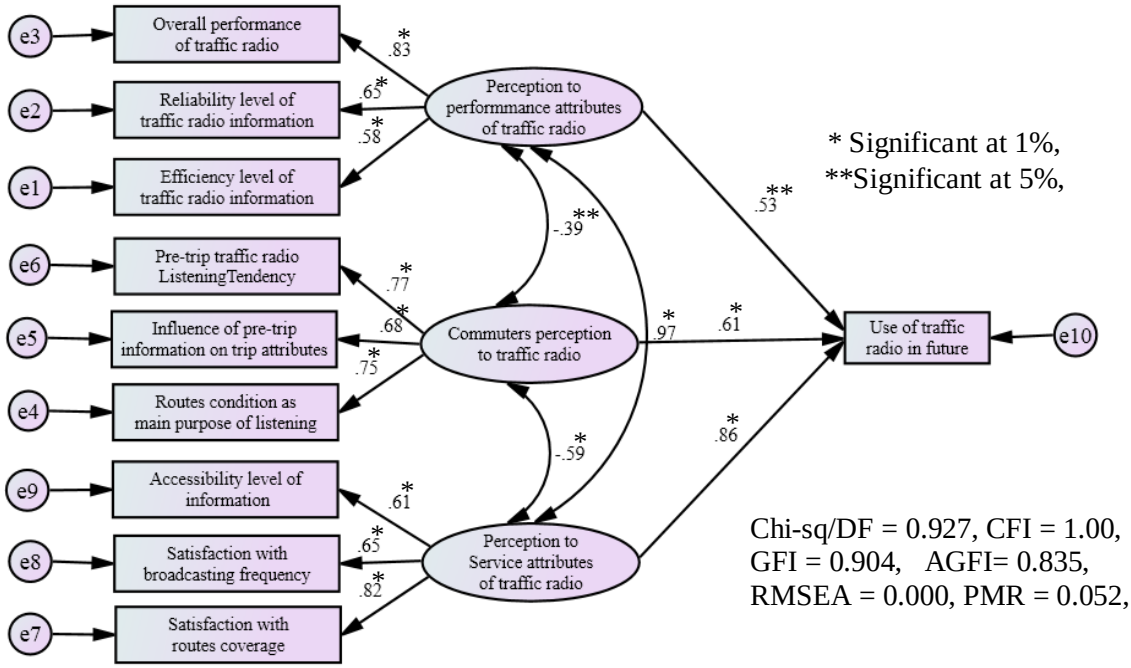

Fig. 9: Structural model of the relationships between commuter's perception to traffic radio, performance and service attributes of traffic radio and use of traffic radio in future

the reasonable ranges i.e. χ^2/DF < 3.0, GFI > 0.90, 'CFI >0.90, and PMR < 0.10 which conclude that this model has moderately good approximation of commuters' perception to traffic radio whereas RMSEA = 0.00 which indicates that model has exact fit with respondents data.

From the model it can be recognized that there is a very strong relationship between the variables. In this particular model, the findings showed that by improving the attributes of quality of service of traffic radio would enhance the use of traffic radio in future and can also encourage to potential listeners. The strong co-relation between perception to service and performance attributes indicates that the level of performance can be enhanced by improving the level of service.

6. CONCLUSIONS

Real-time traffic information services are considered as important policy measure and can solve traffic problems in an effective way. An integrated information and mass communication approach as radio traffic information service has been considered in this paper which includes a positive and active attitude to maximize the efficiency of road infrastructure and to minimize the traffic problems in Lahore city. The results of statistical analysis conclude that commuters prefer to change route frequently and follow alternative routes instead of changing departure time or mode of trip.

The findings of cross analysis diagnose that non-drivers also have same kind of exposure to radio information which might be due to higher proportion of students in the sample because students mainly travel by campus bus and infotainment nature of traffic radio makes students more attractive to listen. The model of future preferences also reveals that use of traffic radio in future is highly dependent on commuters' current exposure and satisfaction with the performance and service attributes of traffic radio. The findings of analysis demonstrate that the effectiveness of a traffic information system or service is related to the performance of its service attributes. It can be concluded that broadcasting frequency, geographical coverage, reliability or accuracy of information are the key parameters or attributes in the effectiveness of radio traffic information service. Almost 41% of respondents did not show any exposure to radio information which argues that there is need to make public aware about this FM 88.80 traffic radio through workshop or seminar programs and advertisement about this service in newspaper. Overall analysis and evaluation reveals that such kind of advance traffic information is very effective in order to change the commuter's behavior and to address congestion oriented problems in an appropriate manner. Further it can be mentioned that soft or psychological TDM measure like driver's education and advance traffic information initiatives should be considered concurrently with other policy implications in order to mitigate traffic management issues especially in developing countries where financial and institutional resources are in deficit.

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