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Performance Evaluation of the Intelligent Transport System in Delhi

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Abstract

This paper describes the application of a number of statistical analysis techniques undertaken to estimate the impact of various ITS modules such as APMS, VMS, and ATIS in Delhi. Major findings of a survey of drivers or users conducted in Delhi are presented. Models relating driver awareness, usage and understanding of ITS modules to various driver and trip characteristics were developed. A study of the demand for specific types of traffic or traveler information was also undertaken in order to understand the potential market for these systems as well as how the users will affect transport choices. Several trip and personal characteristics affecting drivers or users desire for different types of information were identified. Many of these factors were found to be directly related to the drivers or users perceived knowledge of the intelligent transport system.

1. INTRODUCTION

There has been increasing awareness of the negative effects of road traffic, especially in terms of accidents and environmental impairment. This awareness provides the public support for establishing modern traffic system management using advanced traffic control strategies and technologies. Intelligent Transportation Systems (ITS) is a broad range of diverse technologies applied to transportation to make systems safer, efficient, reliable and environmentally friendly, without necessarily having to physically alter existing infrastructure. A range of technologies includes sensor and control technologies, communications, and computer informatics and cuts across disciplines such as transportation engineering, telecommunications, computer science, finance, electronic commerce and automobile manufacturing. As the ITSs are information technology oriented devices, which offer drivers a wide range of information on the performance of a transport system. This information has a great influence on the user behavior. Therefore, it is important to investigate driver response to the existing ITS modules since it is not clear what types of drivers are using them and how they are influencing.

2. CURRENT SCENARIO OF ITS IN DELHI

Delhi is the second largest metropolis in India, with a population of 16.7 million as per 2011 census. As of 2008, Delhi had 5.5 million vehicles within its municipal limits, making most vehicle populous city of the world. The Commonwealth Games were held in October 2010 in Delhi. In order to ensure and monitor the

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movement of athletes, games family, etc; and the city traffic, the ITS technologies and facilities will be installed on major roads and areas of Delhi. This highly intelligent and autonomous system shall enable all individual traffic systems to operate collaboratively and seamlessly to manage major traffic incidents that have wider impact on the road network.

The NCT of Delhi is divided into 3 ranges, 10 districts and further sub-divided into 39 traffic circles for administrative purposes. There is a central traffic control room at one location and a separate control room for the split cycle offset optimization technique (SCOOT) based Area Traffic Control (ATC) System and a control room for traffic monitoring system. The central control room is a communication hub which uses conventional and trunked wireless and telephone facilities to communicate with field officers. There is a dedicated computer centre co-ordinating all IT related activities of Delhi Traffic Police. There are 701 signalized traffic junctions out of which 100 junctions are managed through SCOOT based ATC System. The other signalized junctions are currently either fixed time VTMS controller based or vehicle actuated traffic signalized junctions, 458 minor traffic junctions have been fitted with traffic blinkers, 100 signalized junctions are managed through real time on line the SCOOT based area traffic control system. There are seven traffic signals which are vehicle actuated signals, 38 pelican signals with a facility of VTMS and S-32 type of controllers, 15 intersections are covered by red light and speed check cameras and nine junctions are fitted with 10 PTZ cameras and 26 fixed cameras. There are three fixed variable message sign boards and six numbers road disaster management vehicles and five parking locations working with APMS technology.

Marell et al (1996) studied the difficulty to the drivers to keep speed within the permissible limits at a very short duration in the restricted areas like hospitals, primary schools, etc; where ESC functions as an alerter in such situations. It was found that around 43 percent of respondents perceived that they would be able to keep speed limit with the help of an ESC. Russell et al, (1995) studied the understanding of parking guidance information systems in Shinkuju of Japan and found that 61 percent drivers of the total interviewed noticed sign boards and 81 percent of drivers understood information to total drivers who noticed the sign boards and out of total understood drivers around 34 percent drivers used or followed sign boards. The two-way contingency table and binomial logit regression model analysis revealed that many infrequent travelers as well as those originating from more distant locations often do not notice sign boards. Understanding depends on various parameters such as education and age of drivers. And finally, use or follow up of sign boards depend on personal variables like gender and age as well as trip variables such as purpose, frequency and duration. Richards et.al (2007) focused on user acceptance of VMS located Southampton in UK, and investigated public's perceived effectiveness and usefulness of these signs through the use of revealed preference questionnaire surveys and travel diaries. The study showed that less than 1 percent of the commuter sample stated

that they had diverted to an alternative route during the travel diary week as a result of VMS information, although this did correspond to 53 percent of drivers originally intending to travel past the incident location. The results showed that the VMS messages were well understood and legible, and also indicated that a default VMS message reporting no problems in the network can indirectly affect a driver's route choice. Benson, 1996 conducted a survey of more than 500 motorists in Washington D.C. area and assessed motorists' attitudes toward VMS and the effect of demographic characteristics on these attitudes. In response to the survey question regarding how often VMS influenced their driving, half the respondents replied 'often', 40 percent answered 'occasionally', and others indicated 'not at all'. It was also found that demographic variables, such as age, income and gender, appeared to have little influence on motorists' attitudes about VMS. Chatterjee, et al (2002) conducted interview surveys in London revealed that 97 percent of drivers were aware of the existence of VMS, 62 percent completely understood the information presented on VMS, 84 percent considered the information presented to be useful, and 46 percent had at least one occasion diverted in response to the travel time information.

3. RESEARCH METHODOLOGY

The following section describes the approach adopted in this study and the surveys carried out for accomplishing each of the envisaged tasks. The study approach adopted includes the review of earlier study reports, research papers and existing proposed development in ITS both in India and abroad, design and conduct of primary surveys, secondary data collection from Delhi Traffic Police office, survey findings of the collected data.

The primary data collection will help to determine actual response of the users to the new system installed in Delhi. Systematic planning of the survey will generate empirical data and analyzing these data will help to identify and quantify the characteristic of users. The questionnaire sheets for APMS, ATIS and VMS were designed for conducting field surveys keeping in view local conditions to cover all important and relevant aspects in order to achieve objectives of the study.

In order to test the suitability of questions framed in performa for their correctness, sequence and the time taken for filling them, pilot surveys were carried out for parking at the Connaught Place, variable message signs at the Connaught Place and at some more locations of installed and at the Delhi Metro station for the traveler information system.

In order to fulfill the objectives of the study mentioned above, field survey is conducted at Connaught Place Parking, Variable Message Signs in the Connaught Place and Traveler Information System in the Delhi Metro in the months of February, March and April 2008 respectively. Data was collected from 9:00 a.m. to 5:00 p.m. every day and this survey work was conducted two weeks for each of the systems. Field study forms the basis for a majority of traffic and transportation

works as better planned and an accurate collection of data will work as a sound foundation for building up the final recommendations of the study.

This survey is useful in understanding responses of users to information presented by VMS boards. They can also give an indication of the level of improvement that can be expected. The numbers of survey samples covered in this study include 198 motorists at Connaught Place for parking, 213 users at the Delhi Metro station for the traveler information system and 227 motorists for variable message sign boards installed locations in Delhi.

Data collected through field survey is scrutinized, edited and checked separately for different ITS modules. Data is then coded and fed into MS Excel. Care is taken to ensure that no information is omitted at the time of feeding data into MS Excel. Collected data is analyzed both in MS Excel and in the SPSS 16 Package to assess user response to the system.

4. DATA COLLECTION AND MODEL DEVELOPMENT

Questionnaire consists of two sections, one presenting the personal information of users, and the other presenting users' responses to the system. Data collected from users included demographic characteristics like age, experience, etc; as well as vehicle type; information regarding purpose of visit or trip and reasons for using the present system; about the system awareness, understand and usage by a user; and information requested by the users in order to make the system effective.

A number of statistical analysis techniques were used to investigate relationships between drivers and trip characteristics and with the ITS modules such as advanced parking system, traveler information, and variable message sign regarding their awareness, understanding and usage of the system. In this study chi-squared test and logistic regression model were used to determine the significance of relationships.

The chi-squared test is used to investigate the independence of driver awareness, understanding and usage or follow up of the system with individual trip and personal characteristics. This test compares two-way frequency count (contingency table) data with expected frequencies estimated assuming independence. If there is no relationship between the variables, the test statistic is distributed according to the chi-squared distribution, allowing critical values to be determined for different levels of significance. This analysis is used to determine if relationships existed between two variables.

Binomial logit regression models are also developed for relating the likelihood of drivers' response to the various trip and personal characteristics. These models are used to identify significant personal and trip parameters influencing the probability of a reaction to the dynamic information. This technique allows the relative influence of a number of Boolean variables on driver response to be estimated.

4.1 Data Collection and Model on APMS

There are currently five locations in Delhi working with Advanced Parking System including Palika Underground Parking, Jantar Mantar-Sansad Marg T-point, Kasturba Gandhi Marg-Connaught Place T-point, Janpath-Connaught Place T-point, and State Entry Plaza T-point. Drivers were interviewed about the notice, understanding and usage or follow up of the parking. Among 226 drivers 198 drivers who have parked their vehicles gave responses. The expected number of samples was collected in two weeks of survey. Drivers were asked questions relating to their trip, parking choice and use, perceptions of the parking information system as well as their desire for various other types of parking related information. Data about numerous personal and trip characteristics are also collected.

Primary purposes of trips were work (40 percent), shopping (29 percent) and business (21 percent). Based on the age profile of respondents, it was found that parkers are mainly in the age group of 25 years to 40 years (53 percent). It was found from the survey that most of the respondents are of 12th class (26 percent) and hold bachelor degree (37 percent). It was also found that the most of the respondents have driving experience ranging from 6 to 15 years. Most of the daily trips (55 percent) are either work or business purpose related (being shop owners at Palika Bazar).

Fig. 1: Entrance Gate at Palika Parking

Fig. 2: Sign Boards Showing Availability of Spaces for Parking

The chi-square values for different variables are calculated using contingency table method. The chi-square values for the different variables as taken for the parking information and their corresponding degrees of freedom are shown in the Table 1. The calculated chi-square values as shown in the Table 1 are tested with chi-square tabulated values and their corresponding levels of significance of dependence are obtained and are given in Table 2.

(a) Notice of Parking Sign Boards

The collected data shows that 81 percent of total drivers interviewed have noticed sign boards during their trips. Two-way

Table 1: Chi-square Values for Variables of APMS

Variable Type	Degrees of Freedom	Calculated Chi-Square Value		
		Notice	Understand	Follow
Age	3	1.616186	39.15125	8.649333
Frequency	3	102.6713	49.12253	9.13987
Experience	3	8.996438	4.924586	0.469515
Vehicle Type	1	14.1376	1.247163	14.42527
Purpose	4	37.78458	7.408744	24.77621
Education	3	1.630796	27.5921	3.065527

Table 2: Chi-square Contingency Results for the Parking Information

	Notice of sign boards	Understand of sign boards	Following sign boards
Age	n.s.	***	**
Frequency	***	***	**
Experience	**	n.s.	n.s.
Vehicle type	***	n.s.	***
Purpose	***	n.s.	***
Education	n.s.	***	n.s.

n.s. - Not Significant *** *- Significant @ 1%* ** *- Significant @ 5%*
* *- Significant @10%*

contingency table (Table 2) reveal that there is a significant relationship between those drivers who notice parking sign boards with trip frequency, experience, purpose and vehicle type.

Log it regression results reveal that trips made with experience, as well as the trips with a substantially higher proportion of drivers with high trip frequencies are more aware of the sign boards (Table 3). The negative coefficient of the trip purpose indicates that the drivers with shopping as well as recreational trips seem to be less aware of parking information boards. It was found from survey records that most of these trips are occasional trips. And also, the vehicle type has influence in noticing parking boards. Car users are more aware of sign boards since the Palika underground parking system is more suitable to car users as compared to two-wheeler users. The best fit log likelihood value for APMS (noticed by the drivers) at 95 percent level of significance is -125.279.

(b) General understanding of the Parking Sign Boards

Drivers, who noticed parking sign boards during their trip, were also asked whether they understood the parking information. About 89 percent of drivers who had noticed the parking sign boards claimed that they understood the boards. Contingency table analysis revealed that there were significant relationships

Table 3: Notice of Parking Sign Boards

Variable	D.F	Coefficient	Standard error	Significance
Frequency	1	0.695	0.036	0.032
Experience	1	0.211	0.064	0.112
Purpose	1	-0.114	0.020	0.001
Vehicle type	1	0.599	0.057	0.043

between drivers' general understanding with age, trip frequency and education (Table 2).

Log it models developed confirmed these relationships. Drivers with lower trip frequencies have less understanding as compared to drivers with high frequency trips. The positive coefficient of education indicates that drivers' understanding is increased with increase of educational qualifications. It seems that drivers who are of either degree or master degree holders are more likely to understand parking information or instructions presented on the parking sign boards at Connaught Place in Delhi. While, the negative coefficient of age profile of the respondents indicates that drivers' understanding decreases with increase in age of drivers. The sample survey reveals that most of the respondents with age above 45 years are claiming that understanding problem exists because of luminance of sign boards. The best fit log likelihood value for APMS (understood by the drivers) at 95 percent level of significance is -74.776.

(c) Use / Follow of Parking Sign Boards

A considerable number of drivers stated that they used or followed (84 percent) signs during their trip. The contingency table shows the influencing variables for use or follows up of the parking sign boards are trip purpose, vehicle type and frequency (Table 2).

The log it modeling confirmed that vehicle type and several trip variables (purpose, frequency) are found to be related to those of drivers in using sign boards. The purpose, both business or work trips and those made on a daily basis are more likely to follow the instructions or information presented on the parking sign boards. This is so because there is a positive relationship between sign use with business, work and frequent trips. The negative coefficient of age group shows that drivers above age 40 years are not able to park their vehicles, since the visibility of the sign boards is not clear. The ability of parking systems to inform drivers of age above 45 years seems to be limited. The best fit log likelihood

Table 4: Understand of Parking Sign Boards

Variable	D.F	Coefficient	Standard error	Significance
Frequency	1	0.331	0.032	0.061
Age	1	-0.104	0.063	0.031
Education	1	0.220	0.287	0.012

Table 5: Use or Follow of Parking sign boards

Variable	D.F	Coefficient	Standard error	Significance
Frequency	1	0.762	0.220	0.012
Age	1	-0.120	0.028	0.081
Purpose	1	0.508	0.112	0.007
Vehicle type	1	0.931	0.032	0.031

value for APMS (followed by the drivers) at 95 percent level of significance is -193.014

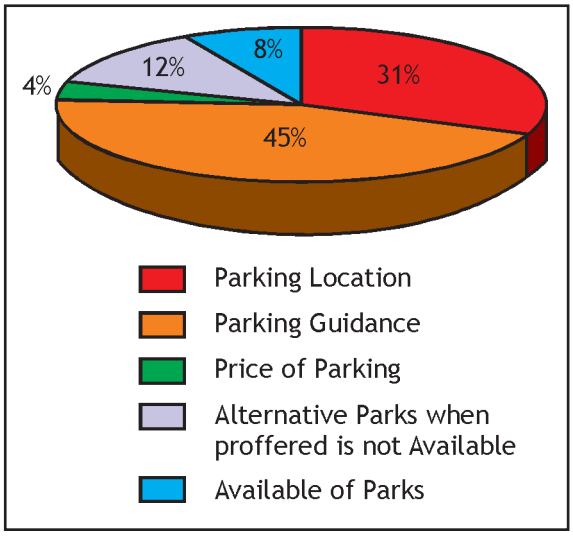
(d) Type of Information Requested by the Drivers

The drivers were also requested information regarding the expected parking information from parking sign boards. As shown in the Fig. 3 around 45 percent of drivers requested parking guidance information while 31 percent of drivers requested parking location information. Fig. 3 also provides the distribution of different types of information requested by drivers. For these drivers, parking guidance information boards and location map of parking facilities should be placed in prominent locations.

4.2 Data Collection and Model on ATIS

Delhi Metro is a mass rapid transit system, which serves many parts of Delhi. As of 2007, the Metro operates on three lines with a total length of 65km and 59 stations while several other lines are under construction. Line 1 runs between Rithala and Shahdara. Line 2 runs in an underground tunnel between Vishwa Vidyalaya and the Central Secretariat. Line 3 runs between Indraprastha, Barakhamba Road, and Dwarka. The network is being expanded at a rapid pace with Phase-II under construction (128 km), expected to be completed by 2010. Phase III and IV will be completed by 2015 and 2020 respectively, creating a network spanning 413.8 km, longer than London Underground. The opinion survey of users was taken at the Dwarka sector of Delhi Metro. Users were interviewed about notice, understanding and usage of traveler information. Among the 246 drivers about 213 drivers who parked have given response for the interview. The expected number of samples was collected in two weeks of surveys.

Fig. 3: Distribution of Information Requested by Drivers for Parking



The main purpose of trips was work (37 percent) and recreation (24 percent). Based on age profile of the respondents, it was found that parkers are mainly in the age group of 30 years to 40 years (51 percent). It was found from the survey that most

Fig 4: Delhi Metro

of the respondents hold bachelor degree (39 percent). Most of the daily trips (43 percent) are for work purpose.

The calculated chi-square values as shown in Table 6 are tested with chi-square tabulated values and their corresponding levels of significance of dependence are obtained and shown in Table 7.

(a) Notice of Traveler Information boards

Overall, 81 percent of users interviewed about notice of the traveler information sign boards during their trips in Delhi Metro. Two-way contingency table (Table 7) analysis revealed that there was a significant relationship between those users noticing the traveler information sign boards and trip frequency.

Log it regression results revealed that trips made based on frequency of trip to Delhi Metro has a positive effect on the likelihood of users noticing the sign boards (Table 8). The best fit log likelihood value for ATIS (noticed by the users) at 95 percent level of significance is -103.235

(b) General understanding of the Traveler Information Sign Boards

Users, who stated that they had noticed the traveler information sign boards during their trips, were also asked whether or not they generally understood

Table 6: Chi-square Values for Variables of ATIS

Variable Type	Degrees of Freedom	Calculated Chi-Square Value		
		Notice	Understand	Follow
Age	2	0.25426801	0.15314719	2.50409754
Education	3	1.36321862	23.9241191	2.75355659
Purpose	3	1.9525045	4.62088209	2.77017416
Frequency	2	53.2014356	28.9381636	16.5793633

Table 7: Chi-square Contingency Results for the Traveler Information Sign Boards

	Notice of boards	Understand of boards	Following of boards
Age	n.s.	n.s.	n.s.
Education	n.s.	***	n.s.
Purpose	n.s.	n.s.	n.s.
Frequency	***	***	***

n.s. - Not Significant *** *- Significant @ 1%* ** - Significant @ 5%
* - Significant @10%

the traveler information. About 90 percent of users who noticed the traveler information boards said that they understood them. Contingency table analysis revealed that there were significant relationships between user's general understanding and education and trip frequency (Table 7).

The log it model for understanding of users shows that those with lower trip frequencies tends to have low understanding of traveler information compared to higher trip frequency ones. And also, the users who are educated only upto 10th class do not understand the provided information boards in Delhi Metro station (Tables 9). The best fit log likelihood value for ATIS (understood by the users) at 95 percent level of significance is -101.763

(c) Use / Follow of Traveler Information Boards

A considerable number of users stated that they had used or followed (91 percent) the sign boards during their trips. The number of users using or following the traveler information boards is related to trip frequency (Table 7).

Log it modeling confirmed that only the variable frequency shows positive relationship with the use or follow of the sign boards. The best fit log likelihood value for ATIS (followed by the users) at 95 percent level of significance is -93.143.

Table 8: Notice of Traveler Information Boards

Variable	D.F	Coefficient	Standard error	Significance
Frequency	1	0.381	0.019	0.052
Education	1	0.026	0.048	0.023

Table 9: Understanding of Traveler Information Boards

Variable	D.F	Coefficient	Standard error	Significance
Education	1	0.797	0.440	0.063
Frequency	1	0.730	0.016	0.202

Table 10: Use or Follow of Traveler Information boards

Variable	D.F	Coefficient	Standard error	Significance
Frequency	1	1.30	0.014	0.027

(d) Type of Information Requested by the Users

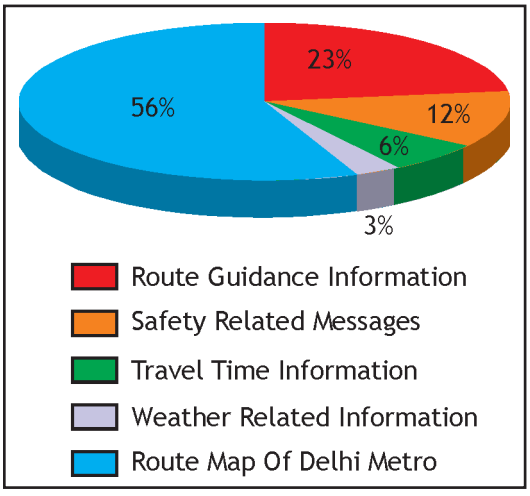
It can be seen that most of the respondents have requested the route map showing all the connections to Delhi Metro stations and also some of the respondents requested the route guidance for using Delhi Metro. Fig. 5 shows the distribution of traveler information requested by the users at Delhi Metro.

4.3 Data Collection and Model on VMS

The installed locations of VMS boards in Delhi are between Ashram-Friends Colony Junction, Madanpur Khadar Junction, Palika Bazar, and Mathura Road near CRRI. Interview survey of drivers was conducted for the use of message provided. Among 268 drivers about 227 drivers have given responses through interviews. The expected numbers of samples were collected in two weeks of surveys. Drivers were asked questions related to their trips and use, perceptions of the VMS as well as their desire for various other types of information.

Based on the age profile of the respondents, it was found that drivers are mainly in the age group of 25 years to 40 years (48 percent). It was found from the survey that most of the respondents hold bachelor degree (40 percent).

Fig. 5: Distribution of Information Requested by Users for Traveler Information



The calculated chi-square values as shown in Table 11 are tested with chi-square tabulated values and their corresponding levels of significance of dependence are obtained and are given in Table 12

(a) Notice of VMS Boards

Around 87 percent of interviewed drivers have noticed the VMS sign boards during their trips. Two-way contingency table (Table 12) analysis reveals that there is a significant relationship between the drivers noticing the VMS signs boards with their education and experience.

Log it regression results also reveal that trips made based on age and also experience have a positive effect on the likelihood of drivers noticing sign

boards (Table 13). It is found that those drivers have more experience as well as higher education have more capacity to notice sign boards. The best fit log likelihood value for VMS (noticed by the drivers) at 95 percent level of significance is -125.279

Fig. 6: VMS at Madanpur Khadar Junction

(b) General understanding of the VMS Boards

Drivers, who stated that they have noticed the VMS sign boards during their trips were also asked whether they understand the VMS. Overall, 92 percent drivers who noticed the VMS sign boards claimed that they understand the boards. Contingency table analysis reveals that there is a significant relationship between driver's general understanding and two personal variables (age and education) (Table 12).

Log it models shows that negative coefficient of age group confirm that drivers having age above 40 years are less likely to understand sign boards. The best fit log likelihood value for VMS (understood by drivers) at 95 percent level of significance is -87.273

(c) Use/follow of VMS Boards

A considerable number of drivers say that they have followed (92 percent) sign boards during their trips. The numbers of drivers using the VMS sign boards are related to age and experience.

The log it modeling confirmed the above relationships. The only one personal variable, age is found to be related to drivers using the sign boards (Table 15). The negative coefficient of the variable age shows that with the increase of the

Table 11: Chi-square Values for Variables of VMS

Variable Type	Degrees of Freedom	Calculated Chi-Square Value		
		Notice	Understand	Follow
Age	2	0.445627	21.13503	5.238323
Experience	3	8.415746	3.698957	1.908956
Education	3	29.00239	14.19213	4.525281

Table 12: Chi-square Contingency Results for the Variable Message Sign

	Notice of boards	Understand of boards	Following of boards
Age	n.s.	n.s.	*
Education	***	***	n.s.
Experience	*	n.s.	n.s.

n.s. - Not Significant *** *- Significant @ 1%* ** *- Significant @ 5%*
* *- Significant @10%*

Table 13: Notice of VMS Boards

Variable	D.F	Coefficient	Standard error	Significance
Education	1	0.651	0.065	0.026
Experience	1	0.358	0.136	0.072

Table 14: Understand of VMS Boards

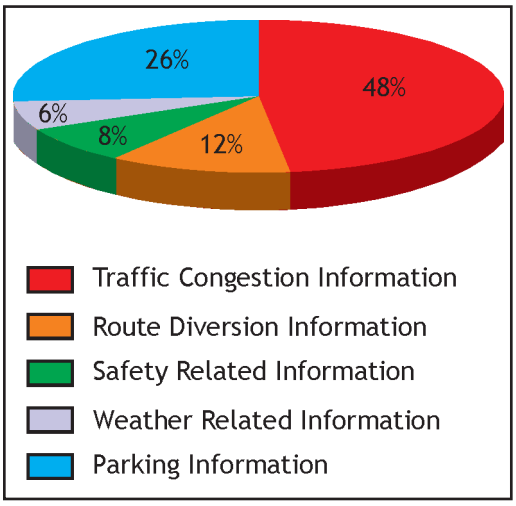
Variable	D.F	Coefficient	Standard error	Significance
Education	1	0.375	0.180	0.056

Table 15: Use or Follow of VMS Boards

Variable	D.F	Coefficient	Standard error	Significance
Age	1	-0.251	0.037	0.087

age of drivers understanding of drivers decreases which affects their following the instructions as provided on the VMS boards. The best fit log likelihood value for VMS (followed by the drivers) at 95 percent level of significance is -113.051.

Fig. 8: Distribution of Information Requested by Drivers for VMS



(d) Type of Information Requested by the Drivers

The drivers were also asked requested information from them regarding the expected information from the VMS boards. As shown in Fig. 7 around 48 percent of the drivers requested the traffic congestion information while 26 percent of the drivers needed parking related information. Fig. 7 also provides distribution of different types of information requested by the drivers. For these drivers, traffic congestion information is provided at the major intersection areas.

5. CONCLUSIONS

Most of the frequent users are more likely aware, understood and followed the parking information at the Connaught Place parking in Delhi. About 50 percent of age group 40 to 50 years, 60 percent of the drivers who were educated up to 12th class and 68 percent of occasional trip frequency respondents have not understood the parking information presented on the sign boards. This shows that personal variables (age and education) and trip frequency of the drivers have prominent influence in understanding the parking information presented on the VMS boards in Delhi. Around 45 percent of the requested information of the drivers is for parking guidance while 31 percent is for parking location. This shows that proper parking guidance information should be provided and also parking map is to be provided. The log likelihood (LL) values

calculated for notice, understand, and followed the APMS at 95 percent level of significance are -125.279, -74.776 and -193.014.

Nearly 75 percent of the occasional trip respondents are not aware of the traveler information presented on the boards. This shows that the trip frequency to Delhi Metro influences awareness about the traveler information. About half of the respondents who are educated up to 10th class and more than 80 percent of occasional trip respondents have not understood the information. Therefore the attributes education and trip frequency of the users are affecting them in understanding information provided on message boards. More than half of the respondents requested the route map of the Delhi Metro showing all the connected location to the Metro. The log likelihood values calculated for notice, understanding, and for following the ATIS at 95 percent level of significance are -103.235, -101.763 and -93.143.

About 45 percent of the respondents having less than 5 years of driving experience and 66 percent of drivers who are educated up to 12th class are not aware of the VMS boards in Delhi. It was observed that 34 percent of drivers who are educated up to 10th class and 40 percent of the respondents in the age group above 40 years have not understood the information presented on the sign boards. This shows that personal variables such as age and education have significant effect on drivers in understanding the message content presented on the VMS boards. Due to traffic congestion problem in Delhi, most of the respondents (about 48percent) requested the traffic congestion information. The log likelihood values calculated for notice, understand, and follow of the VMS at 95percent level of significance are -125.279, -87.273 and -113.051.

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