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Apllication of I.T.S. In India

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Abstract: *This study deals with the estimation of impact of various Intelligent Transportation Modules such as APMS, VMS and ATIS in New Delhi. Major findings of a survey of drivers or users conducted in New Delhi are presented in this report. From this study, the demand for the particular types of traffic / traveler information was also undertaken in order to understand the effectiveness of the system in the way they affect the users / drivers' transport choices. The personal and travel characteristics of the users / drivers which affect the users / drivers desire for different types of information were found. And also it is found that many of those factors are in direct relationship with the driver's awareness on Intelligent Transportation System.*

I. Introduction

Almost everyone in the world of Intelligent Transportation System (ITS) agrees that Intelligent Transportation System (ITS) advances are conceived to improve transport efficiency, enabling inter-modality among different transport means, diminishing the environmental impact and enhancing the experience of travelers. In order to achieve these objectives, it has been proven that new information and communication technologies are key elements. Among the different transportation modes involved in Intelligent Transportation System (ITS), it is probably the road sector the one that has focused most of the efforts during the past years.

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 System (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 Intelligent Transportation systems (ITSs) are information technology oriented devices, which offer drivers a wide range of information on the user behavior. Therefore, it is important to investigate driver response to the existing Intelligent Transportation System (ITS) modules since it is not clear what types of drivers are using them and how they are influencing.

II. Current Scenario of Intelligent Transportation System (ITS) in New 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. In order to ensure and monitor the safe movement of city traffic, the Intelligent Transportation Systems (ITSs) 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 im**pa**ct 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. A Central traffic Control room is established and also a separate control room for SCOOT (Split Cycle Offset Optimization Technique) based ATC (Area traffic Control) 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 coordinating 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 fixed time VTMS controller based or vehicle actuated 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.

III. Components of ITS

In 2000, the Faculty approved the formation of the multi-disciplinary Intelligent Transportation and Vehicle Systems (ITVS) programme to be coordinated by the Centre for Transportation Research. This programme draws on the expertise of academic staff from the Department of Civil Engineering, Department of Electrical and Computer Engineering, Department of Industrial & Systems Engineering and Department of Mechanical Engineering. Our Faculty's initiative has a "V" added to the commonly used ITS acronym to emphasize the fact that vehicles are an integral part of the entire transportation system.

The ITVS programme has three components:

- Research Programme
- Education Programme
- Professional Activities

Majority of the research activities are hosted by the ITVS Laboratory in the Department of Civil Engineering, with several other research projects hosted by the Vision and Image Processing Laboratory, and Digital Systems & Applications Laboratory in the Department of Electrical & Computer Engineering. The research activities at the ITVS laboratory are supported by three laboratory officers, two research fellows, one research engineer and 18 research scholars. The research thrust, as reflected by the research projects conducted by faculty members and full-time research staff, may be grouped under the following categories:

- Real-time traffic detection and prediction
- Traffic control and management
- Traffic safety and human factors
- Traveller and spatial information systems
- Road network management systems
- Transportation logistics
- Image processing
- Voice recognition for vehicle navigation and control
- Vehicle dynamics

Figure shows the components

Figure 1: Various intelligent transportation systems components.

The need for intelligent transportation systems stems from the fact that traffic congestion has been increasing all around the world because of increasing population, increasing amount of transportation vehicles and increasing urbanization.

- **Wireless Technologies**
  Wireless communication technologies have been proposed, tested and used for intelligent transportation systems. From the short-range communications systems like WAVE or IEEE 802.11 protocol to the range extended by utilizing mesh networking or mobile ad hoc networks, many possibilities exist. Long-range communications systems like GSM or WiMAX which are far more expensive and complicated have also been proposed.
- **Computational Systems**
  The installation of operational systems and processors in transportation vehicles have also allowed software applications and artificial intelligence systems to be installed. These systems include internal control of

model based processes, ubiquitous computing and other programs designed to be integrated into a greater transportation system.

- **Floating Car Data or FCD**
  Floating car data on the other hand makes use of the availability of location data garnered from mobile phones by the network carriers. Since this data is updated constantly throughout the day, they can be used as traffic probes showing points where there is traffic congestion, the average traffic speed and traffic direction. Moreover, since this system requires no costly infrastructures and equipment like cameras or sensors and is not affected by adverse weather, it is one of the strongest contenders for intelligent transportation systems.
- **Sensing Technologies**
- Sensing technologies involve embedding sensors along the road or the surrounding infrastructure like traffic posts, signs and buildings. These sensors include inductive loops that can sense the vehicles' speed, the number of vehicles passing as well as the size of these vehicles. Video detection, on the other hand, involves the installation of video cameras onto road structures such as poles or billboards to detect occupancy information on the lanes, vehicle speeds, vehicles heading the wrong way, etc.

IV. Literature Review

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. Chatterjee, et al (2002) conducted interview surveys in London revealed that 97 percent of drivers were aware of the existence of Variable Message Signs, 62 percent completely understood the information presented on Variable Message Sign, 84 percent considered the information presented to be useful, and 46 percent had at least on occasion diverted in response to the travel time information. 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 43 percent of respondents perceived that they would be able to keep speed limit with the help of an ESC. 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 motorist's 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 motorist's attitudes about VMS.S.S. Jain, et al, 2011 conducted a study of about 200 users are surveyed and among them, about 50 percent of age group 40 to 50 years, 60 percent of the drivers who were educated up to 12 th class and 68 percent of occasional trip frequency respondents have not understood the information of VMS. And it also states that around 45 percent of the requested information of the drivers is for parking guidance while 31 percent is for parking location.

3.1. Advanced Public Transportation System using Information Techniques

Information from roadside surveillance and monitor equipment and other traffic organizations are delivered to Traffic Control Center, where information is gathered, analyzed, processed, and distributed to allow traffic control personnel to react, recognize, determine rapidly, and the public can also get the real-time traffic information through the Internet, mobile phones, traffic signals, and other facilities. Such information is also published to general public through all types of sign boards or related equipment on the roads. Below is an illustration of Intelligent Transportation Systems as shown in figure 2and figure 3.

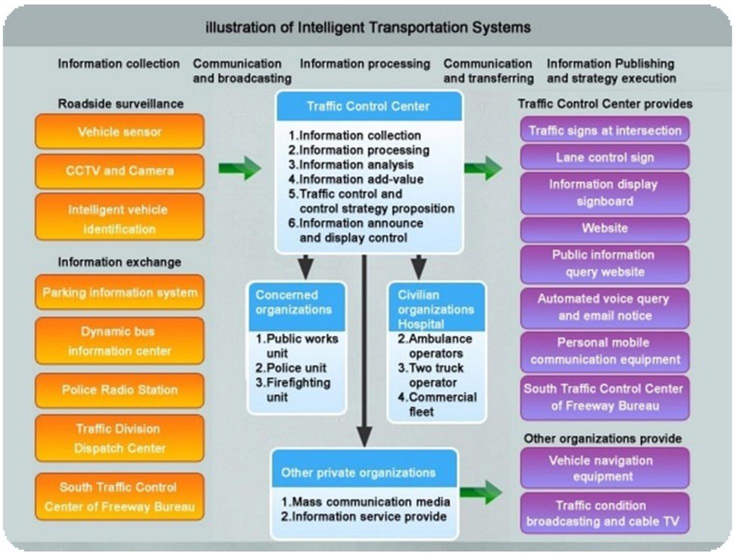


Figure 2: illustration of Intelligent Transportation Systems

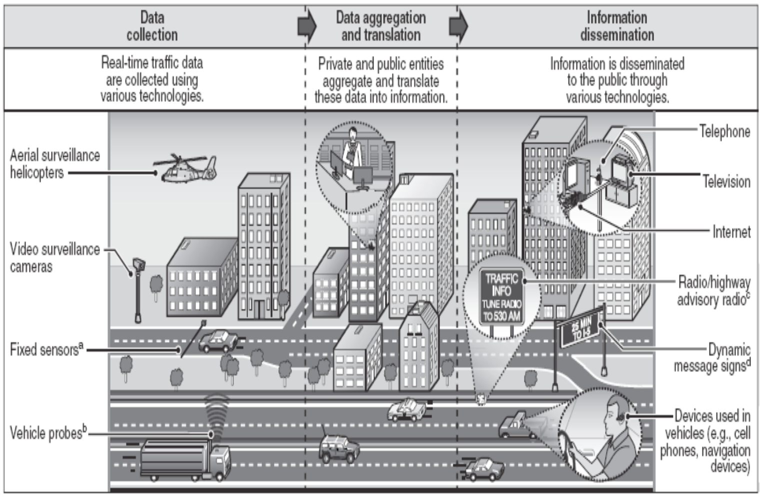


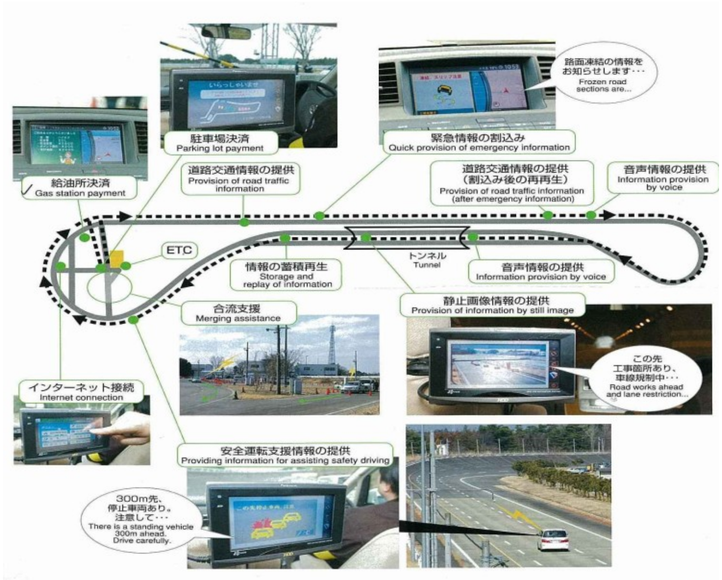
Figure 3: Example of Technologies Associated with Real-Time Traffic data Information

Intelligent transportation systems represent such a critical emerging set of IT applications that it is important to identify which countries lead in their development and deployment and to understand why these countries are ahead and why others are lagging. This report seeks to ascertain what the leading countries are doing differently than the lagging countries and to offer recommendations for countries that seek to be leaders in intelligent transportation systems.

3.1.1. ITS in Japan

Japan leads the world in intelligent transportation systems based on the importance ascribed to ITS at the highest levels of government, the number of citizens benefitting from use of an impressive range of operationally deployed ITS applications, and the maturity of those applications for optimal route guidance to avoid accidents, congestion, weather, and/or roadway hazards. VICS thus provides drivers with in-vehicle, real-time traffic information and can assist the driver in selecting (and plotting) an optimal route to get to his or her destination.86

Initially, VICS collected traffic data through sensors embedded in or beside the roadway, traffic cameras, or traffic reports (for example, from police or motorists). But since 2003, traffic and congestion information in Japan has been generated increasingly through the use of probe vehicles, specifically by making VICS-enabled vehicles the probe vehicles themselves. Japan views probe vehicles as "a system for monitoring and collecting data on the precise traffic flow, traffic behaviour, positions, vehicle behaviour, and weather and natural states by using vehicles as moving traffic-monitoring devices."87



3.2. Arterial and Freeway Management System

Arterial and freeway management systems manage traffic by using traffic signal control systems, system detectors, closed-circuit television (CCTV) cameras, ramp meters; variable message signs (VMS) and bus probes to improve the efficiency of arterial and freeway roadways. The purpose of these systems is to use information to improve the flow of traffic, increase safety, reduce costs and improve traveller experience along arterial and freeway corridors.

3.2.1. Monitoring and Traffic Surveillance

The primary goal of traffic surveillance systems is to supply information about conditions in the field to other system components so that appropriate response and control actions can be taken. Monitoring and traffic surveillance strategies include the use of closed-circuit television (CCTV), system detectors, and communications networks. These tools can help improve incident management, inform control decision-making and determine traffic conditions for information dissemination. Surveillance can enhance traffic operations and planning by serving the following purposes:

- Detection and verification of incidents that have an impact on traffic operations;
- Monitoring of incident clearance;
- Monitoring traffic for emergencies and special events;
- Monitoring of traffic operations and supporting the implementation of control strategies, such as adaptive ramp metering and automated traffic signal coordination systems (ATCS);
- Monitoring pavement and environmental conditions;
- Monitoring of traffic operations to generate data for planning and research purposes.

These data can lead to information on space-time series on link travel time, link space mean speed, traffic flow rate, space occupancy, and origin destination flows.

Data collection can be accomplished through a number of detector surveillance technologies that measure traffic parameters including: (*11*)

• Inductive loop detector and magnetometer, which are embedded in the roadway; • Non-intrusive detector including microwave/radar, laser, infrared, ultrasonic, acoustic, digital video imaging; and

• Vehicle probes using automatic vehicle identification (AVI) and automatic vehicle location (AVL).

Detection and surveillance systems can reduce the time lapsed between the occurrence of an incident and its reporting to the traffic management centers or emergency services (detection time). To verify incidents CCTV is commonly used with the automated detection systems. CCTV can help to determine the location of the incident and its severity. In addition, CCTV can supply digital video images to video image processing algorithms, which can be used to automatically detect the occurrence of an incident.

Using CCTV can also reduce verification time, since all incidents must be verified prior to the dispatching of response vehicles and personnel. A computer simulation model comparing the situation before detection and surveillance systems deployment to after deployment found the following quantifiable benefits of detection and surveillance:

• Reduction of non-recurrent delay along the corridor;
• Reduction of secondary crashes along the corridor;
• Reduction of primary crashes along the corridor;
• Reduction of vehicle emissions associated with delay reduction; and
• Reduction of fuel consumption associated with delay reduction.

The Oregon Department of Transportation (ODOT) is currently operating the Advanced Transportation Management System (ATMS) in the Portland Metro region.

V. 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 Opinion survey conducted at Palika Bazar.

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 sheet is 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 Connaught Place. 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 the VMS boards. They can also give an indication of the level of improvement that can be expected.

VI. Data collection

A Questionnaire has been prepared which consists of two sections, one presenting the personal information of the users, and the other presenting user's responses to the system. Opinion Questionnaire survey has been conducted at Palika Bazar, New Delhi as well as from the Scientists of CRRI, New Delhi. Data collected from users included demographic characteristics like age, experience, etc; as well as vehicle type; information regarding purpose of visit or trip; about the system awareness, understand and usage by a user; and information requested by the users in order to make the system effective.

With the questionnaire, the drivers are interviewed about the notice, understanding and usage or follow up of the parking. Nearly 50 drivers gave responses. Totally 72 responses has been collected including the responses of the scientists. This sample size was achieved in 4 days. Drivers were asked 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.

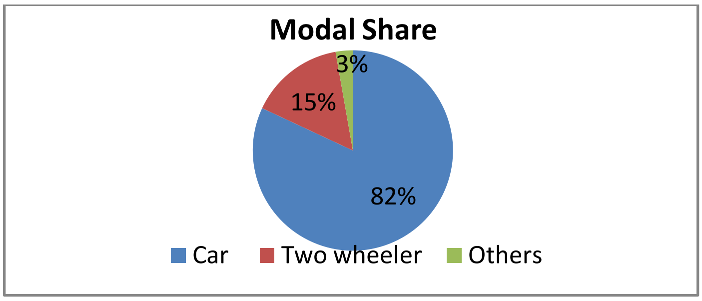
VII. Analysis

6.1. Sample Characteristics:

Based on the age profile of respondents, it was found that parkers are mainly in the age group of 18 to 25 (53 Percent).The responses were obtained from the users of Male population of 72 percent and Female population of 28 percent. About 22 percent of the users are of Government sector, 28 percent are of Private sector and 19 percent of the users are Business people. Primary purposes of trips were shopping (47 Percent) and work (46 percent). Majority of the respondents (58 percent) earn Rs. 10000 to 25000 per month and 32 percent of people earn above Rs.25000 per month.74 percent of the respondents were married and 26 percent of the respondents were unmarried. Most of the people have completed Under Graduate (50 percent) and nearly 22 percent of the respondents have completed Post graduation. About 67 percent of the users were having 1 to 10 years of driving experience.

6.2. Type of vehicle used for the current trip:

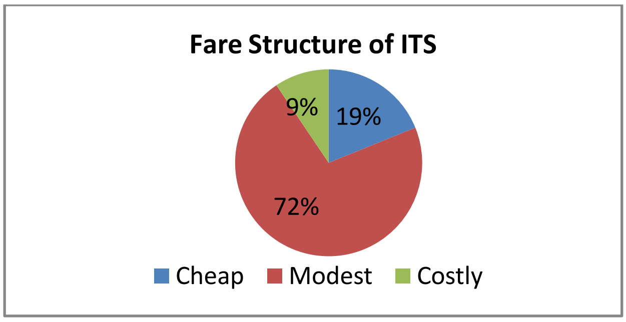
82 percent of the respondents were come by car and 15 percent of the respondents were using two-wheelers.



6.3. Frequency of trips:
74 Percent of the respondents were regular travelers.

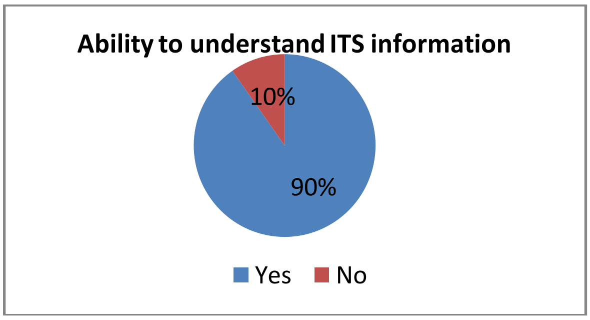
6.4. ITS applications:

All the respondents are responding that ITS applications are proving Time saving. Majority of the respondents (75 percent) claim that the fare structure is modest.



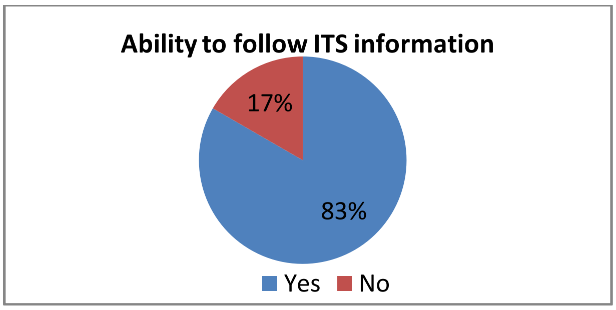
6.5. Understandability of Variable Message Sign (VMS) information:

The survey results say that 90 percent of the people can understand the Variable Message Sign (VMS) information.



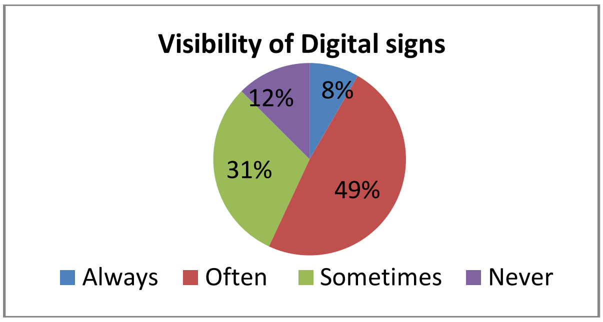
6.6. Ability to follow the VMS information:

83 percent of the respondents can follow the information disseminated by Variable Message Sign Boards.



6.7. Visibility of the Variable Message Sign Boards:

It is clear that, more than 50 percent of the respondents can see the Variable Message Sign Boards during driving.



VIII. Conclusion

Most of the frequent users are more likely aware, understood and followed the parking information at the Connaught Place parking in New Delhi. About 53 percent of age group 18 to 25 years, 50 percent of drivers were educated up to Under Graduation and 72 percent of the regular 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 New Delhi. Around 74 percent of the requested information of the drivers is for parking location while 22 percent is for Parking guidance. This shows that proper Parking guidance information should be provided and also proper Parking map should be provided.

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 influences awareness about the traveler information. About half of the respondents who are educated up to 12th class and more than 70 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 the message boards.This study shows that personal variables such as age and education have significant effect on driver in understanding the information presented on the VMS boards. Due to traffic congestion problem in Delhi, most of the respondents requested traffic congestion

7.1. Applications of Intelligent Transportation Systems

- **Automatic Toll Collection**
  Intelligent transport systems are used for automatic toll collection where the vehicles can pass through without slowing down. This eliminates choke points along routes having toll booths and enforces cordon zones in some cities. Automatic toll collection systems make use of radio devices, infrared systems, RFIDs, license plate recognition systems and barcode stickers.
- **Vehicle Notification Systems**
  Intelligent transport systems particularly the FCD model can also be used to provide advance warning to motorists of traffic jams, accidents and other emergency situations. This system can then provide alternative routes or recommendations to motorists so as to avoid congestion and travel delays.
- **Cordon Zones**
  With the intelligent transportation system, cordon zones can also be enforced where mass transportation systems are available and their use encouraged. Cordon systems make it possible to collect taxes from those entering city areas with high traffic while encouraging the use of mass transit.

information.

7.2. Benefits From ITS Deployments In Urban Areas

These have the potential to offer the following benefits**:**

• Arterial management systems can potentially reduce delays between 5% and 40%with the implementation of advanced control systems and traveller information dissemination.

• Freeway management systems can reduce the occurrence of crashes by up to 40%, increase capacity, and decrease overall travel times by up to 60%.

• Freight management systems reduce costs to motor carriers by 35% with the implementation of the commercial vehicle information systems and networks.

• Transit management systems may reduce travel times by up to 50% and increased reliability by 35% with automatic vehicle location and transit signal priority implementation.

• Incident management systems potentially reduce incident duration by 40% and offer numerous other benefits, such as increased public support for DOT activities and goodwill.

Many areas of the urban transportation system can be effectively improved through ITS deployments. These areas include arterial, freeway, freight, transit, incident, emergency, regional multimodal traveller information, and archived information management systems. The benefits include improved safety, efficiency, mobility, accessibility, and intermodal connections. ITS deployment improvements also include the promotion of environmental responsibility, energy use, and economic development. These benefits can be increased through regional cooperation and partnerships. Oregon's transportation infrastructure is being asked to serve a growing demand while financial resources are becoming increasingly limited. New methods should be explored in order to meet the needs of today and into the future. ITS technologies are a way to cost effectively increase efficiency and safety needs in Oregon's transportation system. The investigation shows that ITS eployments can be effectively implemented to address a vast range ofissues and conditions across vastly different regions.(Christopher M. Monsere, Ph.D., P.E._Thareth YinPortland State University Civil and Environmental Engineering PO Box 751 Portland, OR 97207-0751 April 2005**)**

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