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A STUDY ON LEVEL OF SERVICE FOR MITIGATING TRAFFIC CONGESTION WITH REFERENCE TO INTELLIGENT TRANSPORTATION SYSTEM

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ABSTRACT:
Intelligent transport systems have efficiently and effectively proved themselves in settling up the problem of traffic congestion around the world. The multi-agent based transportation system is one of the most important intelligent transport systems, which represents an interaction among the neighbouring vehicles, drivers, roads, infrastructure and vehicles. We offer two theoretical explanations for this effect: (i) ITS help individual commuters to make better travel decisions; and (ii) ITS help local governments to develop an urban traffic management capability. Empirical evidence supports the underlying theoretical mechanisms and shows that ITS help commuters to schedule travel more efficiently, choose better navigation routes, and optimize their work-trip transportation mode. Second, the effect of ITS is contingent upon road supply and public transit services. We also find that the traffic-reducing effect of ITS is larger when commuters use more online services for traffic information. Intelligent Transportation Systems deliver superior benefit-cost returns when compared to traditional investments in highway capacity. Intelligent Transportation System maximizes the capacity of infrastructure, reducing the need to build additional highway capacity. ITS have a central role to play in funding countries' transportation systems. Increasing driver and pedestrian safety, Enhancing mobility and convenience, Delivering environmental benefit, Boosting productivity, economic, and employment growth. The simulation model has showed a significant reduction of at least 50% in the average time delay and thus a real improvement in the entire journey time.
Keywords: traffic congestion; transportation analysis; road traffic; road evaluation, traffic measure

INTRODUCTION:

Road transport industry is the backbone of the strong economy and the dynamic society. It is therefore a vital, indispensable link in the continued economic growth and development of any country. Road transport connects places of production with places of manufacturing. This is considered the backbone of the "Door-to-Door concept" and there are certain requirements that should be adhered to in order to meet both local and international standards when building roads. However, even with all of these benefits, road transport suffers from many problems in Egypt. The poor infrastructure and the increasing rate of vehicles both have a subsequent effect on the traffic congestion and safety, which has seen an increased rate of accidents and death, especially on highways. Recently, new trends have emerged that assist in solving such problems through the use of applying Intelligent Transport Systems (ITS).

Traffic congestion is one of the important issues in developing cities and it depends on the change in land use. Regulation of zoning and land use playsa major role to mitigate the traffic congestion. Integration of Land use and transport system is one of the best solution to manage the traffic congestion is developing cities. Traffic congestion leads waste of time, fuel, delay, air pollution and imposes cost on society. There are two principal categories of causes of

congestion and they are: (a) Micro-level factors (e.g. relates to traffic on the road) and macro factors relate to overall demand for road use. The macro level factors are, for example many people and freightwant to move at the same time, too many vehicles for limited road space, poorly timed traffic signals special events like mass social gathering, political rallies, bad weather condition etc. The micro level factors e.g. land use-pattern, employment patterns income levels, car ownership trends, infrastructure investment regional economic dynamics etc. also may lead to congestion.

LITERARTURE REVIEW:

Tanzina Afrin et al (2020) the currently available measures are detailed and compared by implementing them on a daily and weekly traffic historical dataset. The results showed each measure showed significant variations in congestion states while indicating a similar congestion trend. The advantages and disadvantages of each measure are identified from the data analysis. This study summarizes the current road traffic congestion measures and provides a constructive insight into the development of a sustainable and resilient traffic management system.

Hussein Magdy El.Husseiny (2019) the research adapted a descriptive case study that was conducted on one of the main Egyptian highways which is "Cairo-Alexandria desert highway". In order to investigate the applicability of the ITS, in-depth interviews were carried out with two parties: the first party was the constructor of the highway "Arab Constructors Company", and the second party are the trucking companies as users of the highway. Moreover, a focus group was conducted with freight forwarders companies in order to verify the current problems on Cairo-Alexandria desert highway and best practice to overcome these problems.

Haresh D. Golakiya et al (2020) ITS have a central role to play in funding countries' transportation systems. Increasing driver and pedestrian safety, Enhancing mobility and convenience, Delivering environmental benefit, Boosting productivity, economic, and employment growth. In this paper patch of highway in Gujarat has been selected and toll collection system i.e. existing conventional transportation facilities is studied and compared with intelligent transportation system.

Matheus S Quessada et al (2020) we propose the development of a system to monitor vehicle traffic, informing about events that are taking place on the roads in real time. The system can recommend new routes to drivers or allow drivers to take action based on information received from a particular road. As well as, the system uses driver location information for traffic monitoring, which will later be available for any devices, either a mobile device (smartphone) or a desktop. For the evaluation of the proposed system, a user case was developed for the Catanduva city in which we performed a test with the proposed system and was possible to verify a reduction in vehicle stopping time by 42% and a shorter travel time of 50% with an average speed of 33 km/h.

INTELLIGENT TRANSPORT SYSTEMS

Information and communication technologies have recently been applied in programmes to support sustainable urban development. In particular, initiatives in the transportation sector aim at improving the safety, efficiency and sustainability of large cities. Intelligent transportation systems (ITS) are among the first applications in this sector. ITS are, generally speaking, combinations of technologies for increasing efficiency in vehicular traffic. Mainly focused on road transport, ITS also have applications in rail, water and air transport and include navigational devices. The scope of this paper however is mostly limited to urban road transport.

Globally, ITS development has been driven largely by Government policy in the United States, while the technology has evolved generally under the leadership of private developers in Western Europe. The rationale for governmental leadership in formulating ITS policies is

to avoid duplication in structural investments and to enable systematic management of ITS services to evolve.

ITS and related information technology solutions for transport infrastructures are becoming a key means of boosting urban mobility. While ITS are often promoted, no unified definition of ITS prevails. Client agencies or countries in much of the world are apt to adopt definitions that accord with their specific purposes or objectives. ITS in different cities have been implemented according to the physical infrastructure and the policy environment in each place, including their state of urban development and their level of readiness to accept and use ITS services. While similar problems prevail in each place, they have been dealt with in different ways.

Benefits and Objectives of Intelligent Transport Systems:

Intelligent Transport Systems can deliver a wide range of significant benefits and objectives to the transportation field. Moreover, it can help meeting increasing demand through applying latest advanced and communication technologies in improving safety and making the most effective use of existing roads. Since the researchers suggest 6 main benefits and objectives of ITS such as: Safety, Mobility, Efficiency, Productivity, Energy, and Environment.

An ITS Architecture is important for a number of reasons:

1. it ensures an open market for services and equipment, because there are “standard” interfaces between components;
2. an open market permits economies of scale in production and distribution, thus reducing the price of products and services;
3. it ensures consistency of information delivered to end-users;
4. it encourages investment in ITS since compatibility is ensured;
5. it ensures inter-operability between components, even when they are produced by different manufacturers, which is also good for SMEs (Small and Medium sized Enterprises);
6. it permits an appropriate level of technology independence and allows new technologies to be incorporated easily;
7. it provides the basis for a common understanding of the purpose and functions of the ITS, thus avoiding conflicting assumptions

Root Causes of Congestions:

Congestion in urban or metropolitan areas may occur due to various reasons, such as excess demand, signal, incidents, work zones, weather-related, or special events. Depending on various root causes, generally, road traffic congestions can be classified into two categories: (1) recurring congestions and (2) nonrecurring congestions

Recurring Congestion In most metropolitan cities, travellers experience congestion every day during daily peak hours. According to FHWA, roughly half of the congestion experienced by traffic users is recurring and Nonrecurring congestions generally occurred due to unpredictable events, such as traffic incidents, work zones, weather, or other particular circumstances. Nonrecurring congestion can initiate new congestion in the off-peak periods, as well as can increase the delay due to recurring congestion.

Current Approaches to Measure Congestion:

To quantify the congestion level, numerous congestion measures have been developed considering different performance criteria. Depending on these criteria, the congestion measures can be categorized into five categories: (i) speed, (ii) travel time, (iii) delay, (iv) level of services (LoS), and (v) congestion indices, as shown in Figure. Moreover, some measures are used by the DOT-FHWA to quantify the congestion level annually. These federal congestion measures are listed. The congestion measures employed in other countries may differ from the ones discussed in this paper.

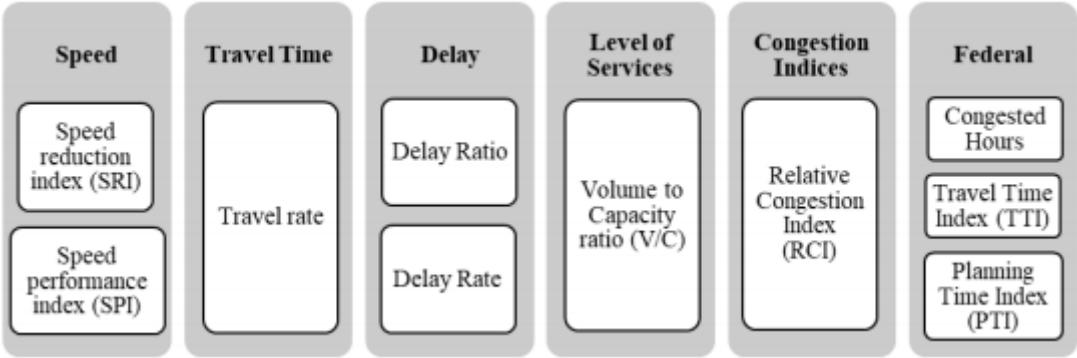


Figure. Congestion measures in different categories

Management of the transport system:

The road network and vehicles should be considered as a whole, since the same infrastructure and the same types of vehicles can yield quite different transport capacities. In other words, how the system is managed makes a big difference. Whether the streets have one- or two-way traffic, whether one can turn in any direction at all intersections, whether traffic lights are synchronized, whether average vehicle occupancy is high or low, or whether buses are given priority on the roadway, are all factors that change the outcome. In fact, it is the combination of infrastructure, vehicles and transport management that determines transport capacity or supply.

Advanced Transportation Management Systems:

Advanced Transportation Management Systems (ATMS) operate with infrastructure fitted with vehicle detection systems, automatic vehicle identification and CCTV to allow for real-time traffic data to be both sent and delivered through various service devices or facilities including Variable Message Sign (VMS), the World Wide Web or mobile devices. The data are transformed into various ITS services including Real-time Traffic Information, BIS and ETCS. The diffusion of such information helps alleviate a range of environmental and congestion problems. In the case of South East Asia, most mega-cities have installed such ATMS technologies as traffic signals, CCTV and VMS in order to optimize their current transportation infrastructures. An interesting illustration is system recently tested in Bangkok (Thailand), which combines sensors fitted on the highways with probabilistic modelling to evaluate the impact of small changes in traffic patterns, and take remedial actions. (see box below).They have also installed APTS technologies to improve public transportation.

Mitigating Traffic Congestion: The Role of Demand-Side Strategies Articulates a framework for understanding contemporary efforts to manage demand and improve the performance and efficiency of transportation systems. The document provides extensive examples of programs already underway in a variety of application settings, including over 25 in-depth case studies from across the country

Frequent calls to expand transport supply:

In a given situation, a high concentration of activities in urban areas and the intensive use of public space, particularly by transit vehicles, can create an imbalance between the volume of traffic and the capacity of the motorways. The result is vehicle congestion, a deterioration in service for drivers and passengers and a poorer quality of life for the population in general. As congestion becomes apparent, one option to combat it is to expand the supply of transport. Supply-side measures include actions affecting roads, vehicles and their operation. Improving any component of supply yields benefits in the form of reduced congestion.

Data and Methodology:

To empirically assess the impact of ITS on traffic congestion, we consolidate a longitudinal dataset of 99 U.S. Metropolitan Statistical Areas (MSAs) (Figure 1) over a period of 21 years from 1994 to 2014 by integrating multiple data sources. The main analysis relies on the

traffic data from the Annual Urban Mobility Scorecard (AUMS) maintained by the Texas A&M Transportation Institute. The AUMS is a comprehensive dataset that integrates highway performance data from the Federal Highway Administration (FHA), and traffic speed data collected by INRIX10 on 1.3 million miles of U.S. urban streets and highways. The AUMS data have been widely used in transportation economics research. To incorporate road network information, we matched AUMS dataset with the Highway Performance Monitoring Systems (HPMS) data for each MSA. The main dependent variable is CONGESTION, measured by the log-transformed annual congestion costs per commuter (COST) and the annual hours of delay per commuter (TIME) for each MSA from the AUMS dataset. As standard measures for traffic congestion in the transportation economics, COST and TIME indicate the amount of extra time and costs, respectively, incurred due to traffic congestion.

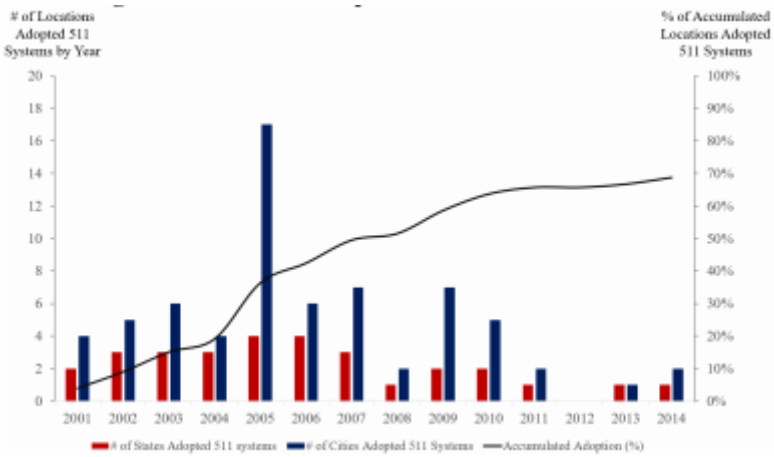
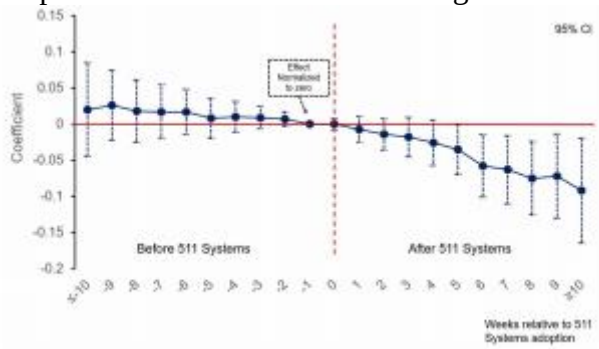


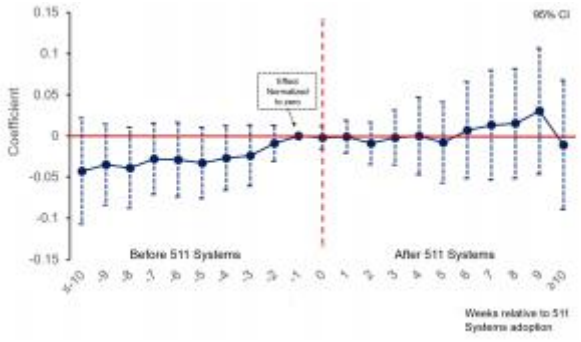
Figure 2. Number of Implemented Locations Over Time

Traffic Applications Developed in the Private Sector:

Recently, technology companies have developed commercial traffic applications (e.g., Google Maps) that became popular among drivers, thanks to the proliferation of mobile devices. Commuters use these applications to obtain real-time traffic information and plan their travels. While our study focuses on 511 Systems that have worked for both commuters and local governments for a long period of time (since 2001) prior to the prevalence of Google Maps. First, we observe that the search intensity of Google Maps is associated with a decrease in excessive travel time, similar to our findings from the 511 Systems. This reinforces our theoretical claim that real-time information provision helps to alleviate traffic congestion. Also, the effects of 511 Systems adoption are still significant conditional on the Google Maps usage across locations and times. Finally and importantly, 511 Systems and Google Maps usage complement to each other in reducing traffic congestion.



Effects of 511 Systems adoption on COST (congestion cost) over years



Effects of 511 Systems adoption on VMT (traffic volume) over years

Determinants of 511 Systems Adoption One concern is a potentially endogenous adoption of 511 Systems. While the results from leads and lags models do not suggest heterogeneity in pre-treatment congestion trend, it is possible that there is stable variation in congestion across treated and untreated MSAs. Specifically, a reverse causality concern may be possible. We first use simple t-statistics to compare the congestion status and traffic volumes.

Level of service: Level of service is one of the important factors to reduce the traffic congestion. The following areas need to be processed in terms of information management, performance monitoring to provide better service.

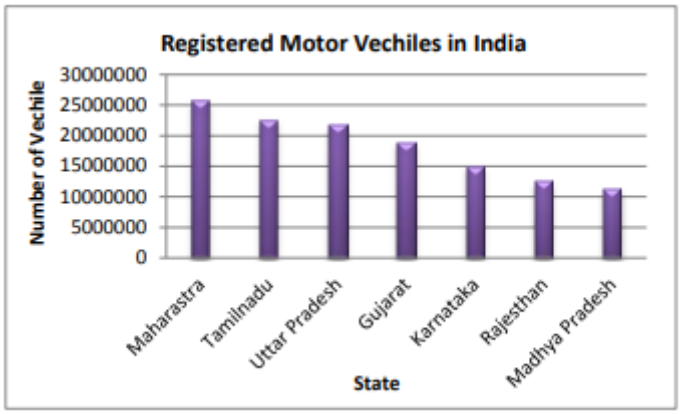


Fig. Number of registered vehicles above 1crore in India

In this study, we investigate the role of ITS in alleviating traffic congestion and quantify this effect by focusing on 511 Systems, the largest federally-supported ITS program in U.S. urban areas. While policymakers hope that ITS can be a viable solution to traffic management, our understanding of whether and how ITS can mitigate traffic congestion is limited.

CONCLUSION:

An emerging field for policymaking, ITS is in need of more systematic in-depth research. Rapid evolutions in information and communications technology are bound to create new applications in transport with potentially huge implications for sustainable development. Further analysis should also be carried out to assess how much ITS can reduce congestion and pollution, and its direct contributions to sustainable development. Future areas for research at the regional level could also include the potential role of ITS in developing safer and more efficient rail systems, in improving journey efficiency and cross-border facilitation.

As urbanization proceeds, cities are swelling and obviously the growth of the cities cannot be curtailed. There must be effective and efficient land use pattern for the cities which have to be studied in depths by taking traffic and transportation plan to be effective with land use plan. Our study highlights the importance of IT in a broader economic and societal setting and identifies a new and promising avenue for IS research on how IT can improve the quality of life and create public value by tackling chronic urban problems, such as traffic congestion. Future research can examine how ITS enhance traffic mobility and safety, how to facilitate

the development of traffic management capabilities for local governments, and how to design effective transportation technologies. We hope our study sparks a new intellectual discourse around IT and transportation in the IS discipline.

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