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A Review on Profitability Evaluation of Intelligent Transport System Investments for Metropolitan Cities Based On Cost Benefit Ratio

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Abstract– *Commuters in urban areas suffer from traffic congestion on a daily basis. Intelligent Transportation System (ITS) provides solution to various problems with the help of new technologies. The paper aims to show overview of intelligent systems and their functions that could help to protect transportation infrastructure. The Objective of the paper is to Study ITS parameters investments and the fundamental different between ITS and road infrastructure investments and how they impact on the profitability evaluation. Hence the ITS cost benefit by device is taken for investments in physical infrastructure to make a comparison analysis of Nagpur city Intelligent Transportation System. The paper features the conclusions extricated from the investigations of various frameworks and furthermore gives the future extension in the field transportation to make it more easy to use and accessible.*

Key Words **- Intelligent transportation system, investment, Congestion**

I. INTRODUCTION

Intelligent Transportation Systems is the application of computer, electronics, and communication technologies and management strategies in an integrated manner to provide traveler information to improve roadway safety, reduce congestion, efficiency of the road transportation systems, to solve and manage the traffic problems and enhance the mobility of people and goods.

ITS is an established route to resolve, or at least minimize traffic problems. Current transportation related problems cannot be solved by using a particular method but by using a suitable set of different methods depending on the decision situation and by comparing the results; a wider and more realistic picture of investments can be obtained. Most studies indicate, the application of these systems reduce travel time, emission and safety savings and highlight different aspects of the profitability and efficiency of transport investments. Different nations have created methodologies and procedures, based on their geographic, social, financial and environmental background, to coordinate the different parts into an interrelated system. All in all, any of the ITS applications utilizes a Traffic Management Center (TMC) where information is gathered, analyzed and joined with other operational and control ideas to deal with the complex transportation issues. Although literature contains numerous studies that endeavor the propose solutions to this congestion problem, the problem is still prevalent today. In order to detract the unsustainable impacts of the congested roadway problem. Intelligent Transportation Systems (ITS) has been utilized to improve sustainable transportation systems by comparing the ITS investments with road building investments and by comparing there cost-benefit ratios for implementation . The purpose of this paper is to analyze the sustainable impacts and performance of the utilization of ITS in the metropolitans cities.

ITS applications deployed to attain strategies goals include two components: intelligent infrastructure and intelligent vehicles. Intelligent vehicle systems consist of collision avoidance, collision notification and driver assistance. Intelligent infrastructure is primarily concerned with roadside traffic operations and management applications, such as freeway management systems, arterial management systems, crash prevention and safety systems, RWIS, traffic incident management, transit management, emergency management, traveler information systems, commercial vehicle operations, intermodal freight management, etc.

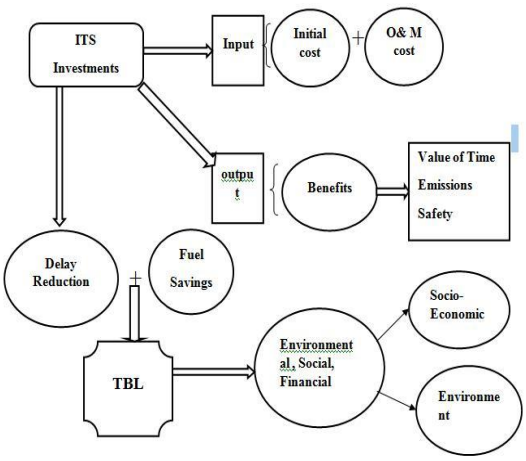

Figure 1: The summary of methodologies in use to determine sustainability and efficiency impacts of ITS

II -LITERATURE REVIEW

Pekka Leviakangas and Jukka Lahesmaa (2002) studied ITS and infrastructure investments are compared with each other and how they impact on the profitability evaluation. Economic evaluation methods for ITS investments need improving , so comparative study is carried out by using suitable set of different methods. In this paper time savings are the most important factors dictating profitability.

Andrius Čiapas and Deividas Rinkevičius (2014) study aimed to analyze whether implementing a public transport priority system is economically beneficial, by estimating the benefit to cost ratio of investing in intelligent transit technologies. Author conducted various studies; such as interviewed public transport management company, surveyed the citizens and estimated the benefits and weighted them against cost of investments. And empirical design used to obtain cost and benefit ratio which determines whether the investment is beneficial to the city.

S. B. Pattnaik, S. Rajeev, and Anil Mukundan (1991) discussed the knowledge and the strategy used to arrive at phasing patters , for intersection to be signalized. The main objective discussed in this paper is to install signals, updated with changing traffic patterns. The methodology based on expert knowledge of experienced engineer for traffic signal design.

Evangelos Mitsakis (2015) examined the important to convert costs and benefits into equivalent values when conducting a Cost-Benefit . Analysis and Compared to other transportation projects. ITS contain innovation solution for travel demand and traffic management. In this paper framework based on a CBA is given, evaluation of costs and benefits of ITS projects implemented in the city of Thessaloniki. And the benefits of the system is transferred and scaled up according to the environment condition.

O.M.J. Carsten, F.N. Tate (2005) proposed vehicle speed control project which gives prediction of the accident savings with intelligent speed adaptation and predicted the value of costs and benefits implementation. The outcomes are saving accident i.e. the most powerful collision avoidance system. In this paper safety benefits realised will be persuasive in future and accident savings and the cost-effectiveness of ISA enhanced by joining a dynamic component in the framework.

Lucia Janušová, Silvia Čičmancová (2016) The paper expects to demonstrate a review of a few cases of intelligent systems and their capacities that could secure transportation infrastructure. The primary reason for existing is to characterize intelligent transportation systems which could be utilized to ensure components of basic street and rail transportation infrastructure. The implementation of ITS is very important, since their positive effects on traffic safety and efficiency and reducing costs of transportation infrastructure. As it has been studied that implementation of ITS on road transport has more possibilities than rail transport

HE Jianwei, ZENG Zhenxiang, LI Zhiheng (2010) this paper aims to assess that the investment for intelligent transport system can be enlarged more than 20 times which shows significant effect. Thus building up (ITS) is a compelling method to determine the clashes between forcefully increasing vehicle amount and limited city land resources. Paper concludes Leverage effect analysis on the ITS and a survey of evaluation data sources to Assess ITS advantages of other cities through corresponding cities data.

Daniel Brand, Thomas E. Parody, John E. Orban and Vincent J. Brown (2002) describes the comprehensive benefit/cost analysis using model deployments of Commercial Vehicle Information Systems and Networks to improve their safe and efficient operation. This paper clears the significant benefits greatly exceed the costs, so their implementation can be beneficial by determining BCR criterion whether such systems are economically justified for their use. In this paper electronic credentialing scenarios had very high benefit/cost ratios.

III- METHODOLOGY

ITS Cost-Benefit Evaluation Methods :

Various methods have been utilized in the past to evaluate ITS deployments, both pre- and post implementation.

Examples of these approaches include

- Traditional cost-benefit analysis (CBA),
- Multi-criteria analysis (MCA),
- Sketch-planning,
- Before-and-after studies,
- Simulation studies,
- "Willingness-to-pay" analyses and
- Cased-based reasoning techniques.

The discussion that follows will summary past research which employed these methods.

1. Traditional Cost-Benefit Analysis

The traditional cost benefit analysis is the most employed approach by researchers and transportation agencies in assessing the impact of ITS deployments on traffic operations performance. However, the method has languish and has not been refined or improved for several decades (Leviäkangas *et al.*, 2002). Regardless, some researchers continue to believe that CBA potentially represents the best method due to a lack of viable alternatives. Travel time savings are often the most important and applicable benefit gleaned by CBA. A key limitation of CBA is its immanent failure to analyze "risk-return tradeoff," which results in decision makers choosing against the alternative with acceptable Cost/Benefit (C/B) ratio if the probability for excessive cost is high (Yang *et al.*, 2007). Other limitations include the impotence to quantify the value of ITS information dissemination to the user (or system) or the tendency of the user to alter travel behavior (Juan *et al.*, 2006).

2. Multi-Criteria Analysis

The MCA is also often referred to as the analytic hierarchy process (AHP). A solution distinguishing factor of MCA compared to CBA is that priority is placed on investment efficiency rather than C/B ratio (Leviäkangas *et al.*, 2002). Some benefits of MCA include the limit for analysis of criteria not easily quantified monetarily (Juan *et al.*, 2006), decision makers can evaluate ITS alternatives based on priority, and criteria outside the range of CBA can be included. The disadvantages of AHP include the subjectivity of decision makers and it must be performed on case-by-case basis, thus stifling transferability (Leviäkangas *et al.*, 2002).

3. Questionnaire Surveys

The most normally used questionnaire configuration utilized by researchers to break down driver responsiveness to ITS is the stated preference approach. Stated preference questionnaires require the respondent to show how he/she would respond to different situations or the level of significant worth set in the subject of enthusiasm by offering a decision between restricted, fundamentally unrelated options. Stated preference surveys have been utilized by researchers to examine the effect of ATIS on trip changes in various non-recurrent traffic conditions (Muizelaar et al., 2007), on acceptance of transit (Abdel-Aty *et al.*, 2001) and in emergency situations (Robinson *et al.*, 2011). The primary restriction of stated preference surveys is the overstatement of travel behaviors (Richards *et al.*, 2007; Peng *et al.*, 2004).

4. Other Method

Before-and-after investigations represent to another usually utilized approach that endeavors to exhaustively summarize ITS advantages in a practical sense (He et al., 2010). Such examinations can assess the accompanying changes because of ITS arrangement: traffic capacity, human resources, reduction of traffic accidents and duration and frequency of congestion (He et al., 2010; Chen et al., 2010). Before-and-after examinations require field estimation information from devices, for example, vehicle detectors, before and after ITS gadget arrangement. Another frequently employed evaluation method is the simulation study. These investigations are more appropriate for urban roadways where movement traffic signals and congestion are more continuous (RITA, 2011). ITS assessment utilizing simulation has been utilized to assess ICM organization, crash avoidance and security, work zone administration, framework effect of TMC, and the impact of traveler information.

"Willingness-to-Pay" studies have been organized to assess the "Countdown" realtime information system on London transit. Juan *et al.* (2006) performed a real-time survey on transit vehicles to measure user willingness to pay an supplementary amount while riding the bus.

Case-based reasoning (CBR) is a manmade intelligence procedure founded on the premise that people normally take care of another issue by adjusting and overhauling an answer for a past issue. The approach builds up a "case-base" of previous ITS deployments under various traffic conditions with which to compare against.. Sadek et al utilized CBR in conjunction with a DTA model to assess the advantages of redirecting traffic using VMS (Sadek et al., 2003)

5. Findings from Literature Review

Various methods were discussed to perform benefit-cost evaluations. These include, but are not limited to, traditional B-C analysis, multi-criteria analysis, sketch-planning, questionnaire surveys, and others.

The traditional CBA approach is most generally used, but suffers from restriction, for example, inability to analyze risk-return tradeoff, the estimation of ITS information dissemination and tendency of the client to change travel practices.

The multi-criteria investigation represents risk-return tradeoff by placing priority on productivity efficiency rather than raw B/C proportion, while questionnaire surveys can return missing data on client benefits got from data scattering and changes to travel behavior because of ITS.

With consideration to freeway traffic management, ITS benefits include positive impacts on safety, mobility and customer satisfaction. Regarding arterial traffic management, ITS has a positive effect on efficiency, mobility, customer satisfaction and productivity. Advanced public transit benefits include safety, mobility, productivity, customer satisfaction, efficiency and energy/environment. Smart work zones reveal positive impacts on efficiency, productivity, customer satisfaction, safety and mobility. Road weather information systems have consent beneficial in customer satisfaction, safety, productivity, and energy/environment. While regional parking management improves mobility and customer satisfaction.

In September 2011, the US DOT Research and Innovative Technology Administration (RITA) publised a report titled, "Intelligent Transportation Systems Benefits, Costs, Deployment, and Lessons Learned Desk Reference: 2011 Update". The report summarizes a collection of databases known as the "ITS Knowledge Resources", which track developments regarding evaluation of deployed ITS nationwide. The discussion that follows is a comprehensive synopsis of the report contents concerning freeway traffic management, arterial traffic management, advanced public transit, smart work zones, road weather information systems and regional parking management.

IV- CONCLUSION

ITS technologies implementing in Nagpur city will provide many benefits. Also we are going to compare with infrastructure giving a profit benefit. ITS Benefits which are going to achieve by implementation; Strategic goals in ITS are to improve safety, mobility, efficiency, productivity, energy and environmental impacts, and customer satisfaction Many benefits exist for further deployment and continued development of ITS technologies; the most of ITS technologies that already exist and where possible integrate advancements into vehicles and, infrastructure.

The ultimate benefits of a transformed transportation system—one that is fully connected; information-rich; and able to address safety, mobility, and environmental impacts—are wide-ranging and powerful. They will be felt by every one of us, delivering greater livability to our communities and to our daily lives.

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