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RESEARCH PAPER

Benefit Evaluation Framework of Intelligent Transportation Systems

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Abstract: This study proposes a practical framework to assess the evaluable societal profitability of Intelligent Transportation Systems (ITS) projects, which are widely implemented in many cities of China. This work aims to estimate the whole economic benefit into an outcome figure which received great care from government authorities and transportation engineers. The initiative of proved framework is to maintain both the practicability in terms of data accessibility in societal reality and scalability in terms of its convincingness and academic value. A case study of assessing intelligent transportation management and control system in Beijing is conducted to further illustrate the proposed methodology. The investment for ITS can be enlarged more than 20 times, which shows significant "leverage effect" of ITS investment, and establishing intelligent transportation systems is an effective way to resolve the conflicts between sharply increasing motor vehicle amount and limited city land resources.

Key Words: intelligent transportation; evaluation framework; economic benefit; ITS project

1 Introduction

The application of information technology in transportation is concentrated in the generation and development of intelligent transportation system (ITS). With the development of urban intelligent transportation management and control system, people have to examine the transportation system with a broader perspective. Transportation system has not only been confined to the purpose of transferring people or object, but also for the realization of transferring service and information. The application of ITS can generate potential evaluable social economic benefits through improving road capacity, saving manpower, reducing the number of traffic accidents, and environmental pollution. However, just as the emerging technologies, most of the ITS are different from traditional infrastructure projects. With no sufficient experiences, their economic, social and environmental impacts are unpredictable and their risks and costs are difficult to determine. No authority method is formed yet to evaluate ITS projects as the traditional transportation evaluation methods. To sum up, it has become an urgent task to research and analyze the influence generated by the implementation of the urban ITS projects. Since 2000, the motor vehicle inventory has grown rapidly, with an average annual growth rate of 10.91%, but the average annual growth rate of the length of urban road in Beijing is only 3.64%. After the implementation of the ITS project in 2005, the conflict between a rapid growth of motor vehicle inventory and a slow growth of urban road has been alleviated to a certain extent. The system has played an important role in improving road capacity, saving human resources and reducing the number of traffic accidents. The evaluable social economic benefits from the implementation of the ITS project has got much attention and the leverage generated by the investment of the system needs further studies.

Through related literature retrieval, the closest research is the urban traffic control center benefit evaluation method put forward by Professor Wang Wei, from the Southeastern University[1]. By taking Suzhou traffic command center as an example, he made a quantitative analysis on the benefits generated by the implementation of the system. Prof. Wang is also very successful in the research for the sustainable development of urban traffic system[2] and motor vehicle emission factor[3]. Some domestic scholars have other ideas in

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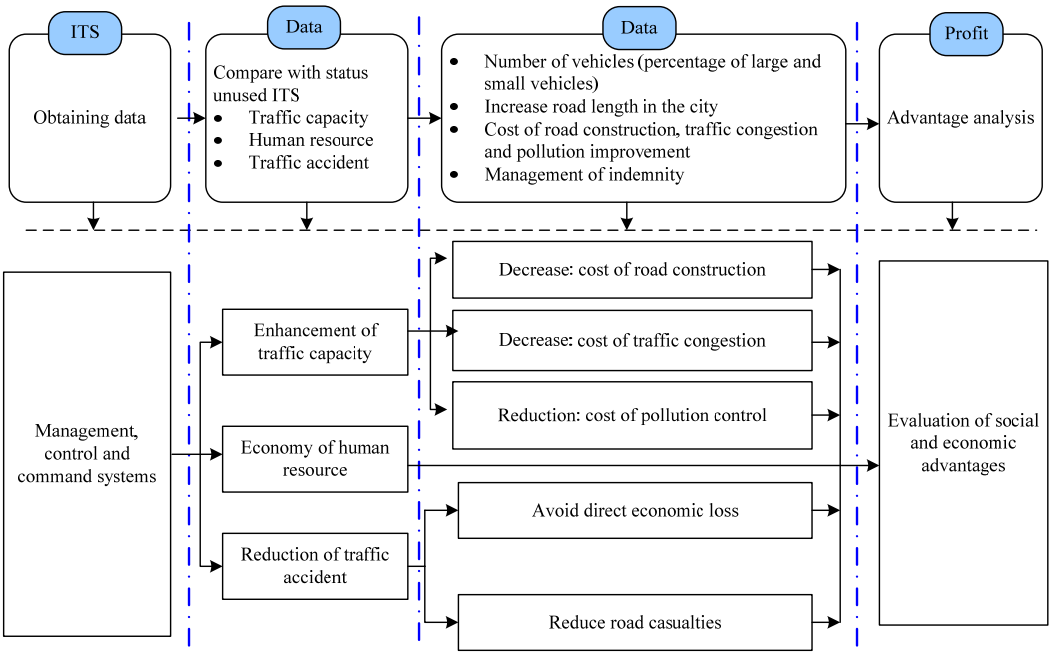

Fig. 1 Evaluation framework of ITS

the analysis on the ITS efficiency which are as follows: considering the three aspects as the delay cost, fuel cost, as well as emission module and through the changes before and after the completion of the system[4,5]. Foreign researchers have studied the multiple influences generated by the implementation of ITS projects from the perspective of simulation[6]. At the same time, some scholars have analyzed the efficiency of investments on traditional transportation infrastructures and the ITS project through actual examples[7]. Other scholars established cost-benefit analysis forms to encapsulate established relevant evaluation models[8].

2 Evaluation framework of ITS project

The aforementioned studies have given out some different perspectives and solutions in ITS projects assessment and can be used in different circumstances but with limitations. However, the problem is that neither of them is organized in a whole-to-part and top-down structure; instead, they mostly go in a bottom-up and part-to-whole way. Thus, when it comes to other real cases that have different structures in systems' application or different bottom-level features to evaluate, or simply cannot provide specific detailed data, they fail to work. In a word, these studies specialize in unique cases yet all bear a lack of universality and practicality in reality applications. This is why the authors do not apply any of these to evaluate Beijing intelligent transportation management and command system; while instead, we try to establish a universal framework in the first place.

Combing with experience in ITS design and construction, we have provided an evaluation framework of ITS for assessing social and economic advantages, and this evaluation method has been used by Beijing Traffic Management Bureau for evaluating advantages of intelligent transportation management and command system. The evaluation framework of ITS is shown in Fig. 1.

First, the most important indexes are chosen to compare the traffic system's performances before and after the ITS project is implemented. Different with the above-mentioned evaluation methods, these indexes can be obtained from official sources easily and they can also represent advantages of implementing ITS. In our research, the enhancement of traffic capacity, the economy of human resources and the reduction of traffic accidents are indexes of ITS.

Second, the ITS benefit evaluation is not a simple addition of the above-mentioned three kinds of indexes, since the unit of these indexes are all different. For solving this problem, these indexes should be converted into economic advantages with the same unit. The enhancement of traffic capacity stands for the saving cost of road construction, traffic congestion and pollution control; the application of ITS can lead to the reduction of law enforcement officials, which can save the cost of human resources; traffic accidents will also decrease because the intelligent transportation management and command system is applied, and the reduction of traffic accidents can avoid direct economic loss and reduce road casualties.

Finally, ITS social and economic advantages can be calculated through accumulating each index's economic advantages.