Public Value of Intelligent Transportation System (ITS) in China

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Abstract. With urbanization prevailing in almost every country in the world, China inevitably becomes the spearhead together with the construction of smart cities fueled by intelligent transportation system (ITS). With the rapid development of smart city, the research on intelligent transportation system has become a research hotspot. ITS applied in public mass transport and private transport provide the public manager a platform to maintain and operate the transportation in China through information exchange between vehicles, traffic participants, and road. On the other hand, the information network established by ITS also offer efficient, safe, convenient, and economic route choices to individuals. The construction and operation of ITS programs in China present in various modes, which makes the profit of ITS shared by the public difficult to analyze. The study introduces theories of public values to estimate the way in which ITS in China contribute to the society. The researcher discusses the public value appraisal of intelligent transportation system according to four aspects: motivation, purpose, evaluation standard, and public value sharing.

Keywords: Public value, intelligent transportation system (ITS), appraisal, co-operator.

1. Introduction

Many countries modulate their strategies to respond to the rapid technological growth in the field of transport to catch up with the competition of digitization. The main development characteristics of intelligent transportation systems are new, smooth, safe, and sustainable, which are also the development direction of the future transportation field. Therefore, innovations and research in the field of ITS thrive in many nations and contribute to not only economy growth but also to environment conservation [1].

Not until 1999 did the intelligent transportation system develop in China. Although during the past 50 years from 1949 when the People's Republic of China set up to 1999, the population in China experienced explosive growth, the urbanization process was relatively slow, developing at a rapid speed only after the Reform and Open Policy in 1978. The lag postponed the time the supposed traffic crowd exists. Therefore, when the government realized there was a traffic problem caused by the large population, ITS came out to be the most likely answer to the problem after it had been developed for about 20 years and been proven feasible in Japan and other European countries [2]. In 1999, the government of China founded the National Engineering Technology Research Center of Intelligent Transportation System (ITS) can be seen in figure 1, which is the beginning of research of ITS in China [2]. After more than 20 years, the development of ITS in China has achieved integrated systems with intelligent and greening progress, reflecting in three aspects: active vehicle safety and intelligent vehicles, vehicle road network synergy, integrated traffic management and emergency systems [3].

Figure 1. National Engineering Technology Research Center of Intelligent Transportation System (ITSC) [4]

In 2015, Ramona Blanes, Robert A. Paton, and Iain Docherty investigated ways to find out government efforts to ITS construction and apprised public value of ITS in both the Netherlands and British [1]. In the article Research and Development of Intelligent Transportation Systems, the author Xinping Yan discusses the development and research of ITS in China [2]. The status quo of related technology growth is also shown in the passage. Intelligent Transportation Systems for Smart Cities: A Progress Review states the achievements made in China in the field of ITS, relating the ITS too smart cities and connecting society with individuals [3].

The article aims to evaluate ITS in China by its public value. To appraise the public value of ITS in China, four factors are included: construction motivation; standards for return evaluation; phased and ultimate goals; and producer and beneficiary of the public value. To address those four problems, the study is based on a literature review and case indication. By studying how ITS benefits the public, the future direction of ITS development could be delineated by a better scope of how to construct an ITS program.

2. Conception Introduction to Public Value and Intelligent Transportation System

2.1. Public Value (PV)

Public value is the willingness of public sectors to maximize the benefit for their stakeholders (individuals, groups, and society as a whole), appearing as the public service and the public product [1]. The role of the public manager should consider both the individuals and the common good so that the public value could optimize the benefit to communities of all levels [5].

2.2. Intelligent Transportation System (ITS)

Intelligent transportation system (ITS) is an approach to facilitate success in surface transportation convenience, safety, and efficiency. The concept of ITS emerged in 1991 to demonstrate the combination of electronic technologies and transportation systems [6]. It is based on satellite location and stable wireless Internet fundamentally. The development of ITS is indispensable for the achievement of technologies of perception and convergence of traffic information, application support for traffic information, and urban traffic management and control systems.

3. Public Value Evaluation of Intelligent transportation system in China

3.1. Reasons for ITS Adoption

Contrary to the rapid growth of population and corresponding traffic demand in China, the developing transport infrastructure suffers too much to offer a good transport experience to traffic participants. Therefore, various policies came out to find a way to solve the traffic crowd such as encouraging the development of public transport, limiting vehicle application by tail number, and employing green flow on traffic lights. With those regulations adopted by well-developed cities in China like Beijing and Shanghai, the intelligent transport system was found suitable for developing a complete traffic system with efficiency [7]. Moreover, transport management could be improved with the help of ITS, assisting the control over the daily flow and traffic emergencies. For individuals, it has been long claimed that it enhances people's capability of choosing their ideal routes through real-time information exchange provided by ITS, which facilitates the fluency of the traffic flow and thus reduces fuel use.

Developing public transport systems is an attempt to make use of ITS. The automobile industry in China expanded at a startling speed starting in 2001 so that many experts predicted that at least 10 million vehicles would be produced per year in 2020, which has been proven now and even far less than the actual production which is 25 million [8,9]. It was just one indicator of the urbanization in China. Therefore, it is demanding but required to establish a public service system in the field of transportation to employ great control on the traffic flow to respond to the rapid process of urbanization. The first effort to forge an efficient management system is the digital bus stations in cities like Beijing and Shanghai, which apply information technologies including computer control technology, wireless network communication technology, and LED display control [7]. With the assistance of digital infrastructure, traffic information such as bus estimate time of arrival and real-time location could be presented to the passengers waiting for buses as shown in Figure 2. What is of greater significance is that traffic information is collected to build an overall service platform by processing signal transfers and analyzed by ITS. With the intelligent transportation system, the bus operation performs more efficiently not only for bus management but also for passengers.

Figure 2. Digital Bus Station (Photo credit: Original)

During the exploration and development of ITS in China, how suitable ITS is for Chinese transport could be proved by the fact that, although the increase of vehicle numbers on the road never stops, the traffic efficiency is improved, which encourages the further development of ITS.

3.2. Standard for ITS Return Evaluation

First Cost-Benefit Analysis (CBA) and Cost-Effective Analysis are introduced to evaluate the function of ITS established in China. In 2006, scholars claimed that the evaluation standard applied in other developed countries was not suitable for the phenomenon in China because of the lack of a database for evaluating the returns of ITS and the difficulty of analyzing how ITS influences traffic systems [10]. Therefore, multi-objective analysis and other methods are applied as ITS is a comprehensive systematic program. In both cases of Nanchang and Shenzhen ITS, the Analytic Hierarchy Process (AHP) is adopted because it can appraise the ITS program systematically and comprehensively in aspects of society, technology, environment etc. [11,12].

To appraise the ITS program in AHP, four processes are included.

a. Indicator Selection

To evaluate the ITS program, indicators should reflect how well is the system operated and maintained, how much convenience it offers to an officer of the system and participants applying it, what factors may influence the mode of operation and maintenance, and whether the system could be sustainable with corresponding capability for development in the fields like economy and environment [11]. Restricted by the difficulty of data collection, the accessibility of statistics to evaluate the indicators is also a standard to tease the indicators. In the case of Nanchang, indicators are categorized into four dimensions: society and economy, traffic safety, resource efficiency, and management efficiency [10] while in Shenzhen with a larger city database, development potential, hardware condition, and software conditions are the main indicators.

b. Allocation of Indicator Proportion

In the process of determining how essential is an indicator to the ITS program, the expert group is always organized. They transfer qualitative issues to quantitative issues by analyzing relative statistics.

c. Mark for Indicators

The expert group should also be responsible for the task of giving a grade to every indicator produced in the first step.

d. Result Analysis

By summarizing grades with their proportion, the outcome would show whether the devotion to the ITS program is deserved.

3.3. Phased and Ultimate Goals

In the Tenth Five-Year National Science and Technology Key Project which is the beginning of ITS development, ITS is described as a superior method to improve traffic conditions. Three phases are proposed [12].

a. The rudimentary phase is the period of forging ITS technology systems and ITS integrated transportation systems, which focus on the transportation systems between cities. Applications including traffic signal systems, public transport management, and service, regional electronic toll collection systems, integrated transportation information systems, and public travel information service systems should be developed by research on collecting and processing technology for traffic information, GPS floating car location technology, smart traffic safety technology, and intelligent vehicle-road interaction system.

b. In the second phase, the goal is to construct national ITS in all kinds of transportation modes. To reach the goal, ITS must be built with a consistent standard in each region to integrate them into the national ITS network. A shared information exchange platform is necessary to ensure a seamless connection between traffic flow and information flow.

c. In the final phase, it is envisaged that ITS has become the indispensable lifestyle for the whole society while individuals, vehicles, and roads form a stable intelligent entirety. Therefore, a comprehensive intelligent transportation system establishes a clear, convenient, safe, economical, and sustainable transportation life. Whenever the factors influencing traffic system changes such as a surgery in traffic flow, the national ITS could automatically accommodate the situation.

According to China's development pace, the goal of ITS is to serve as an essential technological means and entry point to integrate the digital information of transportation, to improve the service quality of China's transportation industry, to enhance traffic safety, and to increase operational efficiency and management level. ITS is supposed to become the support for the construction of China's comprehensive transportation system and the integration of urban and rural transportation. Simultaneously, ITS would also contribute to high-tech research and industry in China, playing a significant role in the development and application of high technology.

3.4. Public Value Stakeholder of ITS programs

To analyze how the public value of ITS programs is shared and co-produced, the operation and maintenance mode of ITS programs should be investigated. Unlike in Dutch where private capital has autonomy, in the context of China the construction of public infrastructure is led by the government, the formation and maintenance of ITS programs have two dominate modes: government-led liability-driven investment & financing and government-led market investment & financing [11].

Government-led liability-driven investment and financing is based on government credit to invoke funds from government finance and government debt financing including national debt, policy loan, and domestic and foreign bonds.

Government-led market investment and financing aims to benefit enterprise involving the ITS programs, which is based on enterprise credit. It utilizes commercial financing for funding. Despite for ABS mode which is one type of government-led market investment and financing, Public-Private Partnerships (PPP) have been the most common way in recent years [11]. ITS in Beijing and Guangzhou applies BOT mode, a mode born out of PPP while TOT is applied in Shanghai and Hong Kong.

BOT mode means that private enterprise should take responsibility for not only construction and operation while the ownership of the program belongs to the government which support the program after a concession period. During the concession period, the private enterprise could benefit from the ITS programs by operating and managing the system. Therefore, the concession period makes sure that the enterprise has relative freedom in profit, so it encourages participation in ITS construction enterprise which feared the risk of investment to relatively large projects, ITS programs.

TOT mode is adopted by transferring the power of management to private enterprises for a certain period while the ownership of the program constantly belongs to the government. It alleviates the pressure of initial investment of the enterprises to encourage their engagement.

4. Conclusion

The study discusses the public management in China on ITS through various motivations, purposes, regulations, and ways to share outcomes. China has made great progress on public value during the construction of ITS.

Findings show that it is the most suitable way to develop transportation in China to fuel economic growth and public welfare no doubt. The efficiency and convenience it bring to society cannot be replaced. Together with the development of transportation infrastructure, simultaneously building of intelligent system looks born to fit the whole system. The analytic Hierarchy Process (AHP) is implemented in the appraisal of ITS programs because it can provide a comprehensive evaluation of all aspects of ITS and can accommodate different regional conditions by different selected indicators and allocation of proportion marks. ITS has its goal to be the tool to set up a systematic and integrated platform for national traffic information exchange, public service management, and individual routes optimization. Government-led investment and financing strategy is dominant in China including government-led liability-driven investment & financing and government-led market investment & financing. BOT and TOT modes have been applied in many cities in China.

Based on those findings, it could be claimed that public value was realized during the construction of ITS because of its efficiency, convenience, and safety to not only society but individuals as well.

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