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Planning and Implementation of Intelligent Transport System in DKI Jakarta Province

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Abstract - **Intelligent Transportation System (ITS) is a transportation management solution using intelligence technology for integration between road networks, modes of transportation systems, and users. The implementation of ITS was started in 2010 in DKI Jakarta to overcome congestion problems. This system manages and uses data sources that are shared between various information management systems that integrate several tools, namely CCTV, Auto Traffic Control System (ATCS), and Camera Counting. Though the Government of DKI Jakarta has performed well in terms of planning and implementation, unfortunately, several problems are still hindering the success of ITS development, following planning and regulation basis, stakeholder cohesiveness, public awareness, and infrastructure development. A cohesive action should be taken in order to encourage participation from the whole stakeholders. A public campaign that encourages people to shift from private vehicles to public transport should be given priority to reduce the service burden on the highway and traffic congestion, at the same time increasing the return on public transportation investment.**

Keywords – **Intelligent Transport System, DKI Jakarta, public transport, advanced traffic management system, transport infrastructure.**

I. INTRODUCTION

The fast growth of population and economic development in big cities in Indonesia enforce an increase in mobility which potentially causes traffic congestion problems. The growth of vehicles that is not matched by the growth of road infrastructure has the potential to cause an increase in the level of congestion. Traffic congestion is a chronic problem in Indonesian metropolitan cities such as DKI Jakarta and its surrounding area, namely Jabodetabek, resulting in significant economic losses caused by increased travel time, increased travel costs, and decreased environmental quality [1].

Rapid changes in the dynamics of people's lives in urban areas in DKI Jakarta encourage city managers to design a quick response and adaptive policy development. Transportation is one indicator of these dynamic changes [2]. The problem that arises is traffic jams that occur all the time and spread throughout the city. Public transportation is already available in various choices of transportation modes and is also growing more and more, but still cannot reduce the level of congestion significantly [3].

An Intelligent Transportation System (ITS) is a transportation management solution that uses technology to integrate systems, applications, networks, and hardware based on intelligence technology for integration between modes of transportation systems. A study from ITS Indonesia estimates that the economic loss due to congestion in Jakarta will reach US$ 6.5 billion or equivalent to Rp. 84.5 trillion by 2020, which increased 6.5 times compared to 2010. Currently, the average speed of vehicles in Jakarta during peak hours is only 10 km per hour. That rate has been decreasing every year for the past 10 years. Various efforts to deal with transportation problems have indeed been carried out by the government and business actors. However, the plans are still implemented in a silo way and sporadic so they cannot comprehensively overcome the challenges [4].

The application of ITS systems and models from developed countries is not easily adopted in developing countries [5]. For example, in Thailand, the success of ITS projects generally depends on collaboration between private, public, and government agencies in policy making and planning, coupled with inclusive agreements and knowledge of technology in the field [6]. From experience in Nigeria, the implementation of ITS requires the development of an evidence-based policy based on the specific context in the country, which is able to intuitively adapt to future traffic demands and inclusively improve transport efficiency and safety [7]

The Ministry of Transportation, Directorate General of Land Transportation, and Directorate of Urban Transport are encouraged to make Grand Design ITS in Indonesia. The preparation of the Grand Design is in line with the implementation of the Minister of Transportation Regulation No. 122 in 2018 concerning the Organization and Work Procedure of the Ministry of Transportation, which is expected to be a guideline for the application of integrated communication technology.

This study aims to obtain an overview of the application of ITS to infrastructure, facilities and transportation facilities in DKI Jakarta. The research question to be answered is to what extent the implementation of ITS in DKI Jakarta is based on the 11 main ITS system categories.

II. METHODOLOGY

This research discusses 11 main systems contained in the ITS Framework in Indonesia that have the potential to be implemented over the next ten years (2020-2030), see Table 1.

Table 1 - DESKRIPSI 11 SISTEM UTAMA PENGEMBANGAN ITS DI INDONESIA

Main Systems	Description
Advanced traffic management system	To improve traffic flow by providing real-time information integrated with traffic control center
Advanced road user information system	To provide real-time information on traffic conditions that affect the selection of optimal routes, modes and travel times
Advanced traffic safety and vehicle control system	To improve vehicle stability, driving safety and make travel safer & more efficient
Commercial vehicle operating system	To manage and provide maximum service, reduce route disruptions, travel delays, improve safety, and cost efficiency
Advanced public transport system	To improve the accessibility of information, the safety of public transport users, the efficiency of public transport and road infrastructure.
Electronic payment system	To provide convenience in payment services for consumers
Emergency management system	To facilitate coordination between traffic authorities in emergency situations
Advanced rural transport system	To improve the safety and efficiency of the mobility of people and goods in rural areas
Advanced travel demand management system	To limit travel requests using private vehicles by prioritizing the use of public transportation
Advanced parking management system	To ensure the safety and convenience of parking management
Autonomous Driving System	To improve the application of autonomous vehicle technology

From the 11 systems discussed, this study will exclude autonomous driving systems because currently there has been no clear framework for the implementation yet.

The research was conducted by literature review, e.g. working papers from ITS Indonesia and relevant research papers; and interviews with relevant stakeholders who have roles as regulators, operators, and consumers, e.g. Dinas Perhubungan (Dishub) DKI Jakarta, Jaklingko, and Jakarta Smart City.

III. RESULTS AND DISCUSSION

Munawar and Sutanta [8] evaluated the application of IT in several cities in Indonesia, namely Jakarta, Bandung, Surabaya, Yogyakarta, Solo, and Denpasar. ITS applications in these cities that have been identified include Area Traffic Control System (ATCS), traffic infrastructure, travel information, public transportation service systems and commercial vehicles, traffic information, and electronic ticket systems. The problems encountered are related to financial support and human resources. Several things are also suggested to be taken into consideration in developing an ITS system, namely sustainability, open system, user-friendliness, vendor support, reliability, investment feasibility, and a high level of domestic components. Meanwhile, Pindarwati and Wijayanto [9] conducted a comparative study in 5 major cities in Indonesia by searching web pages and data from local governments to measure 60 indicators of smart transportation system performance. They stated that this benchmark value might change over time due to the emergence of new technologies that can create new dimensions for the developing urban transportation system.

Putra et al. [10] proposed four aspects of supervision such as traffic control, vehicle supervision, passenger supervision and driver supervision which will produce an applied ITS called Smart Transportation Systems (STS). Sriratnasari et al. [11] conducted a study on how to manage DKI Jakarta's transportation system and how to integrate it into a comprehensive smart city transportation system. A new architecture was developed to integrate smart transportation using the internet of things (IoT).

Susanty et al. [12] investigated the fundamental barriers that made the development of the ITS project in Semarang and concluded that there are three significant obstacles, namely the low interoperability of the system making it difficult to integrate an ITS-based transportation system, the lack of involvement of relevant agencies to build long-term commitment and awareness of the benefits of the ITS project, and political problems (short-term thinking or discontinuity due to political cycles). In line with these findings, Yusuf et al. [13] show the weak coordination between stakeholders and the absence of legal rules governing the implementation of ITS are still obstacles.

Although the application of ITS technology in Indonesia is not yet at the same level as in developed countries, many have shown the potential to reduce congestion, energy use, and pollution. However, there are still many obstacles and challenges that need to be overcome and anticipated in the various applications of ITS in Indonesia. In addition, the impact of ITS on the behavior of transportation users, economic benefits, and environmental impacts have not

been studied much. This study is expected to contribute to providing a broader and deeper understanding for stakeholders in the transportation sector, especially the organizers and users of the intelligent transportation system (ITS), and policymakers.

Some of the implementations have already been realized and some are still in progress. In Indonesia, the development of ITS was initiated in Jakarta since 2010 under the Traffic Control System Management Unit (Unit Pengelola Sistem Pengendalian Lalu Lintas) DKI Jakarta in collaboration with the DKI Jakarta Provincial Government, City Transportation Council, and PT. Transjakarta. This system manages and uses data sources that are shared between various information management systems that integrate several tools, namely CCTV, Auto Traffic Control System (ATCS), and Camera Counting. Through this system, the government hopes that transportation as a whole can work effectively and efficiently as a responsive system for a solution to congestion in Jakarta. Moreover, the implementation of this system should be accompanied by education to the public to increase public awareness.

According to the interview conducted with the Dishub DKI Jakarta, the planning and implementation of the intelligent transport system are managed by the Unit of Traffic Control Management which was established in 2010. We find that there are six strategies for improving and developing ITS In order to meet the improvement and development of ITS in DKI Jakarta, there are six strategies for improvement and development, namely:

a. Traffic Control Management, consisting of:
   - o Improvement and development of ITS Traffic Light through ATCS integration from monitoring so that it can become an actuated vehicle.
   - o Improved SPLL Dishub DKI command center control system by adding a dashboard interaction feature that is useful not only for providing traffic data but including monitoring, evaluation, and real-time data such as incident management systems through surveillance systems.
   - o Addition and improvement of VMS (Video management system)
   - o Added several interactive applications that support ITS Traffic light such as engine interactive command center applications, engine applications for proactive community communication services, mobile applications for mapping the DKI Transportation Agency traffic lanes along with map licenses, vehicle data verification system applications, and video management system applications (VMS).
   - o Development of Green Wave Technology for public transportation, official vehicles, and emergency vehicles.

b. Public Transportation Service Improvement, consisting of:
   - o Tap in/tap out technology development
   - o Development of information technology for arrival schedules, routes, to the availability of places in public transportation in real-time
   - o Development of public transport security technology with CCTV

c. Traffic Safety and Incident Management, consisting of:
   - o Development of accident detection technology through CCTV
   - o Development of traffic accident/incident reporting technology
   - o Development of speed-limiting technology

d. Electronic Payment (Electronic Payment)
   - o Development of Smart Card technology
   - o Development of Near Field Communication (NFC) technology
   - o Quick Response Code (QR Code) technology development

e. Travel Information System (Traveller Information System)
   - o Travel navigation application development
   - o Development of variable message sign (VMS)
   - o Development of travel navigation

f. Goods Transport Operations Management (Commercial Vehicle Operation Management)
   - o Development of walking weighbridge technology (weight in motion)

Currently, to comply with the advanced traffic management system, the Dishub DKI Jakarta has already installed 18 Traffic Counting Sensors, 167 Fix CCTV, 81 pan-tilt-zoom (PTZ) CCTV, 166 Traffic Light with ATCS, and 16 Speakers and Variable Message System (VMS). These systems are connected to the control room which can be managed automatically or manually by looking at the circumstances.

From the aspect of the integrated payment system, in collaboration with Jaklingko, the government continues

to strive to provide a convenient payment system and continues to reduce tariffs so that private vehicle users will switch to public vehicles. One of them is by providing appropriate subsidies to several groups of users of public transportation, such as students, senior citizens, disabled, and low-income groups. Currently, a payment card transition is being carried out from chip-based to server-based so that the provision of subsidies is more targeted and the need for service improvement is being carried out.

In the smart parking system, we can see that the DKI Jakarta Transportation Agency has installed parking equipment on several main roads. In addition, parking officers with mobile parking devices are also alerted in an effort to control and provide easy parking payments.

The implementation of Electronic Road Pricing (ERP) in several special areas in DKI Jakarta is also one of the cross-subsidy schemes being prepared by the Dinas Perhubungan DKI Jakarta. The allocation of ERP will help the government to fund public transportation development, increase connectivity, and protect the environment. Research by Sunitiyoso et al. asserts that the respondents who are road users in DKI Jakarta have positive responses to the ERP plan [14]. Currently, the ERP scheme is still in the stage of drafting local regulations (Peraturan Daerah) as a legal basis for collecting funds from the community.

V. CONCLUSION

ITS planning and implementation in Jakarta have been on a clear roadmap with strong support from relevant stakeholders and adequate funding. Although the COVID-19 pandemic had an impact on the acceleration of ITS development, it is now back in the initial planning with the aim of increasing the movement of private transportation users to public transportation.

The development of communication infrastructure, such as fiber optic networks, is one of the important keys to the distribution of ITS applications [11] in all areas in DKI Jakarta. Data transfer using a wireless network is still considered as an obstacle to ITS infrastructure development in the suburbs of DKI Jakarta.

From the institutional side, the collaboration between institutions, including the provincial government, central government and operators, has been going well in planning integration [13]. However, in terms of funding, more robust coordination is needed to ensure the sustainability of the transportation system after the deployment phase ends.

From the government and operator side, we can see that human resource development is a very important aspect of always being adaptive and responsive to the adoption of new technologies used [15]. Capacity-building training should be periodically held in order to guarantee compliance with the objectives [7].

Various transportation technology infrastructure developments have emphasized the importance of using national resources, including local programmers to deploy and facilitate maintenance processes and improvements for future needs. Nevertheless, systems applicability and reliability should be considered when it comes to practice. Mfenjou proposed four major modules to increase ITS reliability, following autonomous management of control points, detection and diffusion of disturbances, dynamic route planning, and autonomous decision support [16]. Also, the government and operators should prepare a module in security and privacy issues [17].

The active role of the community is needed in helping the government improve the quality of development and maximum transportation services [13]. Currently, there is a city transportation council consisting of various stakeholders, including the public transportation user community, government, operator practitioners, and academics. The City Transportation Council has been actively involved in regular discussions discussing efforts to improve development and transportation services in DKI Jakarta [7-8].

This research is still considered a preliminary study which will be followed by further interviews and focus group discussions.

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