

Intelligent transport construction solutions in the form of new infrastructure

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Abstract. With the advent of the new infrastructure era, new infrastructures such as 5G, AI, BeiDou Navigation and IOT will bring great changes to the transport industry, driving it towards intelligence and digitalization. As an important part of the development of new infrastructure, the transport industry has become a key factor in driving the country towards ecology, digitalization, intelligence, high speed, transformation of old and new dynamics and symmetrical economic structure. Smart light poles are an important part of smart city construction, combining multiple functions in one, including small base stations, video surveillance, LED information screens, environmental sensors, IP broadcasting sound poles and charging posts. This new type of information infrastructure can provide accurate data services for urban governance through edge-cloud collaboration, and provide low-latency support for multi-scene linkage. In the new situation, the study of how to plan and build intelligent traffic light poles is an important part of the transport industry's contribution to the national information development strategy, and is a new topic of great significance for the transport industry's research.

Keywords: new infrastructure, smart transport, smart light poles.

1. Background of Intelligent Transport Construction

Smart transport is an indispensable part of smart city construction, which provides a platform for data exchange and sharing for other smart industries, promotes innovation in transport management, improves the level of service, and provides important support for the transformation and upgrading of transport. Smart transport is designed to provide safe, convenient, efficient and green travel and is a necessary way to realize the modernization of transportation industry.

Intelligent transport construction is to realize the strategy of a strong transport nation and the development programme of digital transport, and to provide support for the development of smart cities. Under the policy requirements, smart transport construction has become an important project, especially in the new infrastructure development situation, the transport industry is developed as a key project. Through smart transport construction, we can solve the problems of the transport industry, refine and activate data resources, eliminate information silos, enhance public services and optimize industry management. At the same time, we can achieve infrastructure, network convergence and iterative construction, and transform data resources into real value. Most importantly, by strengthening transport infrastructure and expanding industry applications, we can promote the development of the transport industry, thereby improving the overall economic benefits to society.

2. Construction Tasks of Intelligent Transport

In this period of unprecedented and significant change, preparations for the 14th Five-Year Plan have begun, and the construction of intelligent transport is no longer limited to the expansion of infrastructure and new application systems. Under the new infrastructure development situation, this paper argues that the construction of intelligent transport focuses on the integration of infrastructure, data and business. The core of this theme lies in the word "integration". Through the construction of new infrastructures, data fusion and sharing are taken as the core, and data computing platforms and

traffic cloud control platforms as well as scenario-based applications are used to promote the development of intelligent transport.

Against the backdrop of new infrastructure development, based on information technology such as 5G, BeiDou Navigation and Artificial Intelligence, we will build a new intelligent infrastructure, which will accelerate the development of transport digitization. "Data, network and intelligence" will be truly applied in all areas of the transport industry, and give full play to its enabling and leading role. Under the new infrastructure development situation, the focus of intelligent transport construction will shift to the following four aspects.

2.1. Establishment of an industry-level transport "data system"

Under the development opportunity of "new infrastructure", "business digitization" will take rapid action to digitize traffic elements such as people, vehicles, roads and clouds, to better manage and control traffic flow. To cope with the huge amount of data in the transport industry, we have established a data management system from collection to value realization, and built a complete set of closed-loop data operation and management on this basis. Through the "Data Central Platform", we can build a powerful data set that can aggregate, integrate, refine and process data, and make data visible and valuable. In this way, we can use the data continuously, realize the mutual service of front and background data, and form an ecological and interoperable environment. Through data technology, we can connect business blocks within the transport system, promote data sharing and integration, improve data productivity, and build new data-based business relationships based on actual needs.

2.2. Establishment of a "digital management system" for transport

The transport industry is a huge industry with a large amount of public infrastructure that is closely related to people's livelihood. To enhance public perception and promote economic development, the core objective of intelligent transport is to strengthen traffic governance. During the construction of the intelligent transport system, many vertical information systems and infrastructures have been established due to business development and traffic management needs, leading to the formation of data silos. As these data resources are distributed in different spaces, they cannot be effectively shared and connected, and therefore cannot fulfil the cloud-side synergy effect. To break down the barriers and make business connectivity possible, we have established a "business centre", which integrates common services in transport projects as well as engineering technologies, applications and supporting tools related to transport business management into the business centre, with the goal of delivering services to form "digital functional units" and achieve networked collaboration. The aim is to provide services and form "digital functional units" to achieve networked collaboration.

2.3. Sorting out new transport-wide applications

With the development of 5G and AI technologies, we can use multifunctional pole technology to integrate new intelligent sensing devices together and develop a multi-pole application deployment solution. In this way, we can achieve more efficient and flexible sensing capabilities in various scenarios. In the transport and high-speed industry, we have developed a high-speed gantry-based full-scene application using the results of the cancellation of provincial boundary toll stations, realized vehicle-road cooperative perception and unmanned driving, promoted the integrated application of cloud-side coordination, and carried out video-on-cloud business.

2.4. Developing a new "infrastructure mindset" for transport

In the context of the development of "new infrastructure", due to the digital characteristics of new infrastructure, there is an urgent need to establish a new "infrastructure thinking" mode for the construction of intelligent transport in the new era. In the process of intelligent transport and urban construction, over-reliance on planning and ignoring the practicality and performance, as well as focusing too much on performance and ignoring the operation and maintenance, this way of thinking

cannot be an effective means to improve efficiency, but also difficult to truly play the driving role of information technology. With the continuous advancement of transport development under the new situation, the traditional way of building transport information technology has been unable to meet the demand. Therefore, we need to re-examine the "traditional infrastructure attitude + Internet platform thinking", and change the understanding of information technology and digital intelligence construction. Emphasis is placed on top-level planning, phased construction, continuous improvement, and cloud-based cross-business collaboration to adapt to the needs of mobile and distributed work, and to promote the development of integrated applications coordinated by the cloud.

3. Policy Development Environment for Smart Lighting Poles

3.1. 5G-related policies provide an important impetus for the scaled-up development of smart light poles

The Ministry of Industry and Information Technology (MIIT) issued a document in 2018 aimed at promoting the two-way sharing and opening of tower resources of public security, municipal, transport and electricity sectors with those of telecommunications. The initiative aims to promote the construction and development of telecommunications infrastructure and improve the efficiency and competitiveness of the industry. The Implementing Opinions on Promoting the Common Construction and Sharing of Telecommunications Infrastructure to Support the Accelerated Construction and Development of 5G Networks puts forward the goal of vigorously promoting the construction of 5G intelligent light poles and "one pole for multiple uses". This initiative aims to promote the sharing and co-development of telecommunications infrastructure to provide users with more convenient and efficient services.

3.2. Policies related to the "New Infrastructure" have created a favourable environment for the construction of smart light poles.

To promote economic and social development, the Outline of the Fourteenth Five-Year Plan for the National Economic and Social Development of the People's Republic of China and the Vision 2035 proposes a series of measures, including strengthening digital transformation, smart upgrading and convergence and innovation, as well as building new types of infrastructure, such as information infrastructure, convergence infrastructure and innovation infrastructure. These measures will help improve the development environment and promote sustainable economic and social development. The twelfth meeting of the Central Committee for Comprehensively Deepening Reform adopted an important policy aimed at promoting the high-quality development of infrastructure to enhance the country's economic and social competitiveness.

3.3. Smart city-related planning provides a development environment for the application of smart light poles on the ground.

In January 2020, the Ministry of Housing and Urban-Rural Development (MOHURD) issued the "Opinions on Carrying Out the Work of Pavement Cleansing and Bicycle Lanes Construction" and proposed the "Multiple Poles, Multiple Boxes, Multiple Wells" recommendations to provide critical support. In the current situation, China's first-tier and new first-tier as well as second-, third- and fourth-tier cities are promoting smart city construction planning.

3.4. Intelligent Lighting Helps to Achieve "Double Carbon" Goal

At the United Nations General Assembly, China pledged to peak its carbon emissions by 2030 and to become carbon neutral by 2060. This is a major milestone, signaling China's great progress in reducing greenhouse gas emissions globally. Achieving the dual carbon target will lead to significant transformation and change in all areas of the social economic spectrum. The lighting industry is an

industry closely linked to energy applications and plays an important role in promoting a low-carbon economy and sustainable development.

4. Smart light pole construction practices

The construction of smart light poles has become a hot topic in countries around the world, and countries such as Singapore, South Korea, the United States, Spain and the Netherlands are vigorously promoting this construction. By means of whole pole replacement or upgrading, these countries are deploying smart city pilot projects to improve the intelligence of their cities.

In 2016, Tongzhou District of Beijing Commission established a smart lighting system through the intelligent transformation of streetlights in Canal West Street, laying the foundation for the construction of smart light poles. In 2018, many cities in China, such as Shanghai, Shenzhen and Chengdu, began piloting smart light poles, which is an important milestone in the construction of smart light poles in China. The commercialization of 5G has created brings new opportunities. The construction of smart light poles has been heavily invested in 2020 across the country. In recent years, more than 20 provincial administrations in China have carried out pilot projects on smart light poles, and the number of these projects has exceeded February 2021. In March 2022, the Smart City Smart Multifunctional Pole Service Functions and Operation and Management Specification came into effect, which is of great significance in promoting the development of this industry, and at the same time, it also lays a solid foundation for the future management integration and multi-pole collaborative work. It also lays a solid foundation for future management integration and multi-pole collaborative work. By adopting a unified standard to manage the use of smart poles, we hope to improve the efficiency and quality of smart city construction.

Our country is now building a network of smart light pole pilot projects comprising four major smart cities in the Bohai Rim, the Yangtze River Delta, the Pearl River Delta and the Central and Western regions. The location and scope of construction of these pilot projects will vary under different population densities, economic conditions and distribution of the smart light pole industry. In these regions, the smart light pole pilot projects have achieved a scale effect, their construction concepts are at a world-leading level, and they have a strong driving effect.

5. The smart light pole industry chain situation

The application of smart light pole technology combines the strategic elements of new smart city, 5G, new infrastructure and "dual carbon", and is an industry that constantly follows the development of policy and market. Shenzhen Infrastructure Investment Co., Ltd. released the "5G Smart Lighting Pole Industry Chain Mapping" at the 22nd Hi-Tech Fair 2020, which is an important milestone, signaling the significant progress in the construction of smart lighting poles in Shenzhen. It is an important milestone, marking the significant progress in the construction of smart light poles in Shenzhen. It has comprehensively sorted out the industrial ecosystem of smart light poles and the various aspects of smart light poles in the construction of smart cities, which has aroused the strong concern of the upstream, midstream and downstream enterprises in the industry chain. In the era of global economy, the connection between enterprises is closer, and the enterprises in the industry chain of smart light poles will continue to strengthen technical exchanges and achieve win-win co-operation in the fields of light pole design, smart display, public broadcasting, wireless Wi-Fi, video monitoring, information security, communication transmission, system integration, and so on.

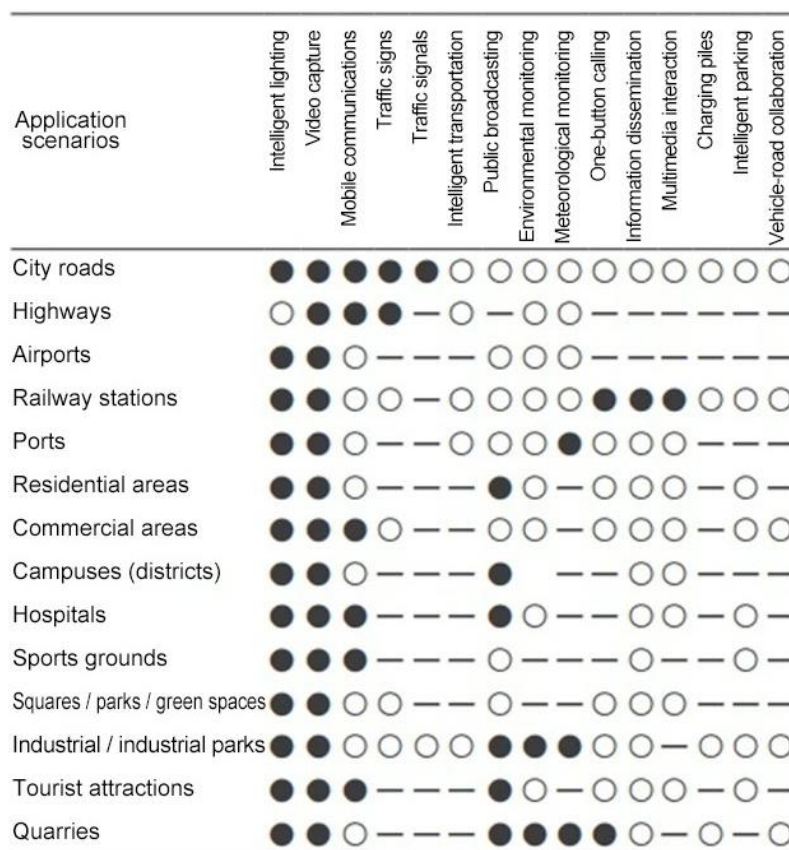


Figure 1. Recommended mounting devices for smart light poles in different application scenarios

The smart light pole ecosystem consists of several parts, including poles, sensors, chips, communication modules, networks, IOT platforms, operating systems and integrated applications. These parts together constitute the core part of the entire industrial ecosystem. The pole of the smart light pole is the "body", the sensor is the "five senses", they work together to complete the collection and processing of external information. The "brain" chip is the core part of the intelligent light pole, responsible for information processing. Communication module is the core part of the intelligent light pole, it is the basic hardware to achieve communication, composed of chip, memory and amplifier. The communication network is the infrastructure for smart light poles to connect to the internet platform. The platform layer is the core part of the smart city, which is responsible for the operation and maintenance of the whole smart light pole system and provides convenient services for users. Smart light poles, lighting systems, video surveillance, environmental monitoring and charging piles are all important parts of the integrated application. According to the analysis of Global IOT Insight, the platform layer and the integrated application layer account for 20% and 30% ~ 40% of the value in the industry chain respectively, which indicates that they have huge profit margins.

6. Smart light pole business model

Studies have shown that the choice of business model for smart light poles is closely related to factors such as the characteristics of the project, confidentiality, scale of investment, area of expertise, sharing and difficulty. Usually, government departments lead the implementation of pilot projects of public interest, confidentiality and government affairs. For projects that require large investments, involve multiple fields of expertise, and are highly shared, the mode of joint construction between the government and enterprises is usually adopted. With the development of the times, the construction and operation of smart light poles have changed from a single government-led model to a diversified model with joint participation of the government and society. This model is not only conducive to improving efficiency, but also can better meet people's needs. In China, there are many representative investment construction and operation organizations, such as Beijing Yizhuang

Intelligent City Research Institute, Meishan HuanTian Intelligent Technology and Jiangsu Future City Public Space.

The construction method of smart light poles can currently be divided into two types: city-level and regional pilot. Urban planning and design is the basis of construction, and is the responsibility of the Bureau of Industry and Information Technology and the Urban Investment Company, and the winning department is usually a planning and design institute with a national background. Pilot projects are procured in a very flexible manner, including departments such as urban management bureaus and tower companies, and there are both state-owned and private companies involved in winning bids. The operation of smart light poles involves multiple parties, including professional operating companies, equipment suppliers, top design companies and general engineering contractors. The following are the Company's main sources of revenue.

(1) Revenue from operation and maintenance of smart light poles: mainly from government investment and commissioned enterprises' operation and maintenance, including aspects such as repairs and maintenance.

(2) Energy-saving benefits from smart lighting projects: By investing in the renovation of smart light poles, the Government will provide subsidies in stages to support enterprises in saving electricity bills.

(3) Rental income from video surveillance systems: from the fees paid by the public security and traffic departments for the installation of the SkyNet and security systems.

(4) Operators generate lease revenue by installing 5G micro base stations on light poles.

(5) When smart light poles are equipped with charging posts, consumers can earn income by charging.

(6) Intelligent light poles can monitor road parking and manhole cover operation, realise intelligent traffic functions and provide management income to the transport sector or other relevant units. These revenues will help improve parking efficiency and manhole cover maintenance.

(7) LED Advertising revenues come from a variety of sources, including businesses, governments and other organizations. These revenues are paid for by the subjects placing the adverts.

(8) Data income from smart light poles comes from a variety of sources, including environmental monitoring data, data accumulated during other operations, and data that have been desensitized. These data may have privacy implications and therefore need to be handled with care. The environmental sector is the main user that pays for the former, while usage users pay for the latter by accessing desensitized data.

7. Construction programme for smart light poles in intelligent transport

First, the focus is on strengthening top-level planning and coordination arrangements to improve efficiency and effectiveness. The development of smart cities is currently a hot topic in the country, so it is important to take smart lighting systems into account as an important consideration when formulating urban planning, and to develop scientific and reasonable plans for renovation and new construction. This can better promote the development of smart cities. To better integrate various types of tower resources, accelerate the construction of "one pole for multiple uses" intelligent light poles, and better maintain road traffic, we need to set up a special department to unify the management of various facilities on the road, including street light poles, monitoring poles, signal poles, communication poles and power poles. Adopting new technology can greatly improve the level of intelligence of existing light poles, laying the foundation for the promotion of the "one pole, multi-purpose" intelligent light pole project.

Secondly, by substantially improving the construction standards and operation of smart light poles, we can substantially improve work efficiency and product quality. To improve the management of smart light poles, all provinces and municipalities should consider local characteristics, formulate applicable standards and management measures, and clarify the responsibilities of all parties concerned to ensure compliance by the relevant parties. We strongly recommend technology

companies and operators to join hands to create unique local products to promote the popularity of smart lighting systems. Adopting a market mechanism to promote the development and improvement of smart light poles, to provide better lighting services to all kinds of people.

Thirdly, more support is provided for the development of smart light poles through the establishment of an industrial alliance. To better respond to local smart lighting needs, it is recommended that a smart lighting industry alliance be established in each province and city. This will allow for better coordination of resources from all parties and improve lighting efficiency. This alliance aims to bring together the technological innovation, production process optimization, market expansion and business management capabilities of local enterprises, and to comprehensively demonstrate the unique advantages of local smart lighting systems. In addition to these, this alliance is also committed to providing public services and a platform for co-operation and exchanges for upstream and downstream enterprises throughout the industry chain, to facilitate market matching and accelerate the synergistic development of industry, academia and research.

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