Research on intelligent management based on expressway business integration

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Abstract. For the whole process business of expressway in Zhejiang Province, many deficiencies of management mechanism and technology were found, and the IOCMM concept was put forward. Based on this concept, a set of whole-process data standards has been established, and a big data platform has been built. Big data platform design principle is that is "1 brain" + "4 business applications" + "N decision support services" to realize the whole life cycle and chain management of expressways, and form an intelligent management scheme of "investment, construction, management, maintenance and transportation" of expressways.Through this platform, the information recycling, collaboration network and scientific decision-making of each project are realized, the horizontal connection, data integration and analogy of multiple projects are realized, and the mining of deep data value is realized.

Keywords: IOCMM ;Digitalization;Data standards ;Big data platform.

1. Introducion

China's expressway construction has played an important fundamental and guiding role in the national economy and regional social and economic development, and has made remarkable achievements in the past 40 years. At present, the length of China's expressways has reached 177,000 kilometers, ranking first in the world. In 2020, with the opening of nine expressways, including the Hangzhou Ring West Double Line and the Wentai Expressway, the expressways in Zhejiang province can directly reach every county. In spite of this, the investment and construction of expressways still cannot meet the people's high-quality requirements for transportation infrastructure. The contradiction between people's growing demand for travel convenience and their satisfaction and the insufficient efficiency of comprehensive transportation infrastructure still exists.[1-2]

Chinese government departments at all levels have issued a number of policy documents, clearly requiring the comprehensive transport system to develop in the direction of high quality, high efficiency and high efficiency. [3-5]The requirements for digitalization are increasingly higher, especially in terms of system governance, facilities and transportation services. With the "data chain" as the main line, we will promote the deep integration of advanced information technology and transportation, build a digital collection system, networked transmission system and intelligent application system, and accelerate the development of traffic informatization to digital, network and intelligence.

The situation of Zhejiang province is seven mountains, two rivers and one field, and the economy is equivalent to that of moderately developed countries. The province's road network, water network and towns are densely distributed, and all kinds of natural resources are relatively scarce. In this case, the project cost of transportation infrastructure projects is increasing year by year, and the financing pressure is also increasing. On the other hand, many common problems of engineering quality have not been fundamentally solved, and the investment in expressway maintenance has been on the rise year by year.usually, We divide the expressway project into three stages: investment decision, construction, operation and maintenance, After the investigation and arrangement, We found that the leading departmental working mechanisms within each stage, There is still room for improvement, The informatization between the project and the project cannot be

synchronized, Different leading departments at different stages can not achieve horizontal connection at different stages, Project information cannot be delivered efficiently, Data induction statistics and data deep value mining are extremely limited, The remaining problems in the previous links cause losses in the subsequent links, Feedback from the post-order link is rarely reflected in the new construction (expansion, upgrade) projects, And then, Can not make the project to achieve the maximum effect of economic and social benefits. This is because there is no evaluation tool for the whole life cycle of the project, and no post-evaluation mechanism for circular feedback. Based on this, it is very necessary to study how to achieve the optimal full life cycle benefits of expressway investment, construction, management, operation and maintenance, and hence the concept of "integration of investment, construction, management, maintenance and transportation".

Based on this, we propose to comprehensively consider the overall benefits of the whole life cycle of expressway investment, construction, management, maintenance and operation, and digitalization is the key tool to maximize its benefits,this idea is called ICOMM for short. The basic concept of ICOMM is to achieve the best point of view of the whole life and the overall benefit of the whole process ，Establish an integrated work system with upper and lower linkage, clear responsibilities, division of labor and cooperation. Strengthen the early planning and overall planning. Pay close attention to design management and implementation. We will strengthen links between construction and operation. Focus on the integration of operational needs. Focus on long-term development, highway high quality and sustainable development.

The biggest problem right now is the "information island" problem. In the past 20 years, various transportation departments according to their own needs, established for its own service application system, database, etc., but limited to technical standards, industry standards, basic standards of inconsistent objective conditions, lead to information cannot be Shared between departments, different stages of information can not be effectively transfer, information can not be synchronized between different projects. Although it can solve some specific and local problems, each system basically exists independently, resulting in an information island under the background of the network. For example, charging, monitoring, communication, pavement, bridge management, road management and emergency management systems have been widely used, they have accumulated a lot of information, because there is no unified information integration platform, resulting in low data utilization. Therefore, we need to build an intelligent management system framework platform to integrate the data at each stages to achieve business collaboration. Mining deep value is conducive to summarizing engineering experience, realizing good internal circulation, and achieving real-time visualization and intelligence of project progress, cost, quality and other indicators.[6-9]

2. Method

2.1 Business tackling of highway

The investment decision stage of expressway project is the key stage to determine the project cost, technical standard, technical scheme and project scale. Whether the early decision of the project is correct or not is directly related to the effectiveness of the project investment. This largely depends on the level of the design unit. However, the design unit or department is limited by its own functions. For some projects in the process of construction and operation of adaptability problems, plus the highway industry management policy from central to local change quickly, design department is difficult to adapt in the short term, adjustment, lead to many project design changes, secondary decoration, functional phenomenon, such as general highway construction not considering overload vehicle weighing facilities, unloading places, maintenance base, bridge cone slope, building and electromechanical system caused secondary decoration due to not synchronous design, etc.

At present, there are 29 operation and management units in Zhejiang Province, 2 central enterprises, and the mileage is 187 km, accounting for 4.6%; 3 subsidiaries of CICO, the mileage is

2193 km, accounting for 54.0%; 18 local government trading companies, 1160 km, accounting for 28.6%, and 6 social enterprises, 522 km, accounting for 12.8%, as shown in the Figure 1 below.
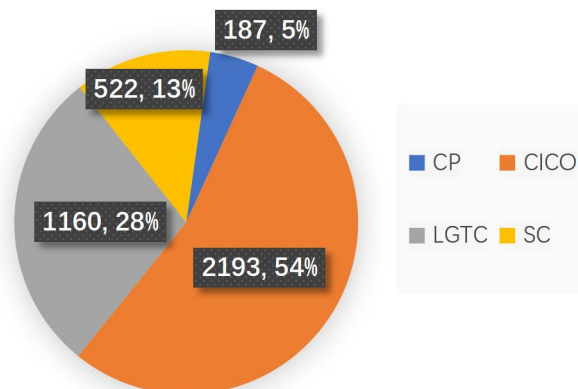

Figure 1. Proportion and mileage distribution

According to the survey results, in the whole process of project organization and participation, the rapid change of the system and mechanism has brought about the inconsistency of the management objectives of different stages and the different data standards of the whole process of construction and management. The problem is concentrated in the following aspects: (1) when the implementation of the whole process of the project, the degree of information coordination of the whole project construction is low. At present, the safety, ease of use and unity of highway construction data management cannot reach the degree that facilitates management and application for owners and relevant management agencies. Moreover, it cannot form a unified and effective data processing platform for engineering construction to assist the management more efficiently.

The operation and maintenance management units do not participate in the investment decision-making and construction stage, resulting in certain differences between the layout of functional facilities and the operation needs of the service area, the maintenance area and the management center.(3) Different construction participating departments, such as design departments, construction departments and maintenance departments, have inconsistent interest objectives, resulting in no more comprehensive perspective to improve the project，the overall benefit of the project is difficult to achieve the best.

Based on the above situation, we make suggestions from the following aspects:

1) Establish the project management unit and the operation management unit as soon as possible, and intervene in the early stage of the project in advance to guide the overall interest layout.

2) The operating unit shall participate in the preliminary design and the internal review of the construction drawing design. Put forward specific opinions on the operational needs of the service facilities.

3) At the end of the project construction period, about 1 / 3~1 / 2 of the excellent management personnel of the project company will stay in the operating company of the road section where the project is located.

Sorting out the whole process of the business process of the expressway is to provide a business basis for the unification of data standards and the establishment of an intelligent framework platform in the subsequent stages.Their logical relation is shown in Figure 2 below.
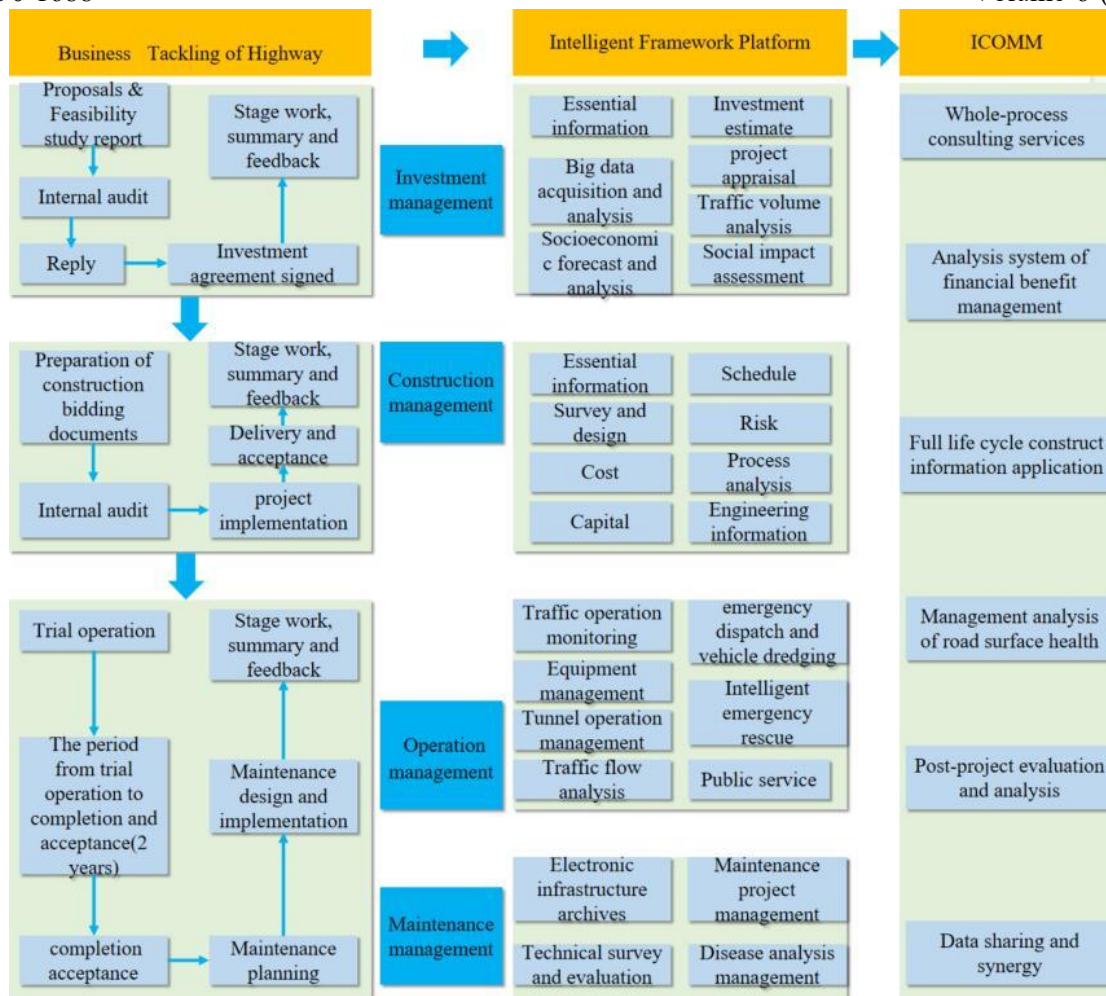
Figure 2. Logical relation of business tackling and intelligent framework platform

2.2 Data standard

Data standards and specifications are divided into data specification system framework, data exchange specification, coding specification, data control specification and data application specification, as shown in the figure below.

1）Data specification system framework

The data specification system refers to the standards issued by the state and the Ministry of Transport, and combines with business practice. Design the data standards and specifications in line with the actual work of the transportation industry, and explain the specific implementation methods of the data specifications.

2）Data exchange specification

The data exchange specification defines the source system and the intelligent high-speed management platform, the hierarchical framework of the business center and the reference model for data exchange. Data exchange specification mainly solves the problems of information exchange between distributed and heterogeneous systems in complex network environment.

3）Code specification

Based on all kinds of coding specifications issued by the Ministry of Communications and combined with business practice, the whole industry-wide coding specifications are formulated. The defined coding will be physically implemented at the integration layer of the subject database and will be managed as the core master data.

4）Data control specifications

Data control specification defines relying on cloud control. Various mechanisms and systems for comprehensive control of data, including suggested role configuration, management system, operation process, etc., covering data collection, system construction, data request, etc.

5）Data application specification

The data application specification provides the service interface specification for the business application and the data center, and the data service interface adopts the SOCKET or REST standard to build the data service interface specification.

2.3 Build a big data platform

By integrating the technical system, dynamic and static data and business process, the big data platform has the ability to timely obtain data and information at any time, at any place and on any equipment, and has the characteristics of visual, measurable and controllable.

The overall design ideas of the management platform include comprehensive perception, deep integration, precise service and scientific decision-making, and their respective characteristics are as follows:

Comprehensive perception: timely access to visible, measurable and controllable data and information at any time, any place and any equipment.

Deep integration: integration between information and data; integration of business and system; integration of resources and business; integration of application and demand; integration of people, technology and business.

Accurate service: make predictions and predictions based on real-time, scientific analysis and modeling of data, and actively deliver them through diversified service channels.

Scientific decision-making: make decisions for highway management based on data analysis and in a scientific and quantitative way.

On the basis of designing data standards and specifications and breaking down business data barriers of all parties, further build "1 brain" + "4 business applications" + "N decision support services" to realize the whole life cycle and chain management of expressways, and form an intelligent management scheme of "investment, construction, management, maintenance and transportation" of expressways.[10-13] As shown in the Figure 3 below：
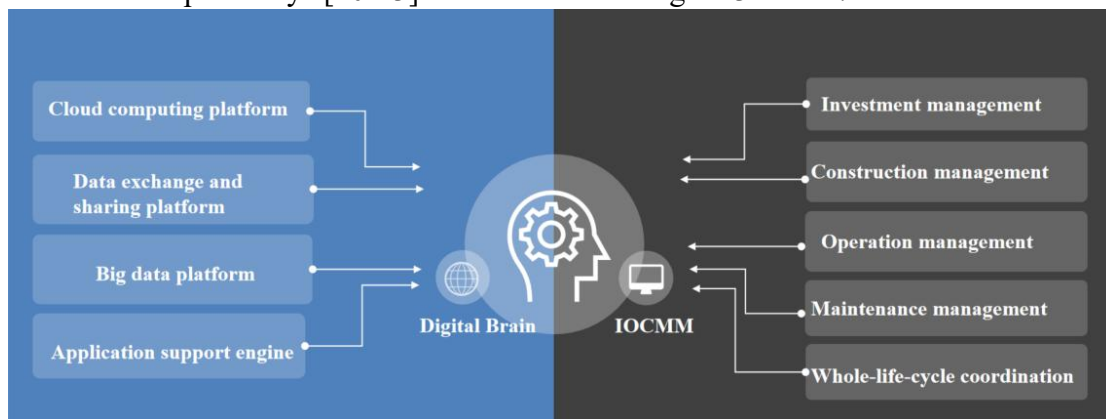

Figure 3. Overall architecture design

3.   Result analysis

Stage within the whole life cycle of highway, target, organization, object, technology management elements such as comprehensive combing, clear the correlation between the elements and complementary relationship, guide different management subject in different stages and different goals in the process of the management as a whole using all kinds of advanced technology tools and management means, build highway wisdom management system framework platform. This is the highway unified portal mainly statistics, charts and geographic information, integration show investment, construction and operation period, in the form of command screen desktop

integration display network data statistics, traffic facilities, traffic equipment, road maintenance statistics, key vehicle statistics, etc., display way for digital display and statistical charts.As shown in the Figure 4~6.

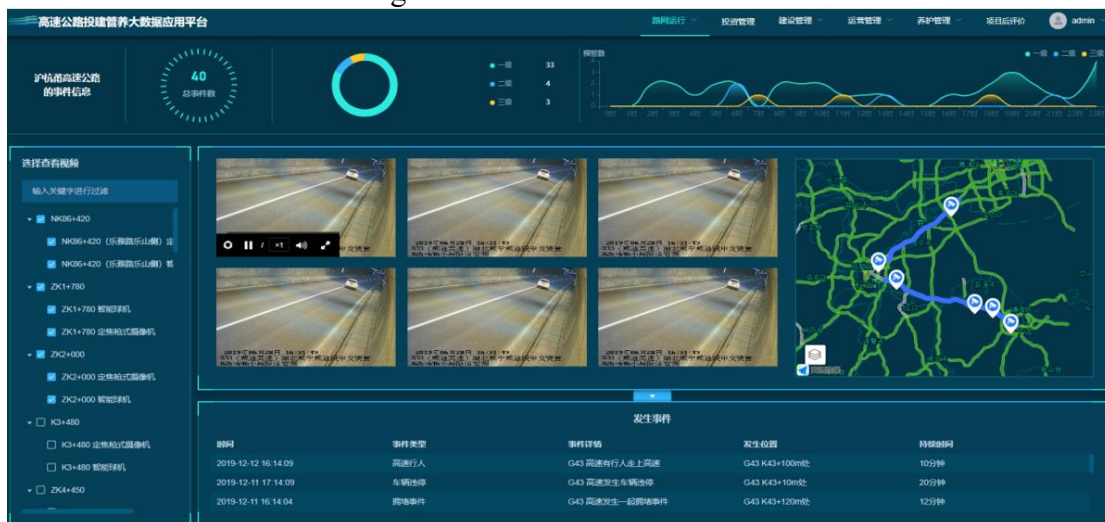Figure 4 Data Center overview

Figure 5 Video intelligent monitoring and early warning platform

Figure 6 Planning and construction management platform

For the management function design of each stage, we should not only address the functional requirements of this stage, but also summarize, feedback and addende the previous stage. In addition, the subsequent stage work should have certain guidance and reference significance. In general, it should be considered from the overall benefit of the whole life of the project. The main purpose of the expressway intelligent management system framework platform is to establish a post-evaluation mechanism of active control and circular feedback. Investment, design, construction, operation, testing and maintenance of the whole process of the project under construction, phased summary and improvement and cycle feedback. Carry out safety evaluation and post-evaluation of the existing expressway projects, and understand the problems and measures in various stages of the preliminary decision-making, survey and design, construction control, and operation and maintenance of the project. Through continuous analysis and summary, we strive to improve the integrated management level, so as to truly realize the intelligent management. Therefore, we must make use of the deep integration of computer technology in the field of traffic engineering. Digitization and information technology are the fundamental way to realize the basic concept of the integration of investment, construction, management, maintenance and transportation.

4. Conclusion

IOCMM is in line with the advanced concept of highway project construction, the use of digital means to improve the intelligent management, which can make the project to achieve better benefits.The basic connotation of intelligent expressway management: covering all the data of the whole process of project approval, survey, design, land acquisition and demolition, bidding, construction management and operation management of expressway construction projects, which is integrated into a unified management platform in a certain standard format. Through this platform, the information recycling, collaboration network and scientific decision-making of each project are realized, the horizontal connection, data integration and analogy of multiple projects are realized, and the mining of deep data value is realized.

Topic

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