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Performance Evaluation and Optimization of Transportation Electromechanical Engineering Based on Big Data

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ABSTRACT

Transportation electromechanical engineering has an important role in the process of transportation engineering construction. After studying the basic situation and problems of the current transportation electromechanical engineering, the author selects the Q city subway line 1 as a test of the effect of quality control of its transportation electromechanical engineering construction, so as to assess its performance. Ten monitoring points are randomly selected, and four groups of control quantities between the monitoring points are detected, and their qualification rate is judged by the gap between the detection results and the standard value. Then, optimize the transportation electromechanical engineering by using big data and emerging detection technology, etc. Construct the performance evaluation index system of traffic electromechanical engineering to evaluate the performance of the optimized traffic electromechanical engineering scheme. The pass rate of the pre-optimized traffic electromechanical engineering in the four groups of control volume testing is 100%, 22%, 80% and 70%, respectively, and the construction performance is poor. The scores of the equipment layer indicators of the optimized traffic engineering scheme were all above 80 points, and 19 indicators scored more than 90 points. The subsystem index scores are between 87.1 and 96.2 points, and the comprehensive score of traffic E&E engineering performance is 92.2 points, which shows that the optimized traffic E&E engineering has achieved more excellent performance evaluation results.

Keywords: big data; transportation E&M engineering; construction quality control; performance assessment

1. Introduction

Traffic electromechanical engineering is accompanied by the rapid development of highways and the emergence of a sub-project specifically for highway management supporting, its application in traffic

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is quite extensive, including traffic monitoring system, highway toll collection system and traffic service system and other aspects [1-4]. Because of its powerful management functions and advanced technical means, it soon penetrates into various fields of road and urban traffic management, and becomes an important technical means and key infrastructure to realize the modernization of highway traffic. In the continuous practice has also proved that it has a strong management function and advanced technical means [5-8].

With the continuous progress of science and technology and the continuous development of society, the highway transportation system on the technical requirements of mechanical and electrical engineering equipment is also constantly improving. In order to improve the safety, convenience and intelligence level of highways, there is an urgent need to strengthen the research and development of electromechanical engineering equipment technology to meet the growing traffic demand [9-12]. And in the context of the big data era, with the help of big data to deeply evaluate and optimize the performance of traffic electromechanical engineering, and explore its effectiveness in the highway traffic system, it is of great practical significance and strategic significance to enhance the operational efficiency of China's highway traffic system, reduce the rate of traffic accidents, and improve the quality of the traffic environment [13-16].

This paper carries out an in-depth study of the current transportation electromechanical engineering, explores its problems, selects Q City Metro Line 1 as the object of construction performance testing of transportation electromechanical engineering, and determines the construction quality control effect of the current transportation electromechanical engineering through the detection of 4 sets of control quantities at 10 monitoring points. Optimize the original traffic E&E engineering scheme through the introduction of the Internet, big data and emerging detection technologies such as laser scanning and artificial intelligence detection. With the help of hierarchical analysis method, the performance evaluation index system of transportation electromechanical engineering is constructed, and the weights of the indexes are calculated. The evaluation model is used to evaluate the optimized traffic electromechanical engineering scheme, and the comprehensive performance evaluation results of the optimized traffic electromechanical engineering scheme are obtained.

2. Evaluation of construction quality control of transportation electromechanical engineering

2.1. Transportation Electrical and Mechanical Engineering

2.1.1. Characteristics of construction technology of transportation electromechanical engineering. Traffic electromechanical engineering is different from other projects, which includes lighting system, power distribution system, communication system, tolling system, monitoring system, etc., and is an auxiliary management project of highway [17]. Due to the substantial growth of highway construction mileage, it makes traffic electromechanical engineering increasingly important. At present, the construction of traffic electromechanical engineering has become an important means of modern highway traffic management, as well as the transformation from traditional highway transportation to intelligent transportation. Traffic electromechanical engineering has the following characteristics:

First, the professional scope covers a wide range. Traffic electromechanical engineering involves highway monitoring, electronic information, electronic toll collection, toll monitoring and other fields, which all reflect the specificity and complexity of traffic electromechanical engineering.

Secondly, it has led to rapid progress in science and technology. Many construction technologies have been rapidly developed in the fields of transportation, electromechanics and so on, such as the automatic toll collection technology of electronic computers.

Thirdly, the technology content is higher. Transportation, electromechanical engineering development to the present, many high-tech products have been applied to it, such as network technology and various types of communication technology.

2.1.2. Current status of transportation electrical and mechanical engineering:

1) Human factor. In the current operation and management of electric power projects, due to some project managers ignore the quality control of the project, only focus on the control of the schedule and cost, the pursuit of profit maximization, resulting in poor quality control of the construction of the project, affecting the normal conduct of the project.

From the current electric power project construction practice, due to the low professional quality of some construction quality management personnel, their professionalism and technical level is generally low, so it is difficult to complete the quality control of high-difficulty projects, resulting in its construction quality is difficult to be effectively guaranteed.

2) Material impact. In electromechanical engineering construction, whether it is the power supply and distribution system, toll collection system, monitoring system, or communication system, the requirements for construction materials are very high. At present, in the quality management of electromechanical engineering construction, due to the large workload of material procurement, it leads to more problems such as unqualified construction materials and inconsistent specifications.

In addition, due to the suppliers in the supply of construction materials, the purchasing personnel of the materials did not test the quality, size, specifications and other aspects of the materials, resulting in the quality of the materials does not meet the specifications. Due to the lack of reasonable material storage and management measures in the construction of the project, the materials were damaged and could not meet the requirements of the construction specifications.

3) Design factors. When the highway is in operation, it has to bear the load of vehicles and also has to deal with all kinds of bad weather, so in the process of highway construction, it is necessary to ensure the scientific nature of its design drawings. Only scientific and reasonable design plans can provide a guiding basis for the overall construction of the highway, so as to facilitate the handling of all kinds of safety hazards caused by natural and man-made reasons. However, at present, the electromechanical installation design scheme of the highway is often inconsistent with the actual situation, and there are a lot of subtle differences, resulting in contradictions in the construction.

4) Equipment factors. In construction, to ensure the quality of construction, it is necessary to use advanced engineering equipment. However, some enterprises often use production equipment that does not meet the requirements because of insufficient funds. In addition, some equipment manufacturing enterprises have good production lines, but due to the lack of professional technicians, resulting in the unreasonable utilization of production line equipment, resulting in the quality of equipment can not be guaranteed.

2.2. Performance analysis

Taking the electromechanical engineering project of Metro Line 1 in Q City as an example, the performance performance of transportation electromechanical engineering is detected through data statistics and analysis of its quality problems. The technical department of the project draws strength to take samples, statistics and sort out the quality problems occurring in the installation of contact rails on the spot. The investigation team took the contact rails just installed at the construction site and measured and monitored their installation dimensions for 10 days. Sampling and measurement process steps and results are as follows:

1) Take a sample point of the first day of installation measurement data, analyze the construction process quality control problems.

Measurement data of 10 measurement points on the first day of installation are shown in Table 1. According to Table 1 analyze the statistics to know:

(1) the first group of control quantities “contact rail contact surface and rail plane spacing (control standard 200 ± 5mm)”, from the table it seems that the construction quality control is appropriate, the construction quality of the qualified rate reached. But carefully analyzed from the table, the distribution of its data is very decentralized, a considerable portion of the data has reached the critical point of qualified quality, such as measuring point 2 (204.4mm), point 7 (195.7mm). In addition, the second control quantity “the height difference between neighboring support points shall not be more than 3mm”, which is directly related to the first control quantity, can be directly calculated from the data of the first control quantity, and its quality pass rate is only 22%. Thus, it seems that there is a big problem in the quality control of this control quantity.

(2) the third group of control quantities “contact rail centerline from the line centerline (control standard 1550 ± 5mm)”, from the table data analysis, construction quality pass rate, reached 80%, similar to the first group of control quantities, data division is very decentralized, a considerable proportion of the data to reach the quality control critical point. The control volume of the construction control still needs to be strengthened.

(3) The fourth group of control quantities “contact rail joint gap (control standard not more than 5mm)”, the construction quality pass rate is only 70%, need to focus on improving.

(4) According to the design requirements, the four control quantities in the table need to be satisfied at the same time in order to meet the quality acceptance requirements. From the results of Table 1 statistics, the four control quantities of construction quality control are unsatisfactory. And the first three control quantities are in the field of the same sampling point data, three control quantities are satisfied with the measurement point seems to be only measurement point 1, so the comprehensive statistics of the construction quality pass rate of only 10%, the level of quality control of the construction process needs to be improved.

Table 1. Measurement data of 10 points in the first day of installation

Point n	Control standard (200±5mm)	Adjacent height difference (n+1-n)	Control standard (1550±5mm)	Control standard (⩽0.5mm)
1	202.7	1.7	1552.5	0.36
2	204.4	-4.9	1548.1	0.44
3	199.5	-2.4	1545.3	0.42
4	197.1	4.1	1545.8	0.55
5	201.2	-0.3	1554.4	0.48
6	200.9	-5.2	1552.2	0.54
7	195.7	6.5	1555.6	0.46
8	202.2	-4.6	1552.7	0.51
9	197.6	6.2	1544.9	0.35
10	203.8		1548.9	0.38
Conformity rate	100%	22%	80%	70%

2) Data from 3 measurement points for 10 days were randomly selected to analyze the quality stability after the installation was completed.

The 10-day data of the 3 measurement points are shown in Table 2. According to Table 2 make the following analysis of the quality problem statistics:

(1) The first group of control quantities "contact rail contact surface and rail plane distance (control standard 200 ± 5mm)" in the construction is completed in the 2nd -6th day, there is a relatively obvious downward trend of change in the 6th day after the leveling off. The amount of change (extreme deviation) of the three sets of data was 2.9mm (measurement point 1), 2.5mm (measurement point 5), 1.5mm (measurement point 9) compared to the permissible value of 10mm of the control standard is not significant.

(2) The second set of control quantities ("the height difference between adjacent support points shall not be greater than 3mm)" varies with the data of the first set of control quantities, so no special analysis was done.

(3) The third group of control quantities "contact rail centerline from the line centerline (control standard 1550 ± 5mm)", the fourth group of control quantities "contact rail joint gap (control standard not more than 0.5mm)", in the range of 10 days have not appeared irregular oscillation. The third group of control volume changes are small, three groups of data extreme difference were 2.8mm, 2.6mm, 2.4mm, far less than the control standard allowable fluctuation value of 10mm. the fourth group of data changes are large, the extreme difference value were 0.33mm, 0.26mm, 0.34mm, from the control standard of the allowable range of 0.5mm is already very close to.

(4) In summary, it can be seen that the four groups of control quantities in the construction and installation is completed, may be affected by the surrounding environment and other factors, will produce different degrees, different trends, different magnitudes of change, and all have a significant

impact on the quality. In the construction process must be emphasized, take the necessary quality control measures.

Table 2. Measurement data of 3 points for 10 days

Control standard	Control standard (200±5mm)			Control standard (1550±5mm)			Control standard (⩽0.5mm)		
Point	1	5	9	1	5	9	1	5	9
Day 1	202.7	201.2	197.6	1552.5	1554.4	1544.9	0.36	0.48	0.35
Day 2	202.3	200.8	197.4	1551.8	1553.7	1544.6	0.29	0.47	0.45
Day 3	201.9	200.6	197.3	1551.2	1553.5	1544.2	0.21	0.48	0.46
Day 4	201.5	200.3	197.2	1550.8	1553.2	1543.8	0.46	0.46	0.29
Day 5	201.1	199.9	197.1	1550.5	1552.9	1543.6	0.31	0.39	0.31
Day 6	200.5	199.2	196.7	1550.4	1552.7	1543.5	0.44	0.48	0.33
Day 7	200.4	199.1	196.7	1550.2	1552.4	1543.4	0.24	0.62	0.55
Day 8	199.9	198.9	196.4	1550.1	1552.3	1542.8	0.54	0.37	0.63
Day 9	199.8	198.7	196.1	1549.7	1551.8	1542.5	0.32	0.51	0.36
Day 10	199.9	198.8	196.3	1550.9	1552.1	1542.9	0.46	0.63	0.56
Variation	2.9	2.5	1.5	2.8	2.6	2.4	0.33	0.26	0.34

3. Optimization of traffic electromechanical engineering

3.1. Optimization schemes based on big data and emerging detection technologies

Highway electromechanical system can also be called intelligent highway transportation system. In the new era environment, the highway engineering system can be mainly divided into electromechanical system and three major systems. Among them, the three major systems mainly include toll collection, communication and monitoring systems. In the tunnel engineering construction project, the electromechanical system can also be divided into power supply and distribution, ventilation, lighting, fire fighting, monitoring and other systems. From the current actual situation, the new technologies are promoting a new round of industrial revolution, in the process of the application of the Internet and big data technology has effectively solved the information asymmetry and natural limitations and other related problems, and the nature of the social economy has also changed. In addition, the new information technology also meets the basic characteristics of urban traffic and road transportation, such as strong mobility, many points and long lines, etc. The combination of the Internet, big data and transportation is also leading the continuous progress of intelligent transportation.

In addition, the introduction of emerging inspection technologies such as laser scanning and artificial intelligence also provides new possibilities for the development of transportation E&M engineering.

1) Laser scanning technology. Principle: The core principle used in laser scanning technology is time-flight measurement [18-19], in which a laser emits pulses of light and calculates the round-trip time of the light wave to determine the distance. The measurement involves more complex considerations such as speed of light adjustment factors and equipment errors. The formula is expressed as follows:

$$d = \left(\frac{c}{n} \cdot t + \varepsilon\right) / 2 \tag{1}$$

where d(m) denotes the distance from the laser transmitter to the target, c(m/s) denotes the speed of light in a vacuum, which has a value of 299792458m/s, and n denotes the refractive index of the medium, which is about 1.0003 for air. t(s) denotes the time of round trip of the laser pulse, and ε(m) denotes the device-specific error, which takes into account the effects of instrument calibration and environmental factors.

The process of laser scanning technology application in MEP construction is shown in Fig. 1.

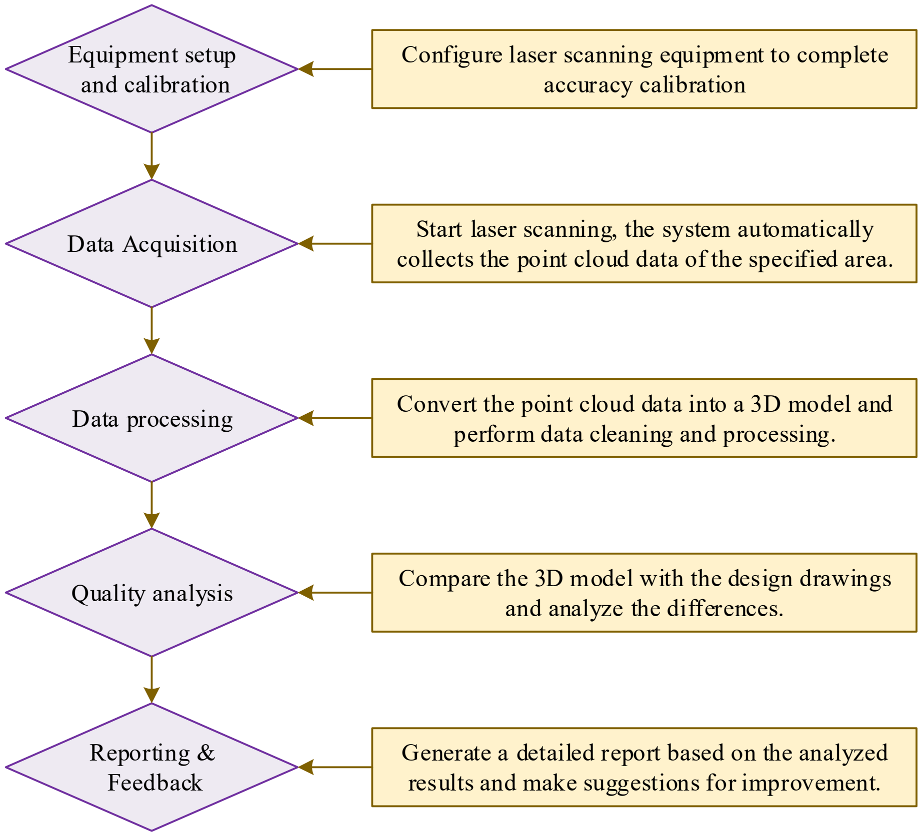

Fig. 1. Application of laser scanning technology in electromechanical engineering construction

The application of laser scanning technology in electromechanical engineering installations greatly enhances the accuracy of spatial data acquisition, which is particularly critical for engineering design verification, construction monitoring and maintenance assessment. The technology generates high-precision 3D point cloud models, enabling engineers to refine layout plans and optimize designs to match actual site conditions. By monitoring construction progress in real time and comparing it to the design model, the technology effectively identifies and resolves deviations, reducing the need for rework and improving construction efficiency. In addition, the detailed 3D data provided by the laser scanning allows the O&M team to conduct accurate condition assessments and maintenance planning after the project is completed, ensuring the long-term reliability and safety of the system.

2) Artificial Intelligence Detection Technology. Artificial intelligence detection technology relies on machine learning and data analysis, especially through algorithmic models such as linear regression, to enhance in-depth analysis of data, automatically identify patterns, predict trends, and make decisions. These models are typically trained on large amounts of historical data to adapt and optimize their ability to process complex datasets, extract valuable information from them, and continuously improve their diagnostic and analytical capabilities. Take linear regression as an example, a statistical method used to predict and explain relationships between variables. The basic form of a linear regression model is:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_n x_n + \varepsilon \tag{2}$$

Where y is the dependent variable, the variable we want to predict or explain. xn is one or more independent variables, factors that may affect the dependent variable. βn is the model parameter where $\beta 0$ is the intercept and $\beta 1 ... \beta n$ are slope coefficients, which represent the average amount of change in the dependent variable for each unit change in the independent variable. ε is the error term, which represents the effect of other factors in addition to the independent variable.

In MEP installations, linear regression can be used to predict continuous outputs such as energy consumption and load changes that are related to multiple factors. For example, equipment performance is predicted by analyzing temperature, pressure, and other environmental factors. This simple linear regression model is not only easy to understand and implement, but it also provides clear quantitative relationships that help engineers and decision makers understand the extent to which various factors influence the target variable, leading to more effective maintenance strategies and operational decisions.

3.2. Performance evaluation index system construction

3.2.1. Basic Indicator System. On the basis of the hierarchical structure of the evaluation index system of traffic electromechanical engineering system, combined with the functional analysis of traffic electromechanical system, according to the principle of index, the evaluation system of traffic electromechanical engineering performance index can be constructed in accordance with the division of "system layer - subsystem layer - equipment layer". The basic index system of traffic electromechanical engineering system performance is shown in Table 3.

In this paper, the performance evaluation of traffic electromechanical engineering system takes the electromechanical system as the entry point, and initially establishes the basic index system for the evaluation of the performance of traffic electromechanical engineering system through generalization and collation. In the evaluation of the performance of the operational traffic electromechanical system, according to the actual detection of the installation of electromechanical engineering system subsystems, the use of traffic electromechanical equipment for adjustment, screening, in the basic index system on the basis of the construction of traffic electromechanical engineering system in line with the actual operation of the system performance evaluation index system, to improve the accuracy and practicability of the evaluation of the electromechanical system.

Table 3. Basic index system of the system of electromechanical engineering construction

System layer	Sub-system layer	Equipment layer
Electromechanical engineering construction system	Ventilation system (A)	Fan (A1)
		Environmental detector (A2)
		Ventilation controller (A3)
	Lighting system (B)	Lamp set (B1)
		Brightness detector (B2)
		Lighting controller (B3)
	Fire control system (C)	Fire detection and alarm equipment (C1)
		Fire and control equipment (C2)
	Traffic control and induction system (D)	Lane indicator (D1)
		Traffic light (D2)
		Variable speed limit (D3)
		Variable intelligence board (D4)
		Vehicle detector (D5)
		Regional controller (D6)
	Closed circuit TV monitoring system (E)	Camera (E1)
		Optical end machine and cable (E2)
		Video distributor (E3)
		Video switching matrix (E4)
		Monitor (E5)
	Emergency telephone and broadcasting system (F)	Emergency telephone (F1)
		Megaphone (F2)
		Console (F3)
	Low voltage distribution system (G)	Power supply and transformer (G1)
		Distribution circuit and distribution box (G2)
		Dynamo (G3)
		UPS equipment (G4)
	Photoelectric cable communication system (H)	Optical transmission equipment (H1)
		Programmed digital exchange equipment (H2)
		Fiber optic integrated business access network (H3)
		Communication power (H4)
	Lightning protection system (I)	Arrester (I1)

3.2.2. Comprehensive Evaluation Model for Transportation E&M Engineering System Performance. Based on the performance evaluation index system of transportation electromechanical engineering system, this chapter will establish the connection between the testing items and evaluation index system of transportation electromechanical engineering system and quantitatively describe the performance of transportation electromechanical engineering system by establishing the equipment reliability evaluation model, the subsystem validity evaluation model and the overall validity model.

1) Equipment Reliability Calculation. The equipment reliability evaluation model adopts the decision tree modeling method, in which the structure of the decision tree is like a tree, which uses the structure of the tree to classify the data records. Equipment reliability model has three layers, the root node for

equipment reliability, according to the different levels of testing projects to establish branches of the tree, in each branch subset of the repetition of the establishment of the lower nodes and branches, the leaf nodes on behalf of an evaluation of the factors (from the project testing sub-projects), you can generate a decision tree model of electromechanical equipment reliability.

According to the decision tree model calculation method can be obtained equipment reliability bottom-up calculation process is as follows:

The intact rate of the testing item:

$$W_1 = Q_{111} \cdot W_{11} + Q_{112} \cdot W_{12} + \cdots + Q_{11m} \cdot W_{1m} \tag{3}$$

Completeness of equipment:

$$W = Q_{11} \cdot W_1 + Q_{12} \cdot W_2 + \cdots + Q_{1n} \cdot W_n \tag{4}$$

Newness of equipment:

$$C = \frac{Y - y}{Y} \times 100\% \tag{5}$$

Then the reliability of the equipment is:

$$K = Q_1 \cdot W + Q_2 \cdot C \tag{6}$$

Where, the meaning of the symbols in the model: K - equipment reliability, Q_1 - the weight of the equipment integrity rate, Q_2 - the weight of the equipment newness rate, $Q_{11}, Q_{12} \cdots Q_{1n}$ --weights for test item 1, test item 2 to test item n, $Q_{111}, Q_{112} \cdots Q_{11n}$ - weights for test subitem 1, test subitem 2 to test subitem n. W - the rate of equipment intactness, $W_1, W_2 \ldots W_n$ - the rate of intactness of test item 1, test item 2 to test item n, $W_{11}, W_{12} \ldots W_{1n}$ - the rate of intactness of test subitem 1, test subitem 2 to test subitem n. C - equipment newness rate, y - number of years in service, Y - service life.

2) Calculation of subsystem validity. Establish the subsystem validity decision tree comprehensive evaluation model, the first layer of the model evaluation factors are: the detection results of the sub-function and the reliability of the hardware equipment associated with the subsystem. The second layer is the equipment layer and the layer of detection items. The third layer is the sub-layer of testing items.

The layer-by-layer calculation relationship of the subsystem validity decision tree comprehensive evaluation model is:

Layer one:

$$K = \sum_{i=1}^{n} \left(K_i \times Q_{1i} \right) \tag{7}$$

where K denotes the overall reliability of the equipment in question, K_i denotes the reliability of the equipment i associated with the sub-function of this electromechanical system, and Q_{1i} denotes the weights of the equipment i.

$$W = \sum_{i=1}^{m} \left(W_i \times Q_{2i} \right) \tag{8}$$

Where, W denotes the intact rate of functional test results, W_i denotes the intact rate of test item i, and Q_{2i} denotes the weight of test item i.

Therefore the validity degree Y of the transportation E&M engineering subsystem can be expressed as:

$$Y = K \times Q_1 + W \times Q_2 \tag{9}$$

That is, the validity of transportation electromechanical engineering subsystems = the overall reliability of the relevant equipment * the corresponding weights + the intact rate of functional test results * the corresponding weights.

The second layer:

K_i represents the reliability of equipment i, the reliability value is obtained from the reliability evaluation model of transportation electromechanical engineering equipment, and Q_{1i} represents the weights of equipment i.

$$W_i = \sum_{j=1}^{k} \left(W_{ij} \times Q_{2ij} \right) \tag{10}$$

where W_i denotes the intactness rate of test item i, W_{ij} i.e., the intactness rate of the j th test subitem of test item i obtained from the third layer, and Q_{2ij} denotes the weight of the j th test subitem of test item i.

The third layer:

W_{ij} indicates the detection results of the sub-function detection results of the sub-layer detection item i of the j th detection sub-item of the detection results, that is, the integrity rate of the detected items, generally 0 or 1. If there are multiple detection points, the maximum likelihood estimation method is used to obtain the parent integrity rate by using the sample integrity rate extrapolated to get the parent integrity rate (the parent integrity rate = the number of qualified / the total number of samples), and the calculated parent integrity rate will be used as the value.

3) The overall effectiveness of the evaluation model calculation. Transportation mechanical and electrical engineering overall effective degree decision tree comprehensive evaluation model calculation formula:

$$Y = \sum_{i=1}^{m} \left(Y_i \times Q_i \right) \tag{11}$$

Where, Y represents the overall effective degree of transportation E&M engineering, Y_i represents the effective degree of the i rd subsystem, which is calculated by the comprehensive evaluation model of the decision tree of effective degree of transportation E&M engineering subsystems, and Q_i represents the weights of the i th sub-function. That is, the overall effective degree of transportation electromechanical engineering $= \sum \left(\text{Subfunction validity} \times \text{weights} \right)$.

4. Performance evaluation of traffic electromechanical engineering after optimization

4.1. *Calculation of evaluation indicator weights*

This subsection calculates the weights of the transportation electromechanical engineering system performance evaluation index system constructed in the previous section through the hierarchical analysis method [20], and the results of the index weights are shown in Table 4.

Table 4. Hierarchy weights of electromechanical engineering construction evaluation system

System layer	Sub-system layer	Weight	Equipment layer	Weight
Electromechanical engineering construction system	Ventilation system (A)	0.0984	Fan (A1)	0.2647
			Environmental detector (A2)	0.3556
			Ventilation controller (A3)	0.3797
	Lighting system (B)	0.0957	Lamp set (B1)	0.1159
			Brightness detector (B2)	0.4213

			Lighting controller (B3)	0.4628
	Fire control system (C)	0.1368	Fire detection and alarm equipment (C1)	0.5024
			Fire and control equipment (C2)	0.4976
	Traffic control and induction system (D)	0.1347	Lane indicator (D1)	0.1385
			Traffic light (D2)	0.1296
			Variable speed limit (D3)	0.2341
			Variable intelligence board (D4)	0.1426
			Vehicle detector (D5)	0.2014
			Regional controller (D6)	0.1538
	Closed circuit TV monitoring system (E)	0.0975	Camera (E1)	0.1575
			Optical end machine and cable (E2)	0.2356
			Video distributor (E3)	0.1818
			Video switching matrix (E4)	0.2578
			Monitor (E5)	0.1673
	Emergency telephone and broadcasting system (F)	0.1272	Emergency telephone (F1)	0.3415
			Megaphone (F2)	0.3274
			Console (F3)	0.3311
	Low voltage distribution system (G)	0.1036	Power supply and transformer (G1)	0.2674
			Distribution circuit and distribution box (G2)	0.2345
			Dynamo (G3)	0.2546
			UPS equipment (G4)	0.2435
	Photoelectric cable communication system (H)	0.1168	Optical transmission equipment (H1)	0.2416
			Programmed digital exchange equipment (H2)	0.2531
			Fiber optic integrated business access network (H3)	0.2635
			Communication power (H4)	0.2148
	Lightning protection system (I)	0.0893	Arrester (I1)	1.0000

4.2. *Evaluation results*

The optimized optimized traffic electromechanical engineering system scheme was evaluated after the basic data experiments and measurements. Data were collected from the participants of this traffic electromechanical engineering by means of questionnaires, 384 questionnaires were issued, 368 valid questionnaires were recovered, and the recovery efficiency rate was 95.8%.

The evaluation results of the equipment layer indicators are shown in Figure 2. As can be seen in Figure 2, all the scores of the equipment layer indicators are above 80, which indicates that this traffic E&M engineering system proposal has achieved a high level of satisfaction among the participants after optimization. Of all the equipment layer indicators, the highest score was for the amplifiers with 98.7 points and the lowest score was for the power supply and transformers with 83.7 points. Nineteen equipment-level metrics scored 90 points or higher, representing 61.3 per cent of all metrics.

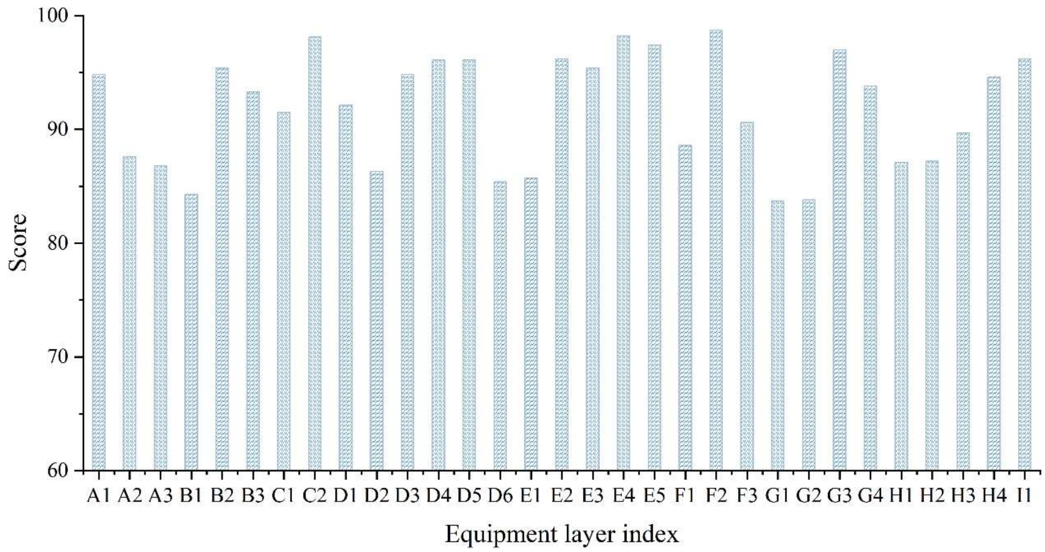

Fig. 2. Equipment layer index evaluation score

The subsystem indicator scores are calculated from the equipment layer indicator scores, and the results are shown in Figure 3. Observing Figure 3, it can be seen that the sub-system index scores are all over 85 points, and the scores of ventilation system, lighting system, fire protection system, traffic control and guidance system, CCTV surveillance system, emergency telephone and broadcasting system, low-voltage distribution system, optical cable communication system, and lightning protection and grounding system are 89.2, 93.1, 94.8, 92.3, 95.1, 92.6, 89.6, respectively, 87.1, and 96.2, with scores around 90, indicating that the optimized traffic E&M engineering scheme has gained a high degree of acceptance from the participants. Calculated from the subsystem indicators, the optimized traffic E&M engineering has a comprehensive score of 92.2. It can be seen that the optimized traffic E&M engineering scheme has achieved excellent performance evaluation results.

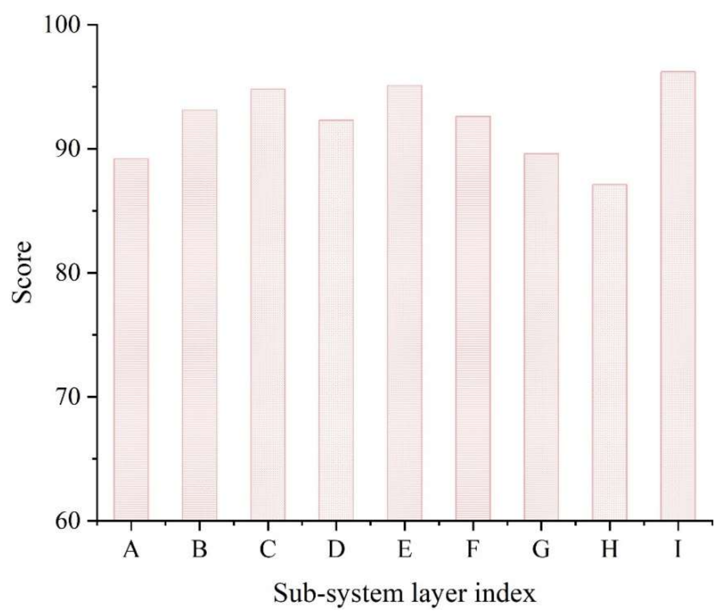

Fig. 3. Sub-system layer index evaluation score

5. Conclusion

After evaluating the current problems and construction quality control of traffic electromechanical engineering, the article proposes an optimization scheme for traffic electromechanical engineering based on big data and emerging detection technology. The evaluation index system of transportation electromechanical engineering is constructed, and the optimized transportation electromechanical engineering scheme is evaluated for performance.

Optimization before the traffic electromechanical engineering in the "contact rail contact surface and rail track plane spacing", "the height difference between adjacent support points shall not be greater than 3mm", "contact rail centerline from the line centerline (control standard 1550) ± 5mm)", 'contact rail joint gap (control standard is not greater than 5mm)' test in the pass rate were 100%, 22%, 80%, 70%, construction performance needs to be improved.

The scores of the equipment layer indicators of the optimized traffic engineering scheme are all above 80 points, and 61.3% of the indicators exceed 90 points, which achieves better evaluation results. The sub-system indicator scores are between [87.1, 96.2], the highest score is the lightning protection and grounding system, the lowest score is the optical cable communication system, and the comprehensive score of the performance of the traffic electrical and mechanical engineering is 92.2 points.

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