Social Security and Administration Management (2023)
Clausius Scientific Press, Canada

DOI: 10.23977/socsam.2023.040702
ISSN 2523-5796 Vol. 4 Num. 7

Construction of Performance Evaluation Model for the Operation and Maintenance of Government Enterprise Cooperation Infrastructure Projects under the ESG Concept

Caichuan Wang[1], Jiajun Li[2,*], Yun He[3]

[1]School of Management, Northwestern Polytechnical University, Xi'an, Shaanxi, China
[2]Northwestern Polytechnical University, Xi'an, Shaanxi, China
[3]Hubei University of Automotive and Technology, Shiyan, Hubei, China
[*]Corresponding author

Keywords: ESG Concept, Infrastructure Project, Operation and Maintenance Performance, Evaluation Model

Abstract: In the Dual circulation, the operation and maintenance management of infrastructure projects under the traditional government enterprise cooperation mode has been unable to adapt to the new situation, and the ESG (Environmental Social and Governance) concept is closely related to the operation and maintenance management of infrastructure projects, and plays an important role in the environment, society and corporate governance. Therefore, the article constructs a performance evaluation model for infrastructure project operation and maintenance based on the ESG concept by analyzing the current situation of performance evaluation for infrastructure project operation and maintenance management. Through experiments, it was found that the ESG concept can increase the average work efficiency of infrastructure project operation and maintenance management from 75.74% to 88.58%. Thus, it can be concluded that the ESG concept is very significant in improving the operation and maintenance management of infrastructure projects.

1. Introduction

The 14th Five Year Plan period is the decisive stage for the comprehensive construction of a moderately prosperous society, and it is also the period with the strongest demand for infrastructure construction investment. With the rapid development of the economy and society, the scale and quantity of infrastructure construction continue to increase, playing an important role in optimizing regional layout and improving regional economic structure. However, with the continuous expansion of infrastructure investment scale, the operation and maintenance management of infrastructure projects is also facing more and more challenges. However, the operation and maintenance management of infrastructure projects under the traditional government enterprise cooperation mode has problems such as high cost and low efficiency, which is difficult to adapt to the new situation under the Dual circulation. Therefore, how to improve the operation and

maintenance management efficiency of infrastructure projects, reduce the operation and maintenance costs, and enable them to adapt to the new situation under the Dual circulation has become an urgent problem.

Scholars around the world have conducted a series of studies on infrastructure projects. Among them, Zheng Chuanbin, based on the Grounded theory, discussed the key factors that affect the performance of PPP (Public Private Partnership) projects in the field of infrastructure. The results show that the three main categories of project characteristics, process management, and external environment have a significant impact on project performance [1]. On the basis of analyzing the influencing factors of residual value risk in infrastructure PPP projects, Xiang Yinghui used the combination weighting method to obtain indicator weights, constructed a fuzzy matter-element evaluation model, divided the risk levels, and conducted residual value risk assessment combined with case studies [2]. Song Jiahui constructs an assessment model for the sustainable development of urban public Transportation engineering engineering construction based on the multi-dimensional perspective of environment economy society. This model takes into account the randomness, fuzziness, and uncertainty of experts in qualitative evaluation, and uses a cloud model to characterize various attribute values of infrastructure projects, allowing for uncertainty measurement of the sustainability of infrastructure projects [3]. Ren Fei emphasized the issues that should be paid attention to and the basic principles that should be followed when establishing the performance evaluation index system for infrastructure construction projects. At the same time, based on the actual situation of Zhengzhou High tech Industrial Development Zone, corresponding countermeasures and opinions were provided to achieve refined management of various work links of infrastructure construction projects in the High tech Industrial Development Zone, and improve the overall quality and safety of the project [4]. Dong Jia discusses how to evaluate the performance of special bond funds for large-scale infrastructure projects, providing reference for public hospitals to strengthen the management of special bond funds [5]. Although the above research is thorough in infrastructure projects, the concept is still insufficient.

ESG focuses on the contribution of enterprises to sustainable development and fulfilling social responsibilities in environmental, social, and corporate governance. Therefore, the article combines the ESG concept with infrastructure project operation and maintenance management, and takes the performance evaluation of infrastructure project operation and maintenance management as the research object to construct a performance evaluation model for infrastructure project operation and maintenance management based on the ESG concept.

2. World Research Status

With the increasing importance of environmental issues in the world, more and more countries have realized the importance of protecting the environment. Therefore, it is always a hotspot for ESG to be included in the operation and maintenance of infrastructure projects. There have been a lot of researches on the performance evaluation of the operation and maintenance of infrastructure projects in China, and also on the performance evaluation [6]. The paper researches the operation and maintenance system of the infrastructure construction from the government angle, with emphasis on operation and maintenance management. From the perspective of Performance Assessment System, ESG is considered to be one of the most important evaluation criteria. The research of operation and maintenance performance evaluation of infrastructure projects mainly focuses on the following aspects.

2.1. At the Government Level

At present, most of Chinese government's research focuses on the operation and maintenance of

basic facilities. Especially, the research on the operation and maintenance of infrastructure projects focuses on the research of government performance evaluation and performance evaluation. First, the operation and maintenance system must be taken into account as a necessary element in assessing performance [7]. On the other hand, it must be borne in mind that the main indicator for evaluating the performance of public administrations is the operation and maintenance of infrastructure projects [8]. In the context of government performance evaluation, a study on the operation and maintenance of infrastructure works shall be carried out in accordance with relevant policies, legislation and regulations.

2.2. At the Enterprise Level

The performance evaluation of infrastructure project operation and maintenance management at the enterprise level mainly focuses on evaluating the performance of the enterprise, while also evaluating its social responsibility. At present, Chinese scholars' research on corporate social responsibility mainly focuses on the following aspects: some people believe that the ESG concept can create more value for enterprises, and take the ESG concept as one of the important criteria for evaluating the company's operating performance [9]; Some people believe that whether a company fulfills its social responsibility would affect its profitability and future development ability, and have constructed an ESG evaluation system that includes 5 dimensions and 12 indicators [10].

2.3. Social Level

In recent years, with the increasing attention paid to environmental issues internationally, relevant research at the social level has gradually become a hot topic. For relevant research at the social level, scholars mainly establish corresponding performance evaluation systems from the perspectives of government, enterprises, etc. At the government level, scholars around the world mainly construct a performance evaluation system for infrastructure project operation and maintenance management through relevant government policy documents. As for the research on the operation and maintenance management mechanism of public infrastructure in Germany, scholars believe that Germany has a relatively mature operating mechanism in infrastructure construction, so a corresponding performance evaluation system can be constructed from the perspective of the government [11]. The research on the operation and maintenance management mechanism of EU infrastructure projects takes the EU as an example to construct a corresponding performance evaluation system, while introducing third-party institutions to evaluate the performance of public infrastructure operation and maintenance management in EU countries. At the corporate level, scholars construct corresponding evaluation systems by drawing on ESG concepts from other countries [12]. The research on the operation and maintenance management mechanism of the UK government's public infrastructure mainly introduces the ESG concept into the UK government's public infrastructure operation and maintenance management mechanism. The research on the operation and maintenance management mechanism of Italian government public infrastructure is to construct a corresponding evaluation system by borrowing relevant systems from other countries' government public infrastructure operation and maintenance management mechanisms, and analyze and summarize them based on national conditions [13].

3. Current Status of Operation and Maintenance Management Based on ESG Concept

The ESG concept encompasses environmental, social, and corporate governance aspects. The environmental aspect includes biodiversity, carbon emissions, etc. The social aspect includes customer relationships, business activities, etc. The corporate governance aspect includes board

structure, shareholder rights, etc. As shown in Figure 1, it is a relatively complete ESG concept ecosystem.

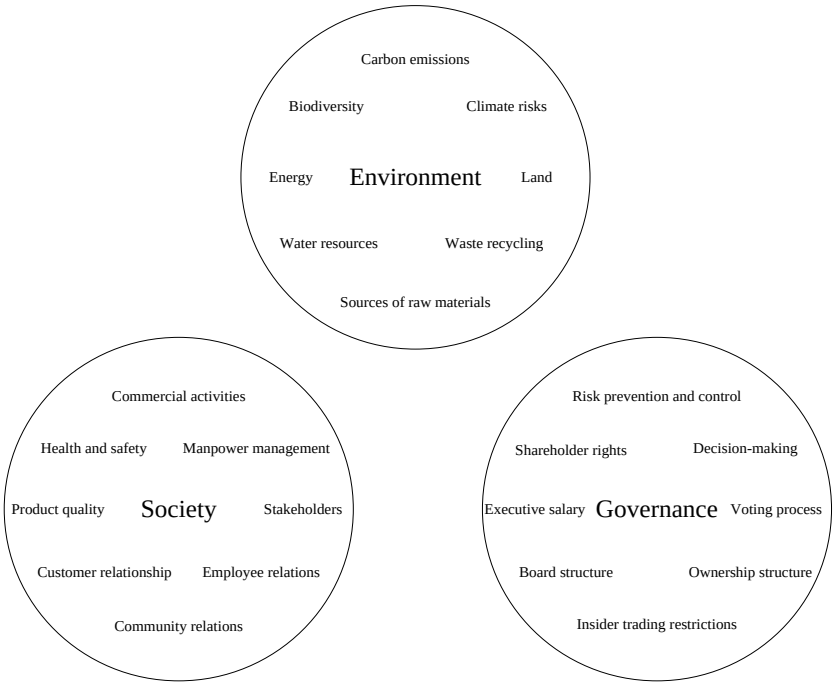

Figure 1: ESG Concept Ecosphere

Along with the increase in the size of the infrastructure investment, there are more and more problems in the running and maintaining of the infrastructure engineering. There are no uniform operating and maintaining management rules and regulations, there is no clear separation of duties in the running and maintaining of infrastructure projects, there is no efficient coordination between the different departments in managing and maintaining the infrastructure projects, which leads to a lot of problems in the running and maintaining of infrastructure projects, the lack of specialized personnel and the aging of the knowledge structure in the construction and maintenance of infrastructure projects [14].

Under the "Belt and Road" policy and "Carbon Summit, Carbon Neutrality", the construction of infrastructure has been paid more and more attention to as a key part of economy. To satisfy the increasing demand of the public, it is an important task for the IM operators to incorporate ESG into their operational and maintenance management in the present cooperative mode of government business. Currently, the study on the performance assessment of the operational and maintenance of infrastructure engineering in is just at the beginning stage. A number of studies will be devoted to establishing a business and maintenance management assessment system in line with ESG principles, whereas no related study has been conducted to establish a functional and maintenance management performance assessment model according to ESG concept. So, article sums up the present situation of RMI in terms of operational and maintenance management and its practical requirements [15-16].

4. Model Construction

Because of the great deal of information contained in the Performance Assessment Index System, the choice of targets is affected by both the subjective and the objective. From the point of view of the parties concerned, article analyses the establishment of a performance appraisal indicator system of open-ended fund [17].

From the point of view of environment, because of its high quality and social character, article considers "item placement", "influence level" and "social satisfaction" as the criteria for evaluating the environment. Second, from a societal point of view, it is considered that the construction and maintenance of infrastructure works for the benefit of the community and the community. For this reason, the concept of "corporate management" is used as an indicator for assessing the enterprise's dimension [18].

Taking into account the effects of both subjective and objective elements during the selection of index, Analytic Hierarchy Process is applied in article to make sure that every index is weighed. At last, article makes a comprehensive assessment of the indexes by means of fuzzy synthetic assessment. Based on the fuzzy comprehensive evaluation results, the article constructs a performance evaluation model for infrastructure project operation and maintenance management, as shown in Table 1.

Table 1: Performance Evaluation Model for Infrastructure Project Operation and Maintenance Management

Performance indicators	Weights	Quantification or not	Evaluation frequency	Source of information
Plan completion rate	A	Y	By node	Progress report
Quality evaluation	B	N	By node	Acceptance report
Organization level	C	N	Every time	Organizational documents
Document accuracy rate	D	Y	Every month	Document inspection records
Number of errors and delays	E	Y	Every month	Error statistics table

When constructing a performance evaluation model for infrastructure project operation and maintenance management, the article fully considers the significant differences between infrastructure project operation and maintenance management work and enterprise operation and management work. Therefore, when establishing the model, the first, second, and third level indicators in the performance evaluation system of infrastructure project operation and maintenance management were simplified to avoid increasing costs due to the complexity of infrastructure project operation and maintenance management work in different enterprises during the implementation process [19]. After determining the content of operation and maintenance management for various infrastructure projects, the article further subdivides the responsibilities of each department and divides the responsibilities of the responsible departments. After determining the responsibilities at all levels, the article further clarifies what specific responsibilities each department is responsible for in the operation and maintenance management process of infrastructure projects. Based on the analysis of the various dimensions and indicator selection methods of the performance evaluation system for infrastructure project operation and maintenance management, the article believes that the performance evaluation model for infrastructure project operation and maintenance management can effectively reflect the responsibilities and operational effects undertaken by enterprises in infrastructure project operation and maintenance management [20].

5. Experiment of Infrastructure Project Application Integrating ESG Concept

The reliability analysis formula for the questionnaire in the article is shown in equation (1).

$$t_{ii} = \frac{2t_{jj}}{1+t_{ij}} \tag{1}$$

In equation (1), t_{ii} is the initial reliability value of the entire test; t_{jj} is the correlation coefficient of test scores. In addition, the use of this method requires the scores of both tests to have the same mean or standard deviation. When this condition is not met, formula (2) needs to be used to estimate reliability.

$$t = 2\left(1-\frac{k_x^2+k_y^2}{k_z^2}\right) = 1-\frac{k_v^2}{k_z^2} \tag{2}$$

In equation (2), t is the reliability value, k_x^2 and k_y^2 are the variance of the test scores, k_v^2 is the variance of the difference in test scores, and k_z^2 is the variance of the total test scores. The data analysis of the article is based on formulas (3) and (4).

$$S = \delta + \frac{\sum ab}{T} \times w \tag{3}$$

In equation (3), δ is the mode, w is the group distance, and $b = \delta/w$ is the group difference.

$$K_d = L_d + \frac{T/2 - L_b}{a_d} \tag{4}$$

In equation (4), L_b is the sum of the degrees of the interval where the median is located, a_d is the degree, L_d is the exact lower limit of the interval, and T is the number of data. The experimental part mainly focuses on the efficiency of infrastructure project operation and maintenance management, and the results are shown in Figure 2.

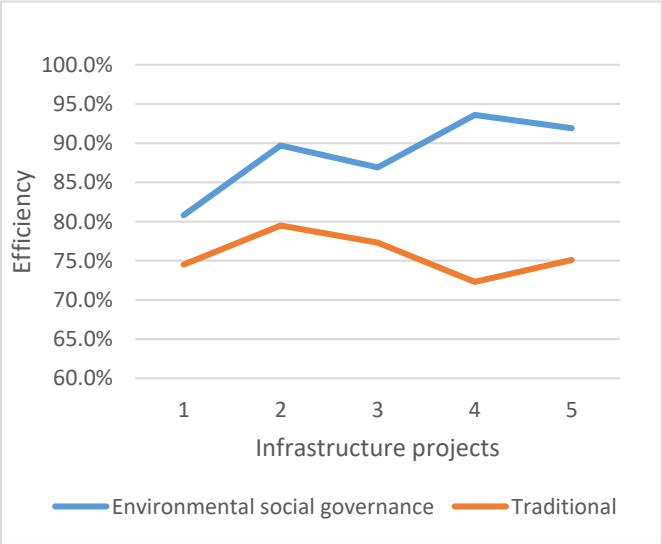

Figure 2: Comparison of Work Efficiency

From Figure 2, it can be seen that when using traditional operation and maintenance management, the average work efficiency of infrastructure projects is only 75.74%. However, after

introducing the ESG concept, the average efficiency has increased to 88.58%, an increase of 12.84%. It can be seen that the ESG concept is very helpful for the operation and maintenance management of infrastructure. At the end of the article, a social statistical evaluation was conducted on the performance of infrastructure operation and maintenance management, as shown in Figure 3.

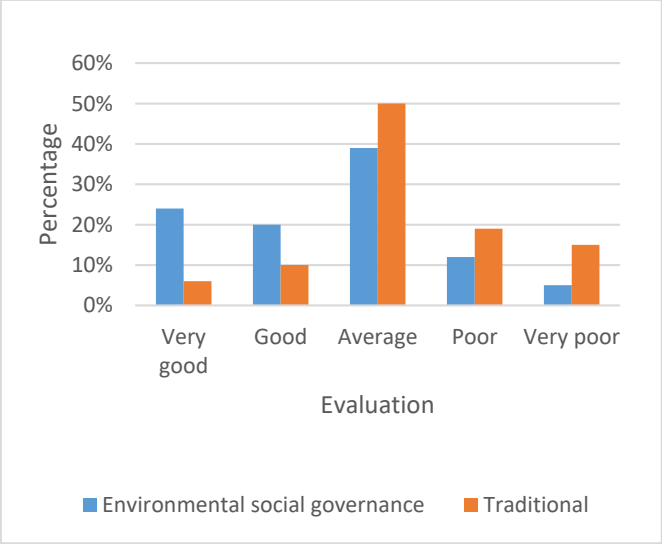

Figure 3: Social Evaluation

From Figure 3, it can be seen that before the introduction of the ESG concept, 50% of people rated infrastructure operation and maintenance management as "average", while 34% rated it as "poor" or below. After the introduction of the ESG concept, the proportion of people who rated infrastructure operation and maintenance management as "good" or above increased from 16% to 44%. From this, it can be seen that the introduction of ESG concept is very effective.

6. Conclusions

In the current new stage of development, the integration of ESG concept and infrastructure project operation and maintenance management is an inevitable requirement for promoting high-quality development of infrastructure projects. The article analyzes the current status of infrastructure operation and maintenance management, draws on the experience of other developed countries in infrastructure project operation and maintenance management under the ESG concept, and constructs a performance evaluation model for infrastructure project operation and maintenance management based on the ESG concept. This article proposes specific indicators at the government and enterprise levels, providing new ideas for promoting the high-quality development of infrastructure project operation and maintenance management work. In the future, while fully utilizing the ESG concept in infrastructure operation and maintenance management, it should gradually promote the integration of ESG concept into other infrastructure operation and maintenance management work, and establish a comprehensive ESG performance evaluation system. ESG can play a positive role in environmental, social, and corporate governance, contributing to the high-quality development of infrastructure operation and maintenance management.

References

[1] Zheng Chuanbin. Analysis of the key influencing factors of PPP project performance in the infrastructure field--Exploratory research based on rooted theory. Construction economy, 2023, 44(3):96- 104.

[2] Xiang Yinghui, Xing Yingnan, Zhao Yu. Residual value risk evaluation of infrastructure PPP projects. Construction Technology, 2020, 49(3):105-108.
[3] Song Jiahui, Fang Yue, Huang Tianjian, Wang Ziying, Ke Yushen, Liu Xun. Research on the sustainability evaluation of infrastructure projects based on cloud model. Value Engineering, 2020, 39(24):66-69.
[4] Ren Fei, Li Jia. Research on the construction of performance evaluation index system for Infrastructure construction projects in Zhengzhou High-tech Zone. Intelligent Construction and Construction Machinery, 2021, 3(8): 123-125.
[5] Dong Jia. H Performance evaluation of special debt and capital for hospital infrastructure construction. Value Engineering, 2022, 41(31):37-40.
[6] Jiang W, Martek I, Hosseini M R, et al. Political risk management of foreign direct investment in infrastructure projects: Bibliometric-qualitative analyses of research in developing countries. Engineering, Construction and Architectural Management, 2021, 28(1): 125-153.
[7] Walker D H T, Vaz Serra P, Love P E D. Improved reliability in planning large-scale infrastructure project delivery through Alliancing. International Journal of Managing Projects in Business, 2022, 15(5): 721-741.
[8] Chileshe N, Njau C W, Kibichii B K, et al. Critical success factors for Public-Private Partnership (PPP) infrastructure and housing projects in Kenya. International Journal of Construction Management, 2022, 22(9): 1606-1617.
[9] Schindler S, Kanai J M. Getting the territory right: Infrastructure-led development and the re-emergence of spatial planning strategies. Regional Studies, 2021, 55(1): 40-51.
[10] Ding X, Li Q. Optimal risk allocation in alliance infrastructure projects: A social preference perspective. Frontiers of Engineering Management, 2022, 9(2): 326-336.
[11] Kouton J, Sanogo W, Djomgoue N. Risk allocation in energy infrastructure PPPs projects in selected African countries: does institutional quality, PPPs experience and income level make a difference? Economic Change and Restructuring, 2023, 56(1): 537-580.
[12] Jallow H, Renukappa S, Suresh S. The impact of COVID-19 outbreak on United Kingdom infrastructure sector. Smart and Sustainable Built Environment, 2021, 10(4): 581-593.
[13] Zeitz A O. Emulate or differentiate? Chinese development finance, competition, and World Bank infrastructure funding. The Review of International Organizations, 2021, 16(2): 265-292.
[14] Alghamdi F, Tatari O, Alghamdi L. Enhancing the decision-making process for public-private partnerships infrastructure projects: a socio-economic system dynamic approach. Journal of Engineering and Applied Science, 2022, 69(1): 1-22.
[15] Hasnat M M, Bardaka E. Distribution of Highway Infrastructure Cost Responsibility and Revenue Contribution Shares Among Highway Users in North Carolina: Present Conditions and Future Alternatives. Transportation Research Record, 2023, 2677(2): 1082-1102.
[16] An H, Razzaq A, Nawaz A, et al. Nexus between green logistic operations and triple bottom line: evidence from infrastructure-led Chinese outward foreign direct investment in Belt and Road host countries. Environmental Science and Pollution Research, 2021, 28(37): 51022-51045.
[17] Ziberi B, Miftari F, Omaj L. The econometric approach of the impact of public investment in the road-infrastructure in the economic growth of Kosovo. Management dynamics in the knowledge economy, 2021, 9(1): 5-16.
[18] Chung M G, Frank K A, Pokhrel Y, et al. Natural infrastructure in sustaining global urban freshwater ecosystem services. Nature Sustainability, 2021, 4(12): 1068-1075.
[19] Zhuang Y, Yang S, Razzaq A, et al. Environmental impact of infrastructure-led Chinese outward FDI, tourism development and technology innovation: a regional country analysis. Journal of Environmental Planning and Management, 2022, 66(2): 367-399.
[20] Brooks L, Liscow Z. Infrastructure costs. American Economic Journal: Applied Economics, 2023, 15(2): 1-30.