Research on Due Diligence Computer Model of Thermal Power Plant Considering through AHP and Big Data

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Abstract. M&A of overseas power plants is an important way for Chinese power generation companies to expand and strengthen their international business. This paper proposes an evaluation model suitable for technical due diligence of thermal power plant mergers and acquisitions. Combined with the AHP, an evaluation model including four first-level indicators of equipment, environmental protection, energy saving, and management is constructed. This model can effectively solve the problems of quantification difficulties, strong subjectivity, and low efficiency in the current technical due diligence work, and make the evaluation conclusions more objective and accurate.

1. Introduction
Since The Belt and Road Initiative was put forward, it has gradually become an important international cooperation platform for extensive participation in the world. It has achieved remarkable results in promoting interconnection construction, trade and investment, economic and social development, and public health construction. During the “13th Five-Year Plan” period, Chinese central SOEs participated in the construction of more than 3,400 projects along The Belt and Road, it’s realized overseas operating income of more than 24 trillion-yuan, total profits is closed to 600 billion yuan, and the the rate of return on foreign investment reached 6.7%. The ability and level of international operation of the enterprise has been significantly improved [1].

In recent years, Chinese energy enterprises have actively responded to The Belt and Road initiative and The Going Out strategy, and their international business capabilities and levels have been significantly improved [2]. At present, the world’s major changes unseen in a century have entered a period of accelerated evolution, and the international environment is complex. The importance of energy and power security to national security is further highlighted, and international energy and power cooperation is also facing new opportunities. Facing the “14th Five-Year Plan” and under the background of building a “Dual Circulation”[3], we must continue to accelerate the pace of going global, coordinate development and security, explore more opportunities, steadily carry out high-quality asset investment mergers and acquisitions, and steadily explore the international market.

Technical due diligence is a work that must be carried out before overseas thermal power mergers and acquisitions, and its evaluation conclusion is an extremely important basis in the process of merger and acquisition decision-making [4]. Therefore, a fast, systematic, objective, accurate, and horizontally comparable technical evaluation method is the basis of technical due diligence [5]. However, the current industry not only lacks unified technical evaluation indicators for overseas thermal power M&A projects, but also lacks a unified evaluation model, which makes it difficult to quantify evaluation conclusions.
In addition, it also lacks auxiliary tools to conduct efficient and multi-dimensional technical evaluation of target power plants.

In response to the above problems, this paper constructs a scientific, comprehensive, systematic, and dynamic On-line Evaluation Method for overseas thermal power mergers and acquisitions technology due diligence, which solves the difficult quantification and subjectivity of evaluation conclusions, as well as low work efficiency and difficult coordination that exist in traditional technical due diligence work. It makes M&A decision-making more efficient, accurate and objective.

2. 4C on-line Evaluation Method for Overseas Thermal Power M&A Technology

The “4C on-line Evaluation Method” for Overseas Thermal Power M&A Technology is a general evaluation method used for corporate due diligence evaluation and decision-making of overseas thermal power M&A technology. The method includes 4 main steps: Unified Fund Collection, Index Comparison, Assignment Calculation, Evaluation Conclusion (4C: Collection, Comparison, Calculation, Conclusion). Examples are as follows (experts conduct technical due diligence on two thermal power plants A and B):

2.1. Unified Fund Collection

According to the evaluation index system of thermal power technology due diligence, organize thermal power experts to carry out online and on-site technical due diligence on thermal power plants to collect funds. According to the fund collection and database information, grasp the basic situation of the power plant. Ensure that the two collections are unified and indistinguishable.

2.2. Index Comparison

Experts use Analytic Hierarchy Process to determine index rights on the software platform, which reduces the influence of the expert's personal subjectivity on the evaluation results. In this step, experts judge the importance of indicators at the same level based on professional judgments, and complete the comparison and judgment matrix of indicators at each level one by one. After the expert completes the comparison judgment matrix, the software platform can quickly perform consistency testing, and if it passes the test, it will assign index weights, which greatly improves work efficiency. If not, the expert will be prompted to check and compare the judgment matrix to fill in the number information.

![Figure 1. “4C on-line Evaluation Method” for Overseas Thermal Power M&A Technology.](image)

In the above model, the technical evaluation score of the overseas thermal power plant merger and acquisition project is set to $Z$. Among the first-level indexes, the Equipment [6]-[7] [8] score is $X_A$, the Environmental Protection [9]-[10] 11 score is $X_B$, the Energy-saving[12]-[13] [14] score is $X_C$, and the Management [15] score is $X_D$.

$$Z = X_A Y_A + X_B Y_B + X_C Y_C + X_D Y_D$$  \hspace{1cm} (1)
In the above formula (1), $Y_A$, $Y_B$, $Y_C$, and $Y_D$ are the weights of the influence of the four first-level indexes of Equipment, Environmental Protection, Energy-saving, and Management on the total technical evaluation score of thermal power plants.

For the score of the secondary index $Z_{A2}$, the main calculation method is:

$$Z_{A2} = X_{A21}Y_{A21} + X_{A22}Y_{A22} + \cdots + X_{A2n}Y_{A2n}$$  \hspace{0.5cm} (2)

In the above formula (2), $n$ is the number of the third-level indexes included in the second-level indexes.

For the scores of the three-level indexes, the corresponding professional experts will score according to the scoring rules and actual conditions.

The method of determining the index weight is the analytic hierarchy process, which mainly includes the steps of establishing a hierarchical structure model, constructing a judgment matrix, hierarchical ranking and consistency checking\[16\] \[17\].

2.3. Assignment Calculation

Experts in various disciplines use the range transformation method to process and score the three-level indicators of thermal power plants, and upload the experts’ scoring instructions on the corresponding indicators in the software. Based on the assignment of indicators, the software can quickly calculate the scores of secondary indicators and the scores of the whole plant and power plants, and obtain the quantitative results of technical evaluation.

2.4. Evaluation Conclusion

Experts call the radar chart analysis results of the whole plant, first-level indicators, and second-level indicators on the software platform, and carry out comparative evaluations based on the radar charts, and obtain all-round evaluation conclusions from "whole-part". On this basis, a technical due diligence report and related evaluation conclusions are formed.

According to the “4C on-line Evaluation Method”, thermal power experts can carry out technical evaluation work for different professions in the same thermal power plant remotely, online, and simultaneously. While avoiding the common problems of traditional technical due diligence, it greatly improves the coordination efficiency of technical due diligence work.

3. Implementation Effect

The research results of this paper have been successfully applied in the technical due diligence of a power plant in Russia, a power plant in Bosnia and Herzegovina, and a power plant in Australia. The technical evaluation conclusions of the relevant power plants are comprehensive, in-depth and objective, and clearly point out the numerous technical defects of the target thermal power plants, providing reliable technical support for the company to do the above-mentioned project mergers and acquisitions, and significantly reduce the cost of overseas thermal power mergers and acquisitions. Investment risk has significant economic and social benefits.

3.1. Effectively Improved the Level and Efficiency of Technical Due Diligence

This article builds a technical evaluation system for overseas thermal power M&A projects, develops a cloud evaluation software platform, improves the power industry’s “going out” risk protection, and provides the industry with a more standardized, efficient, objective and comprehensive technical due diligence work process. With more powerful tool support, it solves the long-standing difficulties of the industry, fills the gaps in the industry in terms of specifications and tools, and leads the technological innovation of domestic power companies' overseas mergers and acquisitions and the high-quality development of international business. This method promotes the overseas mergers and acquisitions of domestic power generation companies to a higher level, provides powerful technical guarantees for
central enterprises to become stronger and larger overseas mergers and acquisitions, and has significant social benefits.

3.2. **Significantly Reduced the Risk of M&A Investment**

The research results of this paper have been applied to many overseas thermal power M&A projects of a large Chinese power generation company, clearly pointed out the many technical defects of the target thermal power plant, and provided reliable technical support for Chinese energy companies to engage in similar project mergers and acquisitions. It reduces the investment risk of overseas thermal power mergers and acquisitions, effectively avoids large-scale risk investment, is conducive to the risk management of Chinese enterprises' overseas assets, and improves the efficiency and efficiency of Chinese enterprises' overseas investment, which has significant economic and social benefits.

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