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Analyze the Similarities and Differences in EPC Mode Power Engineering Between China and Other Countries from the Perspective of Risk Avoidance in Enterprises

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Abstract: The subject of this paper is to explore the application of the EPC model in China and other countries electric power engineering projects. Engineering Procurement and Construction Mode refers to an engineering contracting mode under the deep intersection of Engineering, Procurement and Construction, where the project contractor integrates these key activities to improve the efficiency and quality of the project and control the cost and risk. However, due to the differences in culture, market and development history between the policies of China and other countries, the EPC model applicable to China's power engineering projects is not fully applicable to power engineering projects in international cooperation, which leads to the obstruction of Chinese power enterprises in participating in the construction of international cooperation. To delve deeper into the applicability and risk management of the EPC model. This study employs methods such as case study, literature review, and comparative analysis. Considering the current market regulatory requirements for risk management requirements of power engineering project strict, increasing attention, the power engineering project risk management system, although relatively mature, but EPC mode power project as a new way of cooperation, there is still a risk identification difficulty, risk evaluation error, and many other problems, combined with EPC mode project general contractor responsibility, high risk, so further project risk research is of great significance.

Keywords: EPC mode of electric power engineering, risk management, study case analysis.

1. Introduction

With the continuous promotion of the national "Belt and Road" initiative, China's large power project contractors have become an active promoter and an important participant in the international infrastructure market. The increasing investment in power grid construction and the strong support of international policies have also brought new opportunities for China's power enterprises to participate in the international engineering construction. China's construction engineering EPC model has generally gone through four stages: enlightenment, promotion, standardization and comprehensive development. The Interim Provisions on Several Issues concerning the Reform of the

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Construction Industry and Capital Construction Management System promulgated by The State Council opened the enlightenment stage [1]. The promulgation of the Construction Law promotes a batch of type models of construction projects in the form of clear legal provisions, marking that it has entered the promotion stage [2]. The promulgation and implementation of the General Contracting Management Standard for Construction Projects signifies that China's construction projects have entered a new stage of standardization [3]. The CPC Central Committee and The State Council "Several Opinions on Further Strengthening the Management of Urban Planning and Construction" Guide China's construction project EPC mode into the stage of comprehensive development [4]. This paper focuses on two research subjects: the “Jujuy Province photovoltaic power station project” in Argentina and a photovoltaic power generation project in China. Utilizing industry-recognized theories such as SWOT analysis, crisis management, and differentiated strategy management, the paper conducts an actual analysis of the projects. It particularly emphasizes the types of risks and the factors that induce these risks in the context of Chinese enterprises participating in international cooperation power engineering projects. The paper proposes strategies for Chinese enterprises to avoid risks during their involvement in international projects, thereby paving the way for them to actively promote and become important players in the international infrastructure market.

2. EPC Project Implementation Model of China and Other Countries

2.1. China's EPC Project Implementation Model

After decades of development, China EPC project has formed a set of relatively applicable project management ideas and methods [5]. The implementation mode of its EPC project is mainly based on its own organization, engineering practice experience, staff quality level, learning and absorption ability and other elements, and gradually develops in accordance with certain laws. The implementation method is generally based on the project development progress, after reaching the intention or framework agreement, the company timely establishes the project department and the project team. After the formal contract is signed, the competent department of the company shall prepare the project management outline or the general design and overall schedule of the construction organization, and the project department shall adopt relevant procedures and operation documents, and then carry out the work and activities in the design, procurement, construction and installation, commissioning and completion stages according to the relevant requirements. The company shall control the quality, safety, progress and cost of the project in accordance with the project management outline. However, the function of the company mainly lies in business guidance and regular supervision and inspection, and it is less directly involved in the business activities of the project department.

2.2. EPC Project Implementation Mode in Other Countries

In large multinational engineering companies in other countries, based on long-term project practice and the effective application of advanced management concepts and modern management science, the implementation of EPC projects has very mature, rigorous, complete and relatively typical implementation methods. Foreign company EPC project implementation mode of basic management principle is the company headquarters of the whole process of EPC project different stages of three integrated management-project bidding, project implementation and project management set milestone control nodes and to achieve the quality level, and planned with the project schedule node verification, clear responsibility and division of tasks, to ensure that meet the relevant quality requirements [6]. For example, in terms of labor cooperation, due to the strong strength of the local labor union in Argentina, the company is at risk of being suspended if the company does not employ reported workers or locally registered workers according to the labor union requirements. In this

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regard, the contractor will actively communicate with the union, promising to hire a part of the local labor, the union will recruit, and pay to the union. This part of labor is managed by the trade union, and problems are solved by the trade union. If some skilled workers or special types of work cannot be found in the local area, the contract management team will report to the union in advance and recruit them after the consent of the union.

Other companies pay more attention to communication and cooperation in EPC projects, so as to promote information sharing and problem solving, and to deal with the conflicts of interests of all parties in the project [6]. For example, photovoltaic power station projects in Huhu province, Argentina, have long enjoyed a preferential policy in dollars. In 2019, due to the sharp depreciation of the Argentine peso, the Argentine central bank adopted temporary foreign exchange controls, requiring enterprises to force the settlement of bank dollar loans and dollar trade income into the peso. After learning about the situation, the company immediately communicated with the bank and consulted the local legal professionals. After fully understanding the temporary policy, it provided the central bank of Argentina with the reason for not forcing the compulsory settlement of foreign exchange. Finally, the relevant funds are entered in the form of US dollars, which avoids the financial exchange loss of the project and saves the financial costs.

3. Comparative Analysis of EPC Projects between China and Other Countries

3.1. Common Points of EPC Projects between China and Other Countries

The first thing in common is a one-stop service. The EPC general contracting mode is that a company or a team is responsible for the implementation of the whole project, including the design, procurement and construction of the project. Customers simply work with a contractor, simplifying the complexity of project management [7].

The second common ground is that the responsibility is clear. EPC contractor is responsible for the execution of the whole project and takes responsibility for the success and failure of the project. This model of clear responsibilities improves the efficiency and quality of project execution.

The third common denominator is time cost control. The EPC general contracting mode can concentrate resources, improve the efficiency of project execution, shorten the project cycle, and reduce the project cost. At the same time, this mode focuses on the project schedule and quality control, which is conducive to the successful delivery of the project.

The fourth thing in common is technology integration. In EPC general contracting mode, the same company or team is responsible for the execution of the whole project, which is conducive to the integration and coordination of technology and improves the efficiency and quality of project execution.

The fifth thing in common is risk-sharing. The EPC general contracting mode can reasonably allocate risks to contractors and reduce the risk bearing of customers. The contractor takes more risk in the project, thus encouraging it to improve the execution efficiency and quality of the project.

3.2. Differences in EPC Projects between China and Other Countries

First is in terms of EPC mode, China part of the company has formed its more mature EPC project implementation mode, effective in practice, but most of the company has not refined the molding implementation mode, compare other countries EPC project in the integrity of the implementation mode, systematic, rationality, precision, effectiveness has a realistic gap.

Followed by in terms of the form and content of implementation, the domestic EPC project implementation mode main management content is also basic covers most of the key activities of the project process, function is complete, but consciously not according to the collection, has not established clear logical cohesion, the dispersion of project implementation results is larger, relevant

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personnel to the whole process and different stages quickly establish a large, relatively clear framework concept.

Finally, in the aspect of implementation management, there are major risks in the key activities such as risk management, procurement management, contract management, cost management, such as omission, extensive management, inadequate management, loss of principles, out of control. For example, there is a gap in the knowledge, skills, awareness, and initiative of Chinese EPC project managers compared to actual requirements [8]. The management system, filing system, and functional positioning have not been systematically combed and updated to keep pace with the times. Additionally, there is a lack of sensitivity to the scientific development of project management, as well as absorption and application of new practices. This has resulted in a failure to establish a unified coordination mechanism for projects, resource sharing, and industry standardization. Consequently, the understanding and dynamic management of risks remain at a more casual and primary stage.

4. Analysis of the Sources of Risk Factors for EPC Projects

The EPC mode in the process of project construction, the risk of business areas and the cause of risk factors is diverse, based on the risk of photovoltaic engineering main source of external environment and internal state, can affect risk factors specific subdivided into five dimensions, namely the political policy, economic market, resources and environment, scheme design and organization management.

The influence of political and policy factors as the first dimension includes reporting and review procedure and guiding development. On the one hand, the construction of photovoltaic power generation project involves a number of written documents including project report, construction land, water and soil protection, scheme design, which need the review and approval of the government and many relevant departments and institutions. On the other hand, the promotion of photovoltaic power generation project construction and the development of photovoltaic industry cannot be separated from the security and stability of national politics and the support and guidance of government policies. For instance, the grid parity price is a significant factor affecting the development of photovoltaic (PV) projects, and regional differences have a substantial impact on their growth. Regions with better economic conditions possess favorable conditions for developing PV projects. This disparity became more pronounced after the National Development and Reform Commission (NDRC) announced in 2021 that the central government would no longer provide subsidies for PV projects [9]. In addition, at present, the photovoltaic power generation industry and related projects lack of sound industry standards and regulations, which requires the supervision and management of the government, in order to promote the good and healthy operation and development of photovoltaic power generation projects and related industries.

As the second dimension, in the construction process of photovoltaic power generation project, it is actually in the economic environment and market operation. When the related market factors fluctuate, it is bound to have an uncertain impact on the photovoltaic power generation project, increasing the possibility of risk. Regional economic development level, power generation cost and income, output stability of photovoltaic power generation products, service level of power generation enterprises and power sales level and other market factors can have a significant risk impact on the project construction of photovoltaic power generation projects. In addition, the blind development and expansion of photovoltaic power generation related industries have also increased the risk probability of the economic market.

Resources and environmental factors constitute the third dimension of influence in the construction of photovoltaic power generation projects. The natural environment and solar resources of the proposed region are essential for the project's success. Creating distributed photovoltaic demonstration zones, the effective hours of sunlight are an important factor affecting the development

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of distributed photovoltaic. Currently, regions with good sunlight conditions can be considered as demonstration areas for photovoltaic projects [9].

To mitigate risks, it is important to focus on the protection of the local natural ecology and soil and water conservation, which can significantly reduce environmental resource risks. In addition, attention should also be paid to the risks caused by the changes in other external environmental factors, such as force majeure natural disasters, sudden climate change.

As the fourth dimension, the scheme design factor, in the construction process of photovoltaic power generation project, largely depends on the scientific, reasonable and reliable application of photovoltaic power generation scheme design and related technologies. On the one hand, the photovoltaic power generation project has high requirements for functional positioning, scheme planning and preliminary design; the potential risks of technical scheme change may cause joint risks to the project. On the other hand, the project still has the demand for improvement of photovoltaic power generation technology, and the production and construction of many contents of the photovoltaic power generation industry chain still needs the import of raw materials. It is the existence of such risk factors, photovoltaic power generation technology continues to innovate and improve the ability, improve substitutability, shorten the update cycle, in order to better deal with risks. Finally, the fifth dimension is the operation and management factors. In the construction process of photovoltaic power generation project, the organization and cooperation of capital and material personnel and the scientific progress of project management are an important guarantee to achieve the construction objectives and investment benefits of the project. Its work content covers construction investment, construction schedule, technical quality, safety and civilization, contract information and other aspects. The occurrence of any potential risk factors and related risk events will affect the realization of the comprehensive target benefit of the whole project. Therefore, in the construction of photovoltaic power generation projects, attention should be paid to the monitoring and identification of risk factors in the management organization, and the formulation of scientific and reasonable work plans and processes can effectively reduce the occurrence probability of risks in the management organization.

5. Optimization Measures for Risk Management of EPC General Contracting Projects

5.1. Local Tax Policies

In the construction process of EPC project general contracting project, the cost management personnel of general contracting enterprises must abandon the traditional thinking mode, fully understand the importance of cost risk management, and make clear the correlation between tax payment and cost [8]. On the one hand, the cost management personnel of EPC project general contracting enterprises must be familiar with the local tax policies, and at the same time, according to the characteristics of the project to avoid double taxation and reduce tax risks. On the other hand, the cost management personnel should be good at making use of the local tax policies to strive for more preferential policies for the project and promote the smooth implementation of the project tax management work. In addition, the cost management personnel should also have a good legal awareness, do a good job in legal risk prevention and control work, implement effective risk prevention and control measures, to ensure the smooth progress of the project.

5.2. Engineering Design Change Work

In the construction stage of EPC project, it is crucial to deal with the design change, otherwise the project may cause unexpected risks and uncontrollable consequences. Engineering design changes are usually well managed from the following two aspects. First, the general contracting enterprise of EPC project should actively communicate with the owner to ensure that the design scheme meets the

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requirements of the owner. Second, the general contracting enterprises should do a good job in the disclosure of the design scheme, so that the construction personnel clearly understand the design intention, to avoid mistakes in the actual construction process. If it is necessary to adjust the design, the designer should consider various feasible schemes and make a comprehensive assessment of the adjusted project quantity and cost. Good engineering design change management can not only reduce the additional cost of design change, but also make the construction process of the project smoother.

5.3. Pre-project Investigation Work

During the construction period of EPC engineering general contracting projects, the engineering general contracting enterprises will usually face huge cost risks. Therefore, in the bidding stage, the cost management personnel of the general contracting enterprise must have a comprehensive and in-depth understanding of the local site situation, check the construction site and surrounding environment, identify potential risks and geological problems, accurately estimate the overall construction cost of EPC project, and take effective measures to manage and control the project cost. If the general contractor of the EPC project fails to fully consider various risk factors and make a comprehensive assessment of the project cost, the project will seriously affect the construction efficiency and the final cost-benefit of the project. Therefore, before bidding, the general contracting enterprises should do a good job of on-site investigation, accurately judge and analyze the potential risks, to ensure the smooth implementation of the project industrial economy.

5.4. Cost Management Scheme

In order to effectively control the overall cost of the project, EPC general contracting enterprises need to constantly improve the construction plan and cost scheme from the design stage, and take reasonable measures to control the overall cost of the project in a reasonable range, so as to achieve the expected profit effect. EPC engineering general contracting enterprises can also use the engineering cost control technology, effectively control the design and construction costs, and achieve the maximum economic benefits. In addition, through systematic theoretical analysis, from the perspective of optimization, dynamics, integration and modelling, EPC engineering general contracting enterprises should comprehensively consider various factors, grasp the key of project cost control, implement dynamic control of project cost, so as to realize the effective control of project cost.

5.5. Cost Management Intensity

If the general contracting enterprise does not complete the settlement of the entrusted project, design change review and other processes in time, then after the completion of the project, the enterprise usually cannot accurately understand the situation on the site, thus affecting the quality and progress of the settlement. Therefore, the implementation of EPC general contracting projects must be strictly in accordance with the prescribed procedures, the general contracting enterprises must do a good job in the quantity audit of each sub-project, at the same time must effectively deal with the settlement work, give full play to the value of cost risk management work.

5.6. Material Procurement Work

First of all, the general contracting enterprise should establish a set of material procurement system, so that the procurement personnel can purchase materials in time according to the construction schedule. Secondly, the general contracting enterprises should establish an information service management platform for material procurement, and the procurement personnel can directly

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communicate with the suppliers through the platform, so as to avoid the problems such as random price increases and shoddy suppliers, so as to reduce the construction risk. Finally, before the materials enter the site, the quality inspection personnel need to conduct strict inspection on the specifications, grades and batches of the materials to ensure that the materials meet the construction requirements. When the construction materials are transported to the site, the construction personnel shall carefully check the specifications and quality of the materials, and require the supplier to issue the corresponding certificate of qualification. Once the materials are found to have problems, the quality inspection personnel should reject the materials, and order the supplier to find out the cause of the problem, so as to effectively avoid the problem materials mixed into the construction site.

6. Conclusion

In conclusion, the application of EPC model in countries worldwide has achieved remarkable results, but there are still some significant differences and challenges. Therefore, this study focus on systematic, scientific risk management and cost control refinement during the project implementation , linking China and other countries of EPC project, through the comparative analysis of similarities and differences in five risk dimensions to provide ideas and direction for further optimizing and improving the enterprise performance in EPC project, thus further proposes effectively integrate resources, risk management, and global should complex five response mechanism policy and market environment.

In the future, with the in-depth development of global economic integration and the promotion of technological progress, the EPC model will be more widely used in the field of international infrastructure. Chinese enterprises can accelerate the pace of technological innovation and management innovation, improve the intelligent level of project management, and explore the application of information technology in EPC projects, such as big data analysis, artificial intelligence, so as to improve the precision and prediction ability of project management. At the same time, enterprise should strengthen the connection with international standards, and cultivate a professional talent team with international vision and cross-cultural communication skills, so as to better adapt to and lead the new pattern of global competition.

In short, EPC model is not only the mainstream trend of engineering construction at home and abroad, but also an important means to achieve the goal of sustainable development and promote high-quality economic development. Through continuous optimization and innovation, enterprise can better respond to the challenges of the future and contribute China's wisdom and strength to building a safer, more efficient and sustainable world.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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