Construction of standardization system of construction engineering cost and international comparative study

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Abstract: This paper discusses the current situation of China's construction project cost standardization system, and makes a comparative study with international mature models, so as to provide path suggestions for the international development of China standards. Firstly, this paper analyzes the problems existing in the standardization system of engineering cost in China, such as the disunity of standards and weak execution, and points out the challenges it faces. Then, the paper compares the engineering cost management systems of Britain, the United States, Singapore and international organizations, analyzes their system composition, operation mechanism and core advantages, and summarizes the characteristics of mature systems: high marketization, standardized rules, deep integration of digitalization, clear roles of professionals and high degree of internationalization. Finally, the article puts forward the optimization path of China's engineering cost standardization system, including system integration and standard promotion, deep integration of digital empowerment and BIM, market-oriented reform and mechanism innovation, and talents' integration with international standards, aiming at building a modern standard system of "market pricing, data-driven, international compatibility and digital intelligence" and providing solid support for the high-quality development and "going out" of China's construction industry.

1. Introduction

Driven by the sustainable development of global construction industry and China's "double cycle" and "One Belt, One Road" policies, in 2022, the number of newly signed contracts for foreign contracted projects in China increased, but the industry faced management challenges brought by the expansion of project scale, technical complexity and geographical diversity. Information asymmetry in transnational operations leads to the deviation of cost forecast, and the fragmentation of domestic and international pricing standards intensifies the management difficulty, while the lack of BIM technology penetration restricts the realization of life-cycle cost control [1].

At present, there is a lack of systematic discussion on the coordination mechanism of policy, technology and market in the project cost standardization system in theory, but in practice, the "China Standard" is poorly adapted to international rules. Therefore, this study reveals the dynamic evolution law of standardization, fills the theoretical gap of digital empowerment, and puts forward the internationalization path of China standards by comparing the mature models of international experience, which provides decision-making basis for "going out" enterprises to reduce cross-border transaction costs.

2. Analysis of the current situation of China's construction cost standardization system

The construction industry has ushered in an unprecedented development opportunity. However, the problems existing in the construction cost management are increasingly prominent, such as irregular management and lack of dynamic static management [2-3]. The construction and optimization of China's construction engineering cost standardization system is a complex and systematic project, which involves the whole process management of engineering cost, including decision-making stage, engineering design stage, construction stage and so on. In recent years, the

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awareness of standardized management in China's construction industry has been continuously improved, and more and more enterprises have begun to attach importance to and implement standardized management [4]. Standardized management can not only improve work efficiency, but also effectively control project cost and reduce unnecessary waste. The standardization system of construction cost in China has been initially established, but there are still some problems, such as inconsistent standards and weak execution. The existence of these problems affects the effective operation of the standardization system.

In view of the problems existing in construction cost management, China scholars and professionals are actively exploring dynamic control countermeasures [5-6]. These countermeasures realize the real-time monitoring and adjustment of project cost by establishing a dynamic management system. The construction of China's construction engineering cost standardization system is also constantly absorbing international advanced experience. Through the comparative study with the United States, Britain, Japan and other countries, China can learn from its mature project cost management system and combine its own actual situation to continuously improve its own standardization system.

Although some progress has been made in the construction of China's construction project cost standardization system, it still faces many challenges. In the future, China needs to further strengthen the cultivation of standardized management awareness, improve the standardized management system, explore effective dynamic control countermeasures, and actively carry out international comparative research, so as to promote the continuous optimization and development of the construction project cost standardization system.

3. Comparative study on international engineering cost standardization system

In the global construction market, different countries and regions have developed their own unique engineering cost management systems based on their legal systems, market habits and cultural backgrounds. In-depth comparative study of these systems is the basis for identifying their own shortcomings and drawing on international experience. This paper selects Britain, the United States, Singapore and international organizations as the main comparison objects, and analyzes their system composition, operation mechanism and core advantages. The core comparison dimensions are shown in Table 1 below.

Table 1 Core comparative dimension

Comparative dimension	British system	American system	Singapore system	Current situation in China
Core standards/rules	Published by RICS, it provides a global standard for engineering quantity calculation, with strict logic and clear hierarchy [7].	Focus on the standardized classification of project information, and provide a unified framework for cost data and information management.	Originated from SMM (Singapore Standard Method of Measurement) in Britain, it has been highly localized and deeply integrated with BIM and PPP mode.	National norms coexist with local/industry quotas, and the system is relatively fragmented, with weak international universality.
Pricing mode	Emphasis is placed on the whole process	The degree of marketization is extremely high, and	SMM is adopted to ensure the unified bidding basis, and	Although bill pricing has been

	cost management and control, and QS (Quantity Surveyor) is involved in the whole process of investment decision-making, design, bidding, construction and settlement.	the government does not issue quotas. Cost estimation relies heavily on historical project data (such as RSMeans database) and contractor's enterprise quota.	at the same time, the price competition is fully liberalized. The government promotes best practices through project demonstration and standards [8].	implemented, the quota still dominates the cost determination and control, and the mechanism of market price formation is not yet fully mature.
Digitalization and BIM application	RICS actively promotes the integration of NRM and BIM(ISO 19650), and formulates information exchange standards (such as COBie) to realize the seamless transmission of cost data.	BIM is widely used for visual calculation and cost simulation, with mature software ecology (such as Autodesk, Bentley) and high integration with cost database.	As part of the "Smart Country" plan, it is mandatory to submit BIM models for projects above a certain scale, and SMM and BIM standards are deeply integrated to realize automatic calculation.	Although it is being popularized, it is mostly used for design display and collision detection, which fails to achieve deep integration with the cost process and lacks a unified data exchange standard.
Professional talent role	Its professional qualification (RICS) is recognized by the whole world, and its role is defined as "financial adviser to customers", providing high value-added services such as value management and life cycle cost analysis [9].	Pay more attention to the technical cost prediction and control, and have various professional certifications (such as CCP/PSP of AACE).	The professional system is perfect, and the role combines the characteristics of QS in Britain and cost engineer in the United States. I know both technology and contract and finance.	The professional level is constantly improving, but the knowledge structure emphasizes quota and local norms, and the compound talents who are familiar with international rules, understand technology and are good at

				management are scarce, and the international recognition needs to be improved.
Degree of internationalization	RICS standard, NRM and QS service are the "common language" of Commonwealth countries and many international projects, which have a profound impact on global engineering management practice.	American model, software and database have great influence in the world (especially in the private sector), and MasterFormat is one of the important international standards for information classification.	As the center of the Asia-Pacific region, its standards and practices not only conform to international practices, but also take into account Asian characteristics, and it is an excellent integration of the "East-West" model.	With the promotion of the "Belt and Road Initiative", the pace of "going out" of China standards has accelerated, but compared with the American and British systems as a whole, there is still a big gap in international acceptance and adaptability.

Through comparison, we can find that mature international systems generally have the characteristics of high marketization, standardized rules, deep integration of digitalization, clear roles of professionals and high degree of internationalization. They are not only pricing norms, but also a complete ecosystem covering information classification, data management, process control and professional services. At present, the biggest challenge for China's project cost system lies in how to change from a static control system with "quota" as the core to a dynamic market service system with "data" and "value" as the core, and integrate with the international mainstream rules.

4. Optimization path of engineering cost standardization system in China

Based on international comparison and analysis of domestic status quo, the optimization of China's engineering cost standardization system should follow the principles of "basing on national conditions, benchmarking internationally, innovation-driven, and systematic promotion", and the specific paths are as follows:

4.1 System integration and standard promotion path

Strengthen the leading role of the national "Code for Valuation of Construction Engineering Bill of Quantities", gradually weaken and integrate the differential quotas of different industries and regions, and build a national unified, hierarchical, compatible and open valuation standard system. Actively absorb and learn from the advanced concepts and frameworks of international standards such as NRM and MasterFormat, promote the compatibility of China's list pricing specification with NRM and other standards in terms of terminology, measurement rules and outcome documents,

and reduce the compliance cost of international projects.

4.2 Digital empowerment and BIM deep integration path

Accelerate the formulation of BIM-based engineering quantity calculation rules and cost information exchange standards (such as the localized application of IFC and COBie), break the data barrier between design and cost, and realize the transformation from "manual calculation" to "automatic and intelligent calculation". Guided by the government and led by industry associations, national and industry-level engineering cost databases will be established to collect, clean and publish real project cost data, providing accurate pricing reference for all parties in the market and gradually getting rid of dependence on traditional quotas.

4.3 Market-oriented reform and mechanism innovation

Encourage large-scale design, construction and consulting enterprises to establish enterprise quotas that reflect their own technical and management levels, form their core competitiveness, and promote the transformation of project cost from "government-guided price" to "independent quotation of enterprises".

Cultivate and promote the role of "Quantity Surveyor" in China, promote the cost consulting enterprises to extend to the early decision-making and late management, provide the whole process and life-cycle cost management services with investment control as the core, and enhance the value creation ability.

4.4 The path of talent and international integration

Reform the university curriculum and strengthen the teaching of international engineering contracts, BIM technology, data analysis, English and other compound knowledge. Promote the mutual recognition or connection between the qualification of domestic cost engineers and internationally renowned qualifications. Support industry associations and enterprises to actively participate in the standard-setting activities of international organizations such as ISO and ICEC, organize the foreign language translation and promotion of China standards, and enhance the international voice and influence of "China Standards".

The optimization of engineering cost standardization system in China is a systematic project that changes from "rule follower" to "rule maker". Its fundamental goal is to build a modern standard system of "market pricing, data-driven, international compatibility and digital intelligence" to provide solid support for the high-quality development and high-quality "going out" of China's construction industry.

5. Conclusion

The mature international system generally has the characteristics of high marketization, standardized rules, deep integration of digitalization, clear role of professionals and high degree of internationalization. These systems are not only pricing norms, but also a complete ecosystem covering information classification, data management, process control and professional services. In contrast, China's engineering cost system is still dominated by static control with "quota" as the core, which urgently needs to be transformed into a dynamic market service system with "data" and "value" as the core, and be in line with international mainstream rules. Based on the above analysis, this paper puts forward the optimization path of China's engineering cost standardization system: strengthening the leading role of the national "Code for Valuation of Construction Engineering Bill of Quantities" and gradually integrating the differential quota; Accelerate the formulation of BIM-based engineering quantity calculation rules and cost information exchange standards, and promote the data integration of design and cost; Encourage enterprises to establish enterprise quotas that reflect their own technology and management level, and promote market-oriented reform; Strengthen the cultivation of compound talents, promote the mutual recognition or convergence of domestic professional qualifications and international qualifications, and enhance the international discourse power and influence of "China Standard". In a word, the optimization of China's

engineering cost standardization system is a systematic project, and its fundamental goal is to build a modern standard system of "market pricing, data-driven, international compatibility and digital intelligence", which will provide solid support for the high-quality development and high-quality "going out" of China's construction industry. In the future, China needs to further strengthen the cultivation of standardized management awareness, improve the standardized management system, explore effective dynamic control countermeasures, and actively carry out international comparative research, so as to promote the continuous optimization and development of the construction project cost standardization system.

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