

Construction and Management of the Organizational Framework for the Review of Final Settlements for Hospital Engineering Projects

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Abstract: Hospital engineering projects bear the attributes of public buildings and medical specialties, containing a large number of special medical systems. Such projects feature numerous design changes during construction, diverse participating parties, and complicated pricing rules. The final settlement review serves as the last line of defense for project investment control, and it exerts a direct impact on the efficiency and compliance of construction fund utilization. At present, hospital project settlement reviews suffer from fragmented organizational structures, low professional matching degree, inadequate process control, and weak risk prevention, which lead to prolonged review cycles, pricing disputes, and unstable review quality. Establishing an organizational framework with clear power and responsibility, as well as professional collaboration, and forming a refined whole-process management mechanism constitute the core solutions to the above problems. In view of this, this paper conducts an in-depth analysis of the construction and management of organizational frameworks for hospital engineering final settlement reviews, aiming to provide references for the standardized implementation of such work.

Keywords: Hospital engineering; Final settlement review; Organizational framework; Risk management

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1. Introduction

With the continuous improvement of China's modern medical system and the development of medical and health undertakings, hospital construction projects at all levels are being advanced, with expanding construction scales and growing technical complexity^[1]. Compared with general civil buildings, hospital projects integrate public building and professional medical attributes. Apart from conventional civil engineering and installation works, they cover multiple special systems including medical gas, smart medical care, and logistics transmission, which are subject to high technical standards and strong system coupling.

In addition, numerous design changes and visa records are frequently generated due to adjustments to medical demands during construction, bringing severe impacts on cost control. Final settlement review acts as a key link in hospital engineering projects, which directly affects the safety and utilization efficiency of construction funds.

At present, many hospital projects still adopt the traditional single-department-led review mode with outdated organizational systems and management mechanisms that fail to adapt to the complex characteristics of hospital engineering. Existing problems include inadequate special item reviews and loose quality control. These issues will not only delay the normal settlement procedures of hospital projects, but also trigger risks such as inflated project costs and non-compliance. Therefore, in light of the characteristics of modern hospital engineering, scientific and rational organizational frameworks for settlement reviews shall be constructed, and supporting management mechanisms shall be perfected to improve review quality and lay a solid foundation for the smooth handover of hospital engineering projects.

2. Core problems faced by hospital engineering final settlement reviews

2.1. Fragmented organizational structure and low cross-stakeholder collaboration efficiency

Hospital engineering settlement reviews involve multiple internal departments and external parties, yet a unified overall coordinating organization is generally absent, resulting in a fragmented overall layout^[2]. Internally, review work is mostly undertaken solely by audit or infrastructure departments, with low participation from finance, legal, medical affairs, and clinical departments. When communication is required to confirm functional demands, reconcile payments, and conduct compliance examinations, there are clear responsible persons and communication channels lacking. Cross-department communication costs remain high with long feedback cycles, and review progress is often hindered due to mutual buck-passing between departments. Externally, there is no unified scheduling mechanism among entities including construction enterprises, supervision institutes, design institutes, and third-party cost consulting agencies, and they adopt inconsistent statistical standards. There are many subcontractors for special medical works, while the rights and liabilities of general contractors and subcontractors remain ambiguous. The communication chain for review matters is overly long, leading to low efficiency in problem feedback and rectification. Moreover, most projects lack special docking modules for medical engineering reviews, and such works are often categorized as ordinary installation projects without professional coordination, forming bottlenecks hindering review progress.

2.2. Distinct professional characteristics with insufficient depth and precision of special reviews

The prominent medical specialty attributes of hospital engineering constitute major difficulties in settlement reviews and frequent sources of cost calculation errors^[3]. On the one hand, special medical works feature unique craft and high customization. Operating room purification, radiation protection, medical logistics, and other systems are governed by respective industry standards for construction techniques and materials. Most conventional cost reviewers lack expertise in medical engineering and only conduct reviews based on general installation quota standards, which easily cause misapplication of quotas and omitted items, failing to accurately judge the rationality of construction techniques and the degree of pricing matching. On the

other hand, a large number of customized medical equipment and special materials lack unified quotas and public market prices, making price inquiries difficult. Construction units often take advantage of information asymmetry to mark up prices, while reviewers cannot effectively cut high costs due to limited professional knowledge. In addition, special medical works contain numerous concealed works with incomplete construction records, making it hard to verify actual construction techniques and engineering quantities during post-completion reviews and increasing review difficulties.

2.3. Non-standard process management and unstable review quality and efficiency

Hospital engineering settlement reviews lack a standardized whole-process control system, and work quality and progress largely depend on the personal experience of handling staff, leading to unstable overall performance^[4]. Firstly, settlement documents are poorly managed. Some projects have completion drawings inconsistent with actual sites, incomplete change visa formalities, and missing records of concealed works, as well as backdated visas and documents without complete signatures and seals. Reviewers have to repeatedly check and supplement materials, greatly extending review cycles. Secondly, the review process lacks node control. No time limits are stipulated for document acceptance, engineering quantity verification, dispute settlement, and report issuance, resulting in backlogs. The settlement review cycle of some hospital projects lasts more than one year, hindering project final accounts and asset handover. Thirdly, no quality control system is established. Most projects lack a multi-level review system, so review results cannot be cross-checked, which may lead to errors in engineering quantity calculation, mismatched fee standards, and inappropriate application of policy documents, failing to guarantee review quality.

2.4. Weak risk prevention with prominent compliance and integrity risks

Hospital engineering involves large investment and numerous special works, bringing prominent compliance and integrity risks during settlement reviews. However, the risk prevention systems of most hospitals remain imperfect^[5]. First, change order and visa control is lax. Strict approval procedures are absent for some design alterations and on-site visas, and the practice of “construction first, formalities later” occurs frequently. Several unreasonable alterations are submitted directly without technical and economic demonstration, which leads to out-of-control project construction costs. Unreasonable changes are submitted without technical and economic argumentation, leading to out-of-control project costs and failure to verify the legitimacy and rationality of changes during reviews. Secondly, significant price control risks exist. Prices of special medical equipment and materials are unclear, and some projects involve designated brands and connected transactions with substantial room for price inflation, lacking a comparative pricing basis for reviews. Thirdly, the integrity prevention mechanism is absent. Double-person supervision and complete traceable records are not required for key pricing negotiations, which may trigger integrity risks involving artificial price manipulation. Fourthly, inadequate compliance examination. Many reviews only verify engineering quantities and prices without checking the performance of bidding documents and contract clauses, which may cause compliance risks where settlement results conflict with contractual agreements.

3. Optimized management strategies for hospital engineering final settlement reviews

3.1. Construct a three-level linked organizational framework and improve collaborative operation mechanisms

A scientific organizational structure serves as the foundation for the efficient operation of the settlement review process; accordingly, an organizational framework comprising a “decision-making layer,” an “executive layer,” and a “support layer”—each seamlessly coordinating with the others—should be established based on the hospital’s management structure and engineering characteristics, the responsibilities of each department should be clearly defined, and coordination issues should be resolved ^[6].

The decision-making level shall establish a Settlement Audit Working Group, with an executive leader overseeing infrastructure projects or auditing serving as the group leader; the heads of the Infrastructure Department, Audit Department, Finance Department, Legal Affairs Department, Medical Affairs Department, and core utilizing departments shall all participate in the group. The primary responsibilities of this working group include: reviewing and approving the audit work plan and the major pricing principles; coordinating and resolving opinions raised regarding the major pricing principles and the audit plan; making final decisions on the pricing results; and supervising the legality and impartiality of the work performed by all audit personnel.

A professional audit working group at the executive level will be established, adopting a hybrid approach that combines “internal audit personnel” with “third-party professional consulting firms.” Based on their respective specializations, the group will be divided into three specialized sub-teams: the General Civil Engineering & Installation Team is responsible for the quantity take-off, standard rates, and fee verification for civil engineering, decoration, as well as general plumbing, electrical, and HVAC systems; the Medical Specialized Team consists of cost estimation professionals with experience in hospital construction projects, dedicated to auditing various medical specialty projects—focusing primarily on whether the construction processes comply with regulations, whether the equipment parameters are appropriately matched, and whether the pricing is reasonable; and the Comprehensive Coordination Team is responsible for overall schedule management, documentation management, dispute resolution consultations, compilation of final results, and external liaison.

The support team comprises all functional departments of the hospital as well as the participating construction units: the infrastructure department and the supervision department verify the authenticity of on-site conditions and documentation; the finance department cross-checks the project payment data; the legal department reviews compliance matters; clinical departments confirm the implementation of functional requirements; and the design unit provides answers to technical questions; together, all these departments provide comprehensive support for the review process.

Additionally, three operational mechanisms are implemented: the unified export mechanism, the consultation and analysis mechanism, and the three-tier quality control mechanism ^[7]. First, the unified export mechanism: all formal external opinions shall be forwarded by the Comprehensive Coordination Group to prevent fragmented communication; second, the consultation and analysis mechanism: for complex or contentious issues, multi-party consultations shall be conducted to produce written minutes that serve as the basis for review; third, the three-tier quality control mechanism: a three-stage quality control system is adopted, comprising initial review by reviewers, re-review by the responsible professional, and final approval

by the project leader, ensuring rigorous quality oversight at each stage.

3.2. Strengthen professional capacity building to address pain points of special reviews

To tackle difficulties in reviewing special medical works, support shall be enhanced from personnel, data, and resource dimensions to improve review accuracy ^[8].

First, build a compound review team. Regular training on special medical engineering knowledge shall be organized for internal reviewers, with hospital infrastructure engineers and technical staff from equipment manufacturers invited to lecture on construction techniques and industrial standards to make up for knowledge gaps. A talent pool for special reviews shall be established, prioritizing professionals with hospital cost experience for major projects.

Second, establish a hospital-exclusive construction cost database. Classify, organize, and accumulate data, including the unit construction cost of completed special medical projects, prices of core equipment and materials, and cost reduction rates, to build a special cost index system. This can provide price references for subsequent project reviews and mitigate information asymmetry.

Third, employ professional third-party cost consulting institutions. For technically complex special medical works, select consulting firms with hospital project track records to participate in reviews, leveraging their professional experience and industrial data to deepen review depth. A performance appraisal system for consulting institutions shall be implemented to dynamically evaluate review quality and efficiency.

3.3. Standardize whole-process control to boost review quality and efficiency

Implementing standardized, node-based full-process management can shorten the review duration while ensuring work quality ^[9]. First, implement a pre-review of settlement documentation by establishing a standardized checklist for hospital engineering settlement documents; this checklist shall specify the formats, signature/certificate requirements, and completeness standards for each type of document—particularly for concealed records of medical specialty projects, equipment parameter data, and acceptance reports. Documents lacking complete information or incomplete procedures will not be formally accepted, thereby reducing the time loss caused by repeated supplementary submissions at the source. Second, refine the control of review process nodes by developing a detailed review progress plan that breaks down the entire workflow—including document acceptance, engineering quantity calculation, account reconciliation and communication, dispute resolution, and final report issuance—into specific time-bound milestones. Regular progress updates should be provided to each professional discipline; when a milestone falls behind schedule, timely early warnings should be issued, followed by prompt coordination efforts. Third, strictly enforce the on-site verification system: for key items such as large-scale modifications, concealed works, and installation of core medical specialty equipment, joint on-site verification must be conducted by the review team, supervision team, and construction team; photographic evidence and verification records must be retained to ensure that the settlement content accurately reflects the actual site conditions. Fourth, establish a hierarchical dispute resolution mechanism: general professional disputes shall be resolved through negotiation among the corresponding specialized groups; if negotiation fails, the Comprehensive Coordination Group shall organize multi-party negotiations; major disputes shall be submitted to the Leading Group for collective decision-making; all dispute resolution processes must be documented, and no ambiguous handling or oral agreements shall be permitted.

3.4. Improve risk prevention system to consolidate compliance and integrity bottom lines

Establish a comprehensive risk prevention and control system by integrating risk management into all stages of the audit process to mitigate compliance and integrity risks^[10]. First, create a list of key risks by identifying high-risk areas within hospital engineering settlement audits—specifically, the pricing of medical special projects, large-scale change orders, pricing for non-standard equipment, and fee standards—thereby defining specific risk points and corresponding control requirements; for high-risk items, implement a dual-person review and a focused re-examination process. Second, strengthen the compliance review of change orders: during the audit phase, the quantity of work specified in the change order must be verified, and the approval procedures, technical necessity, and economic rationality of the change must be traced; change orders with incomplete documentation or insufficient justifications shall be rejected, thereby curbing the increase in unreasonable construction costs at the source. Third, strictly implement integrity risk controls by enforcing an interest avoidance policy, requiring audit personnel to proactively avoid any conflicts of interest with participating construction units; core pricing negotiations and on-site inspections must involve two or more staff members; all audit adjustments and communication opinions must be documented and archived through formal channels, and private contact or verbal promises are strictly prohibited. Fourth, standardize the management of audit results and archives: audit reports must provide detailed records of all increases and decreases, the resolution status of disputes, and any outstanding issues; such reports may only take effect after undergoing a three-tier review process and approval from the Leading Group; all settlement documents, process files, and final audit outputs shall be uniformly archived in a standardized manner to ensure that the entire workflow is traceable and verifiable.

4. Conclusion

The final settlement review of hospital engineering is a systematic project requiring high professionalism and extensive collaboration. Scientific organizational frameworks and complete management mechanisms constitute the fundamental guarantee for high-quality and efficient reviews. In response to existing problems including fragmented organization, insufficient professional matching, and loose process control, this paper proposes a three-level organizational framework with overall decision-making coordination, professional execution, and supporting collaboration, alongside supporting measures of professional capacity development, whole-process control, and comprehensive risk management. These measures can effectively resolve prominent difficulties in hospital settlement reviews and improve the accuracy, efficiency, and compliance of review work.

As hospital construction advances toward intelligence and specialization, settlement reviews will face growing difficulties. In the future, further research shall be conducted on the application of BIM and cost big data in settlement reviews, organizational modes and management mechanisms shall be continuously optimized, and a complete review management system adapted to hospital engineering characteristics shall be gradually formed. This will effectively strengthen investment control, ensure safe and efficient utilization of construction funds, and provide solid support for high-quality hospital development.

Disclosure statement

The authors declare no conflict of interest.

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