

Research on Compliance Risk Control and Optimization Strategies for the Whole-Process Bidding and Procurement of Road, Bridge and Tunnel Inspection Projects

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Abstract: Road, bridge, and tunnel inspection projects are critical to the quality and safety of transportation infrastructure. To ensure the effective implementation of inspection work, enterprises generally adopt bidding and procurement to select qualified and efficient inspection service providers, thereby reasonably controlling the procurement quality of engineering inspection services while improving the efficiency of state-owned assets. Considering the current bidding and procurement of road, bridge, and tunnel inspection projects, these processes are characterized by strong professionalism, high technical evaluation requirements, and dynamic performance management. Traditional risk supervision mechanisms can no longer meet the whole-process control requirements for the procurement of such inspection projects. Accordingly, this paper focuses on summarizing risk issues from four dimensions—preliminary preparation, announcement and bidding document issuance, bid opening and evaluation, and contract performance—and proposes compliance risk optimization measures, aiming to provide a reference for the high-quality development of road, bridge and tunnel projects.

Keywords: Road, bridge and tunnel inspection projects; Bidding and procurement; Whole process; Compliance risk; Intelligent risk control

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1. Introduction

Under the influence of the strategy of building a transportation powerhouse, the number and scale of road, bridge and tunnel projects in China have shown a significant growth trend. In addition, with the rapid annual increase in transportation pressure, the state's supervision of transportation infrastructure construction has become noticeably stricter. This has greatly enhanced the emphasis of road-bridge-tunnel construction

enterprises on engineering inspection, prompting them to abandon traditional inspection mechanisms and adopt bidding and procurement for inspection projects, engaging more professional third parties to provide project inspection services ^[1]. However, the implementation of bidding and procurement for road, bridge, and tunnel inspection projects still faces numerous compliance risks, which seriously constrain the safe and efficient operation of the procurement procedures. Therefore, construction enterprises should take the existing bidding and procurement risks as a reference, optimize the risk control mechanism, and safeguard the safety red line of transportation projects.

2. Characteristics of bidding and procurement for road, bridge and tunnel inspection projects

Bidding and procurement for road, bridge and tunnel inspection projects falls under service procurement and differs significantly from traditional procurement of engineering materials. First, the procurement subject matter is highly specialized. For example, roadbridgetunnel inspection includes safety testing and nondestructive quality inspection of structures, both of which demand extremely high levels of professional expertise from operators and precision from testing equipment. At the same time, the subject matter of inspection bidding is unique in that it does not take a visualizable physical form but is presented in the form of reports. Consequently, it is difficult for supervisory personnel to accurately quantify and evaluate the completion status of the subject matter, which may lead to a loss of control in supervision. Second, fragmentation is evident in the bidding and procurement of inspection projects ^[2]. Different project types—such as new construction, maintenance, and expansion—have different inspection requirements and standards, making it impossible to develop a standardized procurement template. Moreover, largescale inspection projects involve substantial volumes and numerous inspection items, necessitating fragmented, phased, and tiered implementation, which increases the procurement burden. Some enterprises may streamline procedures for convenience, thereby exposing themselves to compliance risks. Third, the bid evaluation system is complex. Compared with other engineering procurement tenders, inspection project bidding requires evaluation from multiple dimensions such as price, technical capability, and qualifications, making the evaluation process more intricate and demanding greater expertise from the evaluation experts ^[3]. However, the technical and qualification review dimensions include nonquantifiable evaluation indicators that are susceptible to subjective influence, potentially leading to improper evaluation practices. Fourth, contract performance management is challenging. In roadbridgetunnel construction inspections, some inspection projects have long implementation cycles, and construction progress or techniques may be adjusted during the process, requiring corresponding adjustments to the inspection plan. If a static contract management approach is adopted, this may result in inadequate control.

3. Compliance risk identification in the wholeprocess tendering and procurement of roadbridgetunnel inspection projects

3.1. Preliminary preparation risks

Inadequate risk control during the preliminary preparation phase of tendering and procurement for roadbridgetunnel (RBT) inspection projects can easily lead to massive and continuous outbreaks of risks in subsequent stages, thereby undermining the effectiveness of risk prevention and control. The compliance

risks at this stage are relatively complex. First, there is information omission in the procurement demand survey. The procurement information survey serves as the core reference for the preparation of tendering and procurement documents; if the information is incomplete, it will inevitably affect the integrity and accuracy of document preparation, resulting in a mismatch between the documented requirements and the actual procurement needs ^[4]. Second, the procurement method may be noncompliant. The most common risk issue is that the document preparers arbitrarily alter the procurement process, leading to the omission of certain critical review steps, which in turn prevents some noncompliant issues from being identified and rectified in a timely manner. Third, the tender documents may not meet the preparation requirements. The preparation of tender documents has clear standards, and the rights and obligations of all parties must be specified in detail and with precision. If the document preparation fails to define the division of responsibilities as required clearly, it will give rise to subsequent disputes and buckpassing.

3.2. Announcement and issuance risks

The announcement and issuance phase is a critical link in ensuring openness and fairness in the tendering and procurement of RBT inspection projects. Improper handling at this stage can trigger numerous risks. First, the announcement may be nonstandard. For example, the platform, content, or duration of the announcement for some projects may not comply with the standards, thereby affecting bidders' comprehensive and accurate access to tender information and disrupting the tendering market. Second, the prequalification review of the announcement may not be rigorous. In RBT inspection projects, the procuring entity's prequalification process may be oversimplified, failing to conduct a comprehensive review of the enterprise's qualifications, performance, credit status, etc., thus allowing noncompliant enterprises to enter the bidding scope and potentially giving rise to subsequent inspection risks ^[5]. At the same time, there may be covert manipulation during the review process, thereby undermining the fairness of the tendering process. Third, the clarification and addendum procedures within the announcement process may be unreasonably designed. If the clarification mechanism of the project's tendering and procurement agency is unfair, it can lead to asymmetric bidding information among bidders, which is inequitable. In addition, improper publication of addendum documents, resulting in frequent changes to the scope of services and technical standards, can easily cause compliance disputes.

3.3. Bid opening, evaluation, and review risks

Bid opening, evaluation, and review are key phases throughout the tendering and procurement process. The compliance risks at this stage are mainly reflected in inadequate process control and integrity issues. First, inadequate control over the bid opening process—leading to superficial registration, inspection, and supervision of bid documents—may result in the loss or substitution of bid documents and consequently cause bid failure. Second, insufficient competency of the bid evaluation experts may affect the quality of evaluation and trigger compliance risks. For instance, RBT inspection projects are highly specialized; if the evaluation experts are not proficient in the project's technical aspects, the accuracy of their evaluation of bid documents will be compromised ^[6]. Moreover, some experts may face integrity challenges during the evaluation process; once they fail to uphold professional ethics, integrity risks may arise. Finally, loopholes in the implementation of evaluation criteria can give rise to compliance risks. If evaluators arbitrarily change the evaluation criteria during the performance of their duties, or fail to review abnormally low-priced bid documents promptly, this may breed the risk of malicious lowprice bidding, leading the winning bidder to

lower service standards to increase profits during subsequent service delivery, thereby compromising the quality of the inspection project.

3.4. Contract performance risks

In the tendering and procurement of RBT inspection projects, the contract performance phase is prone to compliance risk outbreaks, as specifically manifested in the following two aspects: First, there is a serious lack of awareness among both contracting parties regarding contract signing control. For example, if the contract signing time limit exceeds the compliance scope but the parties fail to negotiate on this issue, the contract may subsequently become invalid. Alternatively, there may be arbitrary modifications to the technical standards, payment agreements, and other clauses of the tender documents during contract signing, which severely weakens the binding force of the contract on both parties and may lead to the risk of noncompliant changes. Second, there are supervisory loopholes during contract performance. Contract performance is not merely a unilateral execution of contract terms by the winning bidder; the tendering company must also participate in supervision throughout the process. The tendering party may establish a dedicated contract performance supervision team to carry out oversight in parallel with the inspection unit, focusing on the inspection unit's inspection items, methods, personnel qualifications, inspection equipment, and other dimensions throughout the process, so as to avoid noncompliant operational risks during inspection.

4. Countermeasures for optimizing compliance risk management in the wholeprocess tendering and procurement of RBT inspection projects

4.1. Improving the compliance management system

The key to controlling compliance risks throughout the wholeprocess tendering and procurement of RBT inspection projects lies in relying on a specialized compliance management system to address process and standard loopholes in traditional inspection management, ensuring the compliant implementation of the entire tendering and procurement process. First, optimize the industryspecific procurement management mechanism ^[7]. Construction enterprises may, in accordance with the Tendering and Bidding Law of the People's Republic of China, the Regulations for the Implementation of the Tendering and Bidding Law of the People's Republic of China, the Guidelines for Fulfilling the Primary Responsibilities of Tenderers, and other relevant laws, regulations, and industry rules, select an appropriate procurement method based on project scale and requirements, formulate standardized evaluation rules, and ensure their proper implementation, thereby effectively avoiding the risk of noncompliant procurement. Second, establish a “technology + compliance + legal affairs” tripartite integrated audit system. This system introduces technical departments into compliance procurement risk prevention and control, enabling joint review of tender documents from multiple dimensions—technical, legal, and compliance—to ensure the precision and comprehensiveness of compliance control, prevent ambiguous rights and responsibilities in control provisions, and effectively eliminate hidden noncompliance risks. Third, establish a comprehensive accountability system. The system should clearly define the authority, responsibilities, and compliance standards of all parties, including evaluators, construction entities, and agencies, and compile these into a task checklist. Designate the handling officers and approving officers as primary responsible parties; once any noncompliant issue occurs, accountability can be promptly assigned to the primary responsible parties, thereby eliminating compliance risks such as inadequate performance and noncompliant procurement.

4.2. Refining standardized wholeprocess control

During project tendering and procurement, a wholeprocess closedloop management mechanism should be adopted to standardize the procurement procedures. First, strengthen the optimization of the preliminary procurement process^[8]. Before procurement and tendering commence, staff should conduct a comprehensive and indepth survey of procurement needs to ensure information completeness. At the same time, during document preparation and procurement approval, procurement procedures and approval standards should be established based on the specific project circumstances, so as to ensure that the inspection unit's qualifications and technical standards meet the procurement requirements. In addition, establish a graded approval system that, through multiple layers of review and procedural regulation, builds a safety defense line from the very beginning, effectively blocking loopholes for noncompliant operations. Second, reinforce announcement issuance and qualification review. Announcement issuance must be conducted on statutory media platforms, with the publication period meeting legal requirements and the content conforming to legal and industry provisions, so as to ensure the symmetry of procurement information and the fairness of procurement tendering. Moreover, enterprise review should cover a comprehensive scope, including corporate qualifications, equipment performance, credit records, personnel qualifications, etc., and a uniform review standard should be applied to all enterprises to avoid issues such as qualification namelending and covert manipulation that undermine market fairness. Third, during bid opening, evaluation, and review, a standardized onsite management mechanism should be developed to ensure that each step—including bid document inspection, information disclosure, and confirmation of objections—is guided by clear procedural norms, and that staff keep thorough records of all work activities. At the same time, to ensure the professionalism of evaluation experts, enterprises or their entrusted agencies should establish an expert database, comprehensively collect expert information, and improve the alignment between experts and the evaluation work. More importantly, uniform evaluation and scoring standards should be adopted during review to prevent inconsistencies that compromise the fairness of tendering and procurement. Meanwhile, optimize the clarification and addendum process to safeguard the impartiality of evaluation fully. Finally, contract performance control should be optimized from the perspectives of template standardization and clear rights and responsibilities^[9]. Strictly investigate issues such as dual contracts and unauthorized modification of clauses. In addition, during contract performance, a dedicated followup review team should be established to conduct regular or unscheduled inspections of equipment performance, process implementation, personnel attendance, and other aspects.

4.3. Establishing a sound wholeprocess supervision and assessment mechanism

The problem of “emphasizing tendering while neglecting performance” remains prevalent in the tendering and procurement of RBT inspection projects, which severely affects the comprehensive and indepth implementation of risk prevention and control measures for such projects. Accordingly, construction enterprises need to place greater emphasis on the performance of tendering contracts and establish a wholeprocess supervision and assessment mechanism covering pre, during, and postcontract stages to strengthen performance oversight. First, the management department should participate in precontract signing control from the very beginning, focusing on the review of procurement and tender documents to ensure their compliance and completeness, thereby strengthening source control of compliance risks. Second, the management department should support the rigorous and compliant implementation of

tendering and procurement work through professional teams. Specifically, based on the characteristics and requirements of each procurement and tendering project, select professional supervisory personnel to form a dedicated supervision team, which is responsible for continuously following up and overseeing the contract performance process and maintaining visual and written records of each performance phase to ensure traceability ^[10]. Finally, establish postperformance accountability and evaluation systems. The completion of contract performance does not signify the end of risk control work; management personnel should conduct a comprehensive review of the entire contract performance process, archive the review results in a resource database, and simultaneously include the cooperative enterprise's performance, service quality, creditworthiness, and other information in the database list. This control approach facilitates stricter screening of future partner qualifications.

4.4. Building an industrywide intelligent risk control system

Given the numerous shortcomings of manual control in the tendering and procurement of RBT inspection projects, enterprises may adopt intelligent risk control platforms to establish a fully automated earlywarning and traceability mechanism, with platform modules set up as referenced in **Table 1**. First, construct an online tendering and procurement review platform, creating online review modules for each phase of the procurement process, so that relevant departments and personnel can operate through the online platform to complete the review. This model can overcome geographical and time constraints, enabling multidepartmental simultaneous review and supervision, thereby ensuring comprehensive and timely implementation of oversight. In addition, the construction of an online review mechanism allows for full recording of all work implementation processes, and any modifications can be traced, which not only facilitates the traceability of each work phase but also effectively prevents the risk of offline arbitrary modifications to document clauses. Second, adopt intelligent risk control earlywarning mechanisms to identify potential risks in a timely manner. Based on the project characteristics, enterprises may set reasonable earlywarning thresholds in the warning module, enabling the system to quickly identify risks by comparing contract performance status against the earlywarning standards, and promptly send alert notifications to supervisory personnel, thereby enhancing the efficiency of risk warning.

Table 1. Technical parameter table of the intelligent risk control system for roadbridgetunnel inspection projects

System module	Functional indicator	Technical parameter
Online review platform	Multi-department collaborative review	Review coverage 100%, traceability retention 100%
	Process tracing	Retention period ≥ 5 years
Risk warning module	Anomaly identification	Warning time ≤ 2 hours
	Risk level classification	Threelevel warning

5. Conclusion

In summary, compliance prevention and control in the tender and procurement of highway, bridge, and tunnel inspection projects is a critical link for effectively mitigating procurement risks. However, given the current status of such procurement activities, numerous hidden compliance risks exist throughout the entire procurement process, undermining regulatory compliance and failing to meet the demands of procurement

control. Through the optimization of risk prevention and control strategies, it is possible to build a solid defense line via institutional frameworks, standardize operational behaviors through streamlined procedures, ensure implementation via closedloop management, and strengthen supervision using intelligent technologies. This enables precise identification of compliance risks, eliminates potential hazards at the source, and ensures order in the inspectiontender procurement market. In the future, transportation infrastructure entities should, from the perspective of smart and digital transformation, develop riskcontrol models to enhance the efficiency and quality of risk management, thereby ensuring the safety of highway, bridge, and tunnel projects.

Disclosure statement

The authors declare no conflict of interest.

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