Analysis of Problems and Countermeasures in Engineering Quality and Safety Supervision and Management from the Perspective of Government Supervision

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Abstract: Against the backdrop of the continuous expansion of engineering construction scale, engineering quality and safety supervision and management from the perspective of government supervision still faces numerous problems that hinder the full play of its regulatory role. These include an imperfect legal and regulatory system and an unsound supervision mechanism. To address these issues, systematic measures need to be taken from multiple aspects, such as improving the legal and regulatory system and enhancing the supervision mechanism, so as to ensure the orderly progress of engineering construction and fundamentally safeguard people's lives and property.

1. Introduction

In the field of construction, engineering quality and safety are the lifelines. They not only affect people's lives and property but are also closely related to the improvement of urban functionality and stable social development. With the acceleration of China's urbanization process, the innovation of industrial construction formats, and the continuous emergence of smart parks and underground utility tunnels, the difficulty and safety risks of engineering construction are increasing day by day, posing higher requirements for engineering quality and safety supervision and management. The government, as the main force in engineering quality and safety supervision, bears responsibilities such as regulating market order and safeguarding public interests. However, in the context of increasingly diversified market entities, many problems have gradually emerged in government supervision work. Based on this, analyzing the problems and strategies of engineering quality and safety supervision and management from the perspective of government supervision is an important measure to improve the governance system in the engineering construction field.

2. Problems in Engineering Quality and Safety Supervision and Management from the Perspective of Government Supervision

2.1 Imperfect Legal and Regulatory System

In the engineering quality and safety supervision and management from the perspective of government supervision, an imperfect legal system is one of the core issues, which is mainly reflected in the following aspects: Firstly, compared with the development of new engineering formats, laws have inherent lag [1]. At present, core laws and regulations such as the Regulations on the Administration of Construction Project Quality do not clearly stipulate emerging fields such as the data security of intelligent construction and do not refine the quality traceability requirements for the production of prefabricated components. Consequently, government supervision work can not be relied on and it fails to supervise the construction behavior of enterprises. Second, the local and national law is not trained seamlessly with each other Indeed, some regions are trying to loosen requirements related to quality and safety in the regulatory regulations adopted by the district level with national mandatory norms that disqualify certain regions. Moreover, some cities continue to operate on urban engineering controls that date back ten years and have never incorporated additional clauses for fresh needs like the protection of underground utility tunnels. This results in

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the failure of supervisors to manage complexity and appropriately enhance the fidelity of law enforcement on complex projects. Problems with vague definitions of what constitutes a violation and an unclear standard for penalties is the third. Behaviors like "illegal subcontract" has no clear legal definition, and the fine range is broad with unrestricted discretionary power that leads to frequent acts of abuse of law enforcement.

2.2 Unsound Supervision Mechanism

In government engineering quality and safety supervision, an unsound supervision mechanism is the main problem affecting the improvement of supervision efficiency. At present, in government safety supervision and management, there is a problem of vague division of regulatory powers. Although departments such as the fire department and the housing and urban-rural development department are involved in engineering supervision, their power and responsibility boundaries are not clearly defined. For example, in the safety supervision of deep foundation pit construction, the housing and urban-rural development department is responsible for daily inspections, and the emergency department is responsible for emergency response. However, there are no clear regulations on the transfer and handling process after hidden dangers are discovered, resulting in difficulties in the smooth implementation of hidden danger rectification work. Moreover, there is no clearly designated competent department for the safety of rural self-built houses, leading to a long-term state of no supervision and prominent illegal construction problems. Meanwhile, the government supervision process lacks standardized criteria, and there is a problem of excessive discretionary power. Currently, government supervision work relies heavily on personnel experience, and a unified standard system and content system have not been formed. For example, in the same area, the sampling ratio for steel bar spacing detection by different supervisors can differ by up to 40%, and some personnel even simplify the inspection process. There are no clear time limits for the rectification and acceptance of violations, and enterprises often delay under the pretext of ongoing rectification. Supervisors lack the basis to force rectification, resulting in supervision work becoming a mere formality. In addition, the lack of a departmental collaboration and linkage mechanism and information barriers affect the orderly implementation of supervision. The regulatory information systems of various departments operate independently, and there is a lack of a joint law enforcement mechanism, leading to repeated requirements and increasing the burden of enterprise inspections.

2.3 Lagging Supervision Technical Means

From the perspective of government supervision, lagging supervision technical means are an important factor affecting the efficiency of engineering quality and safety supervision, mainly reflected in the following aspects: Firstly, the real-time dynamic monitoring capability is poor. Higher-risk links, such as deep foundation pit support, have an excessive dependence on frequent inspection by personnel on the ground, and cannot achieve real-time and full-scale capture of risks such as "formwork displacement." Failure is the only time they get exposed to discover any issues. Stage-by-stage verification methods are only used for disguised works and no technical traceability of the construction process means that behaviors such as corner-cutting cannot be detected in a timely manner. Secondly, the utilization efficiency of regulatory data is low. Paper ledgers etc. are used to keep most of the rectification notices and inspection records created during supervision. There is no integral database, so it can not tell which enterprises are high-risk and it is difficult to improve accuracy of supervision. Third, intelligent supervision tools are not sufficiently used. The application of technologies such as Internet of Things sensors has long not been promoted in many regions, leading to the coverage of supervision being extremely limited and an inability to adapt to the evolving scale of engineering construction.

2.4 Insufficient Staff Competence

Insufficient competence of staff is a limitation that hinders the functional effectiveness of government engineering quality and safety supervision. In actual supervision, the professional competence of some staff does not match engineering requirements. They lack professional

knowledge of new formats such as intelligent construction and find it difficult to accurately identify technical hidden dangers when checking projects using Building Information Modeling (BIM) technology. They are not familiar with construction specifications for complex structures and the performance of new materials, and only focus on the surface during inspections, easily overlooking deep-seated quality and safety risks. Some staff have insufficient sense of responsibility and focus more on processes than actual effects in supervision work. They do not attach importance to minor illegal behaviors and do not urge enterprises to thoroughly rectify problems. In addition, staff have poor active learning abilities and insufficient learning awareness. They do not take the initiative to learn continuously updated engineering technologies and regulatory norms and still use old experience and standards to carry out supervision work, resulting in a disconnect between supervision content and current requirements and an inability to meet the requirements of engineering quality and safety supervision.

3. Countermeasures for Engineering Quality and Safety Supervision and Management from the Perspective of Government Supervision

3.1 Improve the Legal and Regulatory System

To address the problem of an imperfect legal and regulatory system in engineering quality and safety supervision, solutions should be formulated from the aspects of dynamically updating regulations, standardizing the connection between local legislation, and refining the definitions of violations and penalty standards to provide legal support for the smooth conduct of government supervision work [2]. In establishing a dynamic regulatory update mechanism, focus on revising core regulations such as the Construction Law and clarify regulatory clauses for emerging fields such as intelligent construction: Add "full traceability of component production" requirements for prefabricated buildings and "data security management" regulations for intelligent construction, clarifying the storage norms and sharing permissions of construction monitoring data to avoid data tampering affecting the effectiveness of supervision. When standardizing the connection between local legislation, issue the Guidelines for the Formulation of Local Engineering Quality and Safety Supervision Regulations, clearly stipulating that local legislation should strictly follow national mandatory standards and prohibiting the lowering of standards to attract investment. Local clauses that conflict with national regulations should be revised within 3 months. Establish a local legislative filing and review mechanism. After local regulations are issued or revised, they need to be filed with the Ministry of Housing and Urban-Rural Development for review by relevant national departments for regulatory consistency. Order the timely modification of local clauses that lag behind engineering development to truly form a joint regulatory force between the national and local levels. When refining the definitions of violations and penalty standards, issue the Detailed Rules for the Identification of Illegal and Violating Behaviors in Engineering Construction, clearly define specific situations of "illegal subcontracting," such as considering "project management personnel not signing labor contracts with the contracting unit" as subcontracting. Widen the scope of administrative fines, refine engineering quality violation fines into "0.5%-1% for minor violations and 1%-2% for serious violations", clearly define the discretion to be severe violations, and use "daily penalty" mechanism, implemen-ting additional fines for high percentage (and daily times) such as enterprise that systematic illegal behavior or not within a time limit.

3.2 Enhance the Supervision Mechanism

In conclusion, to improve the imperfect supervision mechanism in government engineering quality and safety supervision from multiple dimensions such as regulatory efficiency, more attention should be paid to building efficient supervision mechanism of regulation mode gradually. More precisely, define power and responsibility borders leaving no overlaps. Formulate the List of Powers and Responsibilities for Engineering Quality and Safety Supervision, divide departmental responsibilities according to the processes of pre-event prevention, in-process inspection, and post-event handling. The Ministry of Housing and Urban-Rural Development is responsible for

supervising the quality and safety of the entire engineering lifecycle, the emergency management department is responsible for accident emergency rescue and investigation, and the fire department is responsible for reviewing and accepting fire protection designs. Simultaneously, to fill the gaps in regulation, it is necessary to realize that rural self-built houses must be integrated into the regulatory system, and township governments must act as the responsible entity of local supervision by setting up special personnel for regulation. Relevant departments should take the initiative to promote the standardization process of supervision and reduce room for discretionary power [3]. Set the unified Operation Specifications for Engineering Quality and Safety Supervision, with definitions on inspection standards, contents and frequencies. For instance, in the case of residential projects, require inspections once every 10-days during foundation construction and once every 8 days while constructing the main structure. Developed a "closed-loop management process for violation rectification", clearly defined the time limit for rectification, and required enterprises to complete rectification within 7 days in general, and submitted rectification plans and videos of the rectification process. In order to prevent enterprises from utilizing the "rectification–re-inspection–cancel" closed loop mode to delay rectifying problems, supervisors should conduct re-inspections within 3 days after the expiration of the rectification deadline. Also, breaking through the information barriers, establish cross-departmental collaboration and links mechanism. Construct the engineering quality and safety supervision cooperation platform combining regulatory data from departments of housing and urban-rural development department, emergency management department, fire department: The daily inspection discovered correction situation synchronously to the platform of housing and urban-rural construction authorities; hidden danger levels could be monitored in real time by the emergency management [4]. Exploring Building a Joint Law Enforcement System by the Housing and Urban-Rural Development, public security and fire departments; it shall designate complex projects to implement quarterly joint inspections of multiple departments. Unified inspection plans will be formulated freely, inspection shows shared publicly.

3.3 Innovate and Apply Supervision Technical Means

To address the problem of lagging supervision technical means, breakthroughs need to be made in the following aspects to build a modern regulatory system and improve government supervision efficiency. Firstly, build a real-time dynamic monitoring network to cover high-risk links and concealed works. For high-risk operations, it is mandatory to install Internet of Things sensors to collect data such as load changes and formwork verticality in real time and upload it to the government platform. Set warning thresholds, and the platform will automatically generate exceptions and send immediate alerts to construction units and supervisors for early detection and urban micro-learning of risks. For concealed works, take photo images of major construction nodes by smart devices and upload it into regulatory platform for online inspection by supervisors to avoid cutting corners. Secondly, build an all-round integration supervision database. Connect paper ledgers and electronic documents that are scattered all over to create a regulatory database throughout the entire engineering lifecycle and use science data to identify regulatory priorities. Enhance inspection frequency for low-frequency violation links and key supervision + special interviews for high-risk enterprises [5]. Lastly, turn theory into practice and promote the application of intelligent supervision tools to increase the coverage of supervision. Use AI video surveillance system in construction site, using algorithm to automatically identificate potential dangerous behaviors like objects throwing from height and illegal hot work, then issue audible and visual alarm immediately and upload to the regulation platform, which data could be accessible for realtime supervision by executive foreman. In addition, develop a "mobile supervision APP" to achieve full-process operations such as on-site inspection - problem uploading - rectification tracking - acceptance and cancellation. Supervisors can call up project data at any time to improve supervision levels.

3.4 Improve Staff Competence

To improve staff competence, a systematic improvement system should be built to construct a modern engineering supervision team. On the one hand, organize professional training activities to

fill staff competence gaps [6]. Collaborate with universities to offer special courses such as intelligent construction and prefabricated buildings, and impart skills such as BIM model verification and prefabricated component connection detection through theoretical explanations + on-site practical operations. Project supervision work is only for those who have passed the preliminary evaluation. For new building materials, regularly hold technical observation meetings, lead supervisors to benchmark projects, learn performance detection methods of new materials to ensure that the professional degree of staff can meet the engineering needs. Develop a mentor-apprentice pairing mechanism, where senior supervisors with extensive experience as trainers can teach newcomers, and help improve staff practical skills using case analysis and on-site guidance [7]. On the other hand, enhance a mechanism for continuous learning to galvanize updates in staff competence. Establish a continuously updated library of regulatory norms and technologies, promptly incorporate recently amended Regulations on the Administration of Construction Project Quality and new detection technical standards, push these materials to supervisors by an online learning platform, requiring them to complete 8 hours/month of online learning and pass test results. Organize quarterly centralized meeting for policy and technology interpretation, invite third-party experts to give a separate explanation on key points of new regulations, application skills and difficulties of new technologies, etc. Make full use of this platform to make supervisors have an in-depth understanding about the realities required by current requirements Encourage supervisors to obtain professional certificates like a Certified Construction Supervisor, and provide certain rewards for those who have been certified, this can enhance the learning initiative while at the same time preventing knowledge lag resulting in lower supervision levels.

4. Conclusion

By and large, the engineering quality as well as safety of supervision and management through government supervision has been a long-term dynamic complex system and it should involve a broad domain. First, focus on the top-level layout to completely improve the engineering quality and safety level in accordance with advanced countries in terms of laws and regulations, supervision mechanism, staff competence and other aspects; Second, strengthen policy-oriented research making full use of domestic cycles carefully considering actual situation combine efforts to facilitate orderly conduct survey engineering construction work.

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