

Influencing Factors of Quality Defect Immunity in Construction Enterprises

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Abstract: In recent years, construction enterprises are facing the problem of quality management on the basis of pursuing technological innovation and breakthrough. This study explores the importance of construction quality at the theoretical level, analyzes the quality defects in enterprises and their measurement methods, combs the application of medical immune system in enterprise quality management, and summarizes the influencing factors of quality defect immunity in construction enterprises, so as to provide theoretical reference for future research on the influencing factors of quality defect immunity.

1. Introduction

At present, with the stable development of Chinese construction industry, it is necessary to continuously improve urban traffic in the next 100 years, strengthen the restoration of urban ecological construction, maintain and improve the basic function of the project, promote the rational layout of the city, and promote the optimization of urban construction. Construction projects participate in all aspects of people's livelihood, and enhancing construction quality is conducive to the development of all fields of society, thereby improving the quality of life of the people. At the same time, quality has been the fundamental guarantee and core competitiveness of enterprise sustainable development. For construction enterprises, since the whole construction process is greatly affected by external factors, and the whole project involves the implementation of multiple technologies and the safety of personnel, the construction process must have good quality assurance to ensure the smooth progress of construction projects. Therefore, whether from the state, society or the enterprise itself, the pursuit of high-quality development is an inevitable trend for construction enterprises.

A good quality management system is the cornerstone of supporting high quality development of enterprises and the core of sustainable development of enterprises. In the pursuit of design standardization and integration of production and management, improving the accuracy of quality defect management by optimizing quality management system is the key to make sure good quality performance, construction safety and social stability.

In recent years, exploring quality management from the perspective of biological immunity has

become a new research perspective. To some extent, analyzing the quality problems of management from the perspective of biomedicine can break through the traditional research model and refine the quality problems in order to suit the remedy^[1]. Considering the disease-like nature of quality defects, good quality-specific immune function of enterprises can defend against quality defects, so the influencing factors of quality defect immunity in construction enterprises are analyzed^[2].

2. Quality defects in construction enterprises

2.1. Source and connotation of quality defects

At present, Chinese construction industry has developed steadily, and the types of architectural design have been innovated continuously. Various new construction materials have emerged in endlessly. However, with more and more choices in the whole construction process, the construction difficulty is also increasing, resulting in various defects in the construction quality. It is pointed out in the Measures for Quality Assurance of Housing Construction Projects that quality defects are that the quality of housing construction projects does not meet the mandatory standards of engineering construction and the agreement of the contract. Based on the relevant literature, the quality defects of construction enterprises are defined as: construction quality problems that do not meet the mandatory construction standards and contract agreements.

Through literature review, the sources of quality defects in construction enterprises can be roughly divided into six aspects: unreasonable construction period setting, shortage of construction resources, unprofessional management personnel, nonstandard design planning, construction environmental impact and imperfect management mechanism.

(1) Unreasonable construction period setting results in tight construction period and even lack of necessary construction supervision.

(2) There is a shortage of materials related to construction, and there is a phenomenon of material reduction during construction.

(3) The professional ability of managers is not enough to achieve the science and effectiveness of supervision.

(4) The design planning is not standardized, leaving quality risks in the construction preparation stage.

(5) Bad environment. In the construction process, bad weather affects the construction progress or the storage of construction materials and equipment.

(6) The management mechanism is imperfect, the regulatory system is flawed, and all quality problems cannot be identified.

According to the above sources of quality defects, major construction enterprises put forward corresponding rectification measures from the perspective of quality management practice. At the same time, the academic circles consider to explore the causes of quality defects from the perspective of quality management system.

2.2. Structure and measurement of quality defects

Many scholars have explored the structure of quality defects from different perspectives and given the measurement methods of defects. Among them, for the composition of quality defects in construction enterprises, Cao and Zhang^[3], Ren et al.^[4] and other scholars summarize that quality defects exist in cost, equipment, materials, human and technical aspects. Bai and Liu^[5] from the personnel, materials, machinery, methods, environmental five aspects of construction quality defects described and the introduction of dynamic reliability to establish a construction project optimization model. Zhou et al.^[6] Summarize the current construction problems in personnel,

material management, management mechanism and make recommendations.

In view of the defects of different types of engineering projects, domestic scholars analyze from different angles. Su et al.^[7] divided the project into three stages : field data, design, production, transportation and construction, and summarized the performance of prefabricated building quality defects. Zhang and Huang^[8] summarized the quality defects of energy-saving construction projects, and analyzed the causes of quality defects from four angles of production process, equipment, product quality, construction method and technical standard. Among them, some scholars refine the quality defects and discuss the quality problems in construction materials. Zhu and Wu^[9] analyzed the quality defects from the perspective of construction project EIA documents, and proposed that the current EIA documents had quality defects such as in-depth investigation, insufficient engineering analysis, unscientific parameter selection, and infeasible environmental protection measures.

Based on the analysis of quality defects, domestic and foreign scholars put forward corresponding solutions. Hou^[10] used the evidence-based thinking in the field of medicine to dynamically analyze the quality problems in residential projects and put forward suggestions. Park and Yi^[11] used structural simulation model to estimate quality performance and demonstrate and verify resource allocation optimization.

Based on the relevant literature, the quality defects can be measured from the aspects of technical data, production and transportation, construction links, technical standards and personnel management. The specific evaluation indicators are as follows:

- (1) Technical data, including site construction data, design data, evaluation documents.
- (2) Production and transportation, including production equipment, product quality, production costs and production materials.
- (3) Construction links, including personnel and equipment management.
- (4) Technical standards, including product design and quality.
- (5) Personnel management, including human resources management in all aspects.

3. Quality immune system of construction enterprises

3.1. Source and connotation of quality immune system

“System” means that elements interact with each other to play a holistic function, and “immunity” comes from medical concepts, which is a medical phenomenon that the body resists foreign invading viruses or microorganisms. In modern medical immunization, its concept is extended to the sum of actions that the body recognizes, responds and memorizes objects to ensure its stable operation^[12]. Specifically, the function of the immune system is to accurately identify foreign antigens or self-defective cells and carry out immune defense and self-stability through timely response, and then memorize the response results to obtain the continuous improvement of self-defense ability. Based on the above, the immune system can be understood as a system in which the body resists its own defects or foreign invasion objects by cooperating with immune recognition, response and memory functions to maintain the stability of the body.

The idea of evidence-based medicine aims to emphasize the dynamic analysis and treatment of patients in decision-making based on previous experience. Evidence-based thinking has something in common with continuous improvement of enterprises and benchmarking management of enterprises. It emphasizes the virtuous cycle process of comparison, analysis, judgment and improvement to pursue optimal decisions and results. Therefore, considering that enterprise quality defects have the property of disease-like, the existing literature applies evidence-based medicine (EBM) and immune function to quality management, and divides the function of quality management mechanism into quality monitoring, defense and memory.

Referring to other research conclusions, enterprise quality immunity is divided into non-specific immunity and specific immunity. Non-specific immunity and enterprise management through strict internal control and testing at this stage, the quality management system has been established, which can be understood as the function of quality defect recognition, quality monitoring, defect containment, defect defense, defect removal and so on. At present, TQM theory, PDCA cycle, zero defect management theory, six sigma management theory and quality loop are all existing research results^[2]. For those quality defects that cannot be treated by quality-specific immunity, the quality-specific immunity function of enterprises is needed to identify, respond and remember.

3.2. Application of Quality Immune System

At present, the immune system theory is widely used in supply chain and product quality management of manufacturing enterprises, and the research on construction enterprises is less. Li et al.^[13] introduced the immune system into the quality management of the supply chain to construct the quality immune model and the supply chain quality performance model. Zhao^[14] uses immune theory to divide lymphatic system and complement system to focus on enterprise nodes from the perspective of internal supply chain, and constructs immune model combined with external supply chain. Liu et al.^[15] combined with the theory of medical immunology, constructed the organization quality-specific immune adaptation evolution model of manufacturing enterprises and proved that quality-specific immunity promotes organization adaptation evolution.

There are also some literatures on production enterprises and engineering projects. Shi et al.^[16] from the perspective of quality-specific immunity to consider the optimal path of quality performance improvement in product introduction, growth, maturity and decline. Wu et al.^[17] put forward the concept of the immune system of engineering quality defects, and run the immune system of quality defects through the three-level algorithm of rule, adaptation and collaborative identification. They emphasized that the realization of the specific immune function of enterprise quality defects depends on the ability range of the non-specific immune of enterprise quality defects. The specific immune ability of an enterprise for quality defects is the highest means of quality assurance and the core of enhancing the competitiveness of enterprises.

According to the relevant literature, this study argues that enterprise quality defect immunity includes innate immunity and specific immunity. Among them, the specific immune function of enterprise quality defects includes enterprise quality defect recognition, enterprise quality defect response and enterprise quality defect memory. Enterprise quality defect identification is to determine whether the defect factor is remembered, and whether the enterprise quality management team has dealt with relevant cases. If the enterprise management team has program strategies such as relevant design documents, the solution and secondary immunization is directly given through quality defect memory. If the enterprise quality management team has not dealt with the relevant defect cases, the second step of quality immunization and enterprise quality defect response is carried out. Enterprise quality defect response can be understood as the knowledge collection team in the management team, through which the team has targeted learning, comparison, analysis and summary to select the optimal solution and generate specific antibodies. The process of remembering optimal solutions and quality defect management results is the process of database updating. By updating the database, the future similar defect factors can be secondary immune, which saves the cost of quality defect management and improves the quality management ability of enterprises.

4. Influential factors of quality immunity in construction enterprises

The quality immunity of construction enterprises determines the competitiveness of enterprises to a

certain extent. It is particularly important to study the evaluation index and influencing factors of enterprise quality immunity to improve the quality immunity ability of enterprises.

For the evaluation of enterprise quality immunity, most literatures divide it into innate immunity and adaptive immunity. Among them, Lu and Wang^[18] divided the innate immunity into three dimensions: the composition of enterprises, enterprise system and enterprise culture. The dimension of enterprise structure is evaluated by the smoothness of communication platform, leadership system and flexibility. The dimension of institutional rules is evaluated by the effectiveness of incentive mechanism, the rationality of talent training system and the stability of financial policy. The dimensions of corporate culture include corporate culture atmosphere, employee sense of corporate value identity, employee sense of belonging, employees loyalty, employees cooperation spirit, enterprises tolerance to employees and entrepreneurship sustainability. Enterprise adaptive immunity is divided into three dimensions: enterprise monitoring, defense and learning. The enterprise monitoring dimension measures the enterprise risk management ability through the system soundness, implementation and internal control, the enterprise defense dimension measures the enterprise's crisis handling ability through the enterprise crisis consciousness, crisis plan management, crisis resilience and image restoration ability, the dimensions of corporate learning and memory are evaluated by leadership attention, diversity of learning methods and internal knowledge inheritance.

Huang and Zhao^[19] evaluated the immune system of major engineering teams according to the dimensions of innate immunity and adaptive immunity. According to the theory of traditional Chinese medicine, the innate immunity is divided into three dimensions. Among them, early health care is measured by external harmony and internal health care, namely the harmony between the team and the external environment and the completeness of the internal quality management system of the enterprise, when the disease is not attacked, the treatment is measured by the accuracy and completeness of the evaluation system of the four diagnostic parameters, and the four diagnostic parameters are the recognition of quality defect information by the quality management immune system. The prevention of lesions after the onset of the disease is measured by isolation measures, transmission route truncation and monitoring and early warning mechanism. Adaptive immunity was evaluated according to the three dimensions of team identification, team response and team memory. Among them, team identification is measured by the real-time performance of antigen information collection and the accuracy of antigen feature conciseness, team response is measured by decision scheme diversification, decision scheme selection rapidity and coordination patency, team memory is measured by the completeness, flexibility and experience sharing of case base and knowledge base.

For the influencing factors of quality immunity, the existing literature is studied from different angles. Xu and Zhang^[20] analyzed the influencing factors of enterprise quality immunity from the perspective of human immunity. Specifically, from the perspective of human needs to adhere to the movement, the frequency of enterprise practice can affect the immune ability of enterprises, from the perspective of people's mental state, the enthusiasm of employees can affect the immune ability of enterprises. Enterprises should implement incentive mechanism to enrich enterprise culture and create a good working atmosphere for employees. The balanced management of enterprises can affect the quality immunity of enterprises from the perspective of balanced nutrition. Liu et al.^[21] used the interpretive theory to identify the influencing factors of team quality defect management from the perspective of immunity and divided the influencing factors into three dimensions: team quality monitoring, defense and memory. Among them, quality monitoring includes three factors: team differential atmosphere, team commitment and team attention configuration, the influencing factors of quality defense include team leadership behavior, team vitality, team psychological security, team behavior integration, team collective cognition, team

effort, team supervision and team intelligence , the influencing factors of quality memory include team reciprocity preference, team internal social capital and team empowerment climate.

In summary, the factors affecting non-specific immunity can be divided into enterprise structure, institutional rules, corporate culture and market environment. The factors affecting specific immunity can be divided into enterprise defect recognition, enterprise management team response and enterprise quality defect memory. Specifically, by designing a reasonable corporate structure, formulating scientific corporate management rules, and creating a comfortable corporate culture atmosphere, the non-specific immunity of enterprises can be improved to ensure the steady production process and the reasonable allocation of resources. The specific immune function of enterprises can be enhanced by improving the accuracy of quality defect recognition, improving the response efficiency of enterprise management team to quality defects and strengthening the information memory of quality defects. Secondly, the improvement of enterprise immunity can also be analogized from the perspective of human health, physical exercise, mental state, nutritional balance, physical examination and other aspects. The innate immune factors affecting enterprise quality are as follows:

- (1) Enterprise structure.
- (2) Institutional rules.
- (3) Corporate culture.
- (4) Market environment.

The immune factors affecting enterprise quality adaptability are as follows:

- (1) Accuracy of quality defect identification.
- (2) Response efficiency of quality defects.
- (3) Timeliness of data memory of quality defects.

5. Research review and prospect

At present, the research on quality defects by domestic scholars is relatively micro. They mostly analyze the specific quality problems in various construction projects and give specific solutions, and explore the influencing factors of enterprise quality immunity in the form of questionnaires and expert interviews. Foreign scholars pay more attention to the practical application of quality management, and the research on the influencing factors of quality defects is less. This study first explores the source and connotation of quality defects, and determines the structure and measurement angle of quality defects. Secondly, the quality immune system of construction enterprises is analyzed, finally, the influencing factors of enterprise quality immunity are summarized. In the future, the research on quality management of construction enterprises can consider and analyze the quality defects generated in the management link, and strengthen the quality immune function of enterprises by optimizing the management path.

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