

# Research on Quality Management of Engineering Projects Based on Lean Construction Methodology

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**Abstract:** As the core objective and key link of project management, quality management of engineering projects directly affects the life and property safety of the people, and must attach great importance to the implementation of all-round quality control. And with the progress of The Times, China put forward the high-quality development of the construction industry, which means that it is imperative to improve the quality management level of the construction industry. For the many problems in China's current project quality management, the article presents the lean construction theory, systematically expounds its conceptual connotation, lean construction technology and its application value in the construction industry, conducts an in-depth analysis of the problems existing in the quality management of construction enterprises at present, and proposes targeted optimization suggestions from the aspects of comprehensive quality management, 6S site management, quality assurance system for construction projects, and quality management system for construction projects, thereby facilitating the high-quality development of the construction industry.

**Keywords:** Lean Construction; Project; Quality Management; Construction

## 1. Introduction

As the marketisation level of the economy increases, the competitive situation in various industries is getting stronger and stronger, and the construction industry is no exception. In order to obtain sustainable development in the fierce competition, construction enterprises must continuously improve the management and operation mode, ensure the construction quality, improve the production efficiency, reduce the waste of resources, and reduce the production cost. Lean construction is the application of the manufacturing industry's lean production

thinking in the construction industry, i.e., the systematic approach of running lean management thinking throughout the whole process of building construction in order to achieve maximum satisfaction of customer needs. There are many advantages of lean construction, which not only ensures that the quality of the project meets the requirements within the stipulated period of time, but also shortens the period of time and saves costs as much as possible. Therefore, it is necessary to apply Lean Construction practically in construction practice. It is on this premise that this paper explores the aspect of improving project quality.

## 2. Lean Construction Theory

### 2.1 Lean Construction Concepts

The first formulation of Lean Construction Theory dates back to 1993, with the pioneering construction of this theoretical system by the renowned Danish scholar Lauris Koskela. The scholar believes that in order to improve the production management level of the construction industry, the lean production principles of the manufacturing industry can be applied to the construction industry [1]. Although construction production also belongs to the category of production, it is different from production and has its own characteristics. The specific difference between the two is that in production, stationary people produce moving products; whereas in construction production, moving people produce products from a stationary building. However, the concept of Lean Manufacturing comes at a price: construction projects generally have long lead times and are susceptible to interference from various internal and external factors during the construction process, resulting in a highly complex and difficult to accurately predict nature of the construction process. Therefore, Lean Manufacturing is not a simple equivalent of Lean Production, but the core concept of

Lean Production is integrated into construction project management, and by applying Lean Manufacturing thinking to optimise the construction process of the whole project, an efficient and perfect construction system is constructed, so as to create maximum economic benefits for the enterprise. China's Lean Construction Technology Centre defines Lean Construction as a systematic approach that integrates production management theory, construction management theory and the specificity of construction production, and is oriented towards the whole life cycle of construction products, continuously reducing and eliminating waste, and maximally satisfying customers' requirements [2].

## 2.2 Lean Construction Techniques

In order to ensure the smooth and effective implementation of the Lean Construction Theory, it is necessary to use a variety of technical tools to provide strong support. Typical technical tools include 6S site management, kanban management, last-minute planning systems and parallel engineering [3]. Each of these technical tools plays a unique and critical role in the process of lean construction, and together they help the theory of lean construction to achieve ideal results in practical application.

### 2.2.1 6S on-site management

"6S" is a series of key initiatives mainly for the operation site, specifically including the six aspects of organisation, straightening, cleaning, cleanliness, quality and safety. "6S" site management as the construction industry to actively introduce a fruitful enterprise management, has an important position in the industry. Whether in the industrial manufacturing field or in the construction industry, the environment, resources, safety and people are always the core points of management, and are also the focus of daily management.

The "6S" on-site management in this process has shown many significant advantages, it can help enterprises to better integrate all kinds of resources. Through the scientific and reasonable sorting work, the items on the site for screening and screening, distinguish between necessary and unnecessary items, unnecessary items will be cleaned up in a timely manner, to make room for the work site; rectification is to stay in the necessary items for classification of the fixed position, so that the items are placed in a neat

and orderly manner, clear and clear marking, easy to quickly access and return, which greatly improves the efficiency of the work. Cleaning work to ensure that the site environment is clean and tidy, not only for employees to create a good working conditions, but also timely detection and resolution of potential equipment problems, prolonging the service life of the equipment. Cleaning is to institutionalise and standardise the work of tidying up, rectifying and cleaning, forming a regular management mechanism to maintain the site in good condition. The cultivation of quality makes employees develop good working habits and professionalism, consciously abide by the rules and regulations, actively participate in the management, and enhance the overall cohesion and execution of the team. Safety management is carried out throughout the entire "6S" management process to protect the lives of employees, reduce the probability of accidents, and provide a solid guarantee for the normal production and operation of the enterprise.

### 2.2.2 Kanban management

Kanban management is built on the basis of drawings and plans, and through effective information transfer, it strengthens the collaboration of all parties, so as to ensure the co-ordination of construction progress, material supply and customer needs. That is to say, if we want to accurately provide services to customers and satisfy their needs as much as possible, we must do the following two things: firstly, the project will be carried out normally and will not be affected by a variety of factors. The second is, to keep the material inventory on a zero basis and to minimise waste. The role of Kanban management application is to enable enterprises to grasp timely information through the medium of Kanban. Through real-time updating of information, enterprises can reduce the occupation of a large amount of material inventory and increase cash flow. Kanban through real-time transmission of construction information, so that all parties accurately grasp the construction dynamics, thus becoming an important technical support to ensure that the project starts on schedule and quality control.

### 2.2.3 Last-minute planning system

The end-user in an engineering project is the base operator who is specifically responsible for the execution of construction tasks [4]. The last plan system is an important mechanism in engineering project management. It specifically

refers to the implementation of the project process, the executor closely combined with the actual construction situation and the pre-planned programme, to carry out a comprehensive, detailed and in-depth comparative analysis. In this process, the executors need to be keenly aware of and accurate feedback on the various types of problems that exist in the construction process, these problems cover from the application of construction technology to the rationality of resource allocation, from the construction progress to the construction of the quality of the situation of meeting the standards and so on.

Subsequently, the project manager, on the basis of the detailed feedback from the implementers and the actual situation learned from the personal visit to the construction site, conducts a comprehensive analysis and then formulates a targeted and operable summary plan. This summary plan does not exist in isolation, but as an important part of project management, and other management links are interrelated and interact with each other to form a complete environmental control system.

The end-planning system has many advantages. It is conducive to avoiding conflicts between actual operations on the construction site and the planned programme. In the construction process, if there is no effective feedback and adjustment mechanism, it is easy to appear the construction of the actual and the plan is out of line, such as construction progress lagging behind the planned schedule, which may lead to delayed project delivery. And the end of the plan system through timely feedback and adjustment, can make the construction is always along the track of the plan, to ensure that the work is carried out in an orderly manner. At the same time, the system can both improve construction efficiency and ensure the quality of the project. In terms of improving construction efficiency, through the real-time monitoring of the construction process and problem feedback, can be found in a timely manner and solve the factors affecting the construction progress, such as optimising the construction process, rational allocation of resources, etc., so as to make the construction process smoother and reduce the unnecessary waste of time. In terms of ensuring the quality of the project, the strict control of construction quality and timely feedback can prompt the construction personnel to operate in accordance with the standard specifications, timely detection

and correction of quality problems, to ensure that the quality of the project meets the requirements, so as to create high-quality engineering projects, improve the reputation of enterprises and market competitiveness.

#### 2.2.4 Parallel engineering

As an integrated design methodology, parallel engineering emphasises the simultaneous development of products and processes, taking into account full-cycle factors such as quality control, cost management, schedule control and user experience from the start of a project. The goal of parallel engineering is to reduce the time required to build a product. This is achieved by considering every factor that influences the construction of the product, carefully analysing the problems that may arise, and then formulating solutions to address the problems in order to achieve the dual effect of maintaining the high quality standards of the product and optimising the time required to complete the project. Successful implementation of parallel engineering requires the active collaboration of multiple stakeholders, including designers, owners, consultants, construction teams, supervisors and contractors, to achieve common goals and benefits. Parallel engineering is characterised by the fact that each participant can be better defined during the initial stages of a project; decisions are made jointly when designing a building product so that all parties can realise their vision. While traditional manufacturing methods require that each step of the process be completed in strict sequence, parallel engineering innovatively synchronises multiple processes, breaking away from the traditional linear construction model.

From the point of view of construction practice, parallel engineering has deeply penetrated into all construction stages of engineering projects. Construction units often establish parallel projects according to the characteristics and role of technology, so that quality management and parallel projects can promote each other, thus improving the quality management level of construction units.

### **3. The Necessity of Applying Lean Construction Theory for Quality Management of Construction Projects**

#### **3.1 Helpful in Meeting Consumers' Individual Needs**

With the upgrading of consumption, the precise

response to consumers' personalised needs has become a strategic focus of enterprise development. Lean construction plays a key role in this process, which requires the active use of advanced network information technology and the construction of intelligent platforms. Network information technology plays a leading role in today's transformation of various industries, and the construction industry is also using intelligent platforms to achieve a full range of data collection and analysis applications.

The use of intelligent technology can provide an all-round and precise understanding of consumers' individual needs. These data not only cover the consumer's expectations for the spatial layout of the building, such as the functional division of the room, the size of the area, etc., but also include personalised demands for the architectural style, decorative materials, ancillary facilities and other aspects. Then, based on these accurately obtained demand information, scientific and reasonable adjustments are made. In the design stage, architects can personalise the architectural scheme according to the specific needs of consumers to ensure that every detail meets the expectations of consumers. In the construction process, intelligent production equipment and management systems can be used to achieve precise control of construction processes and procedures to meet the requirements of personalised design. And, Lean Construction enables construction at scale. This does not mean simple repetitive production, but efficient large-scale construction by optimising construction organisation and rationalising resources under the premise of ensuring individualisation. For example, the use of standardised modular components combined with personalised customisation improves construction efficiency and meets the unique needs of consumers. In this way, it can not only provide consumers with construction products that meet their hearts, but also improve the market competitiveness of construction enterprises and promote the sustainable development of the construction industry.

### **3.2 Contribute to Cost Savings, Quality Enhancement and Schedule Optimisation**

Achieving alignment of project cost, schedule and quality is one of the core objectives of construction project management, and Lean

Construction delivers a triple benefit to projects: cost savings, quality improvement and schedule optimisation.

Lean construction focuses on the strict control and precise management of the whole construction process. Lean construction means that companies need to adopt strict cost management strategies: on the one hand, through refined budgeting and costing, to control the expenditure of each stage of construction; on the other hand, value engineering tools are used at the early stage of the project to rationally optimise the design scheme and avoid unnecessary expenditure. During the construction process, strengthen the control of raw material procurement, inventory management and construction process to reduce the cost increase due to material waste, rework and other reasons.

In terms of schedule management, adopt the project management method of lean construction and formulate a detailed and reasonable construction schedule. By reasonably arranging construction processes and resource allocation, it ensures that each construction link is closely connected, avoiding waiting and delays between processes. At the same time, the use of information technology for real-time monitoring of the construction progress can detect and solve the hidden problems that may affect the progress in time. In terms of quality management, Lean Construction focuses on starting from the source, strengthens the quality inspection of construction raw materials and components, and ensures that every batch of materials entering the construction site meets the quality requirements. Lean Construction's quality management features: a quality monitoring system that strictly controls work processes; the cultivation of quality management awareness among all staff; and the implementation of a quality traceability mechanism to achieve clear responsibility and traceability of problems.

Through Lean Construction's comprehensive and coordinated management of cost, schedule and quality, it can achieve balance and optimisation between the three, and ultimately achieve the goals of cost reduction, quality assurance and shortening of construction period, providing a strong guarantee for the successful delivery of construction projects, which not only enhances the market competitiveness of enterprises, but also obtains considerable economic returns and social recognition.

### 3.3 Contribute to the Reduction of Unnecessary Waste

The core of the Lean Construction philosophy is to minimise resource wastage during the construction process. Lean construction organically integrates lean thinking and intelligent platforms into the entire life cycle of a building product to achieve efficient use of resources and effective reduction of waste.

In the planning and design stage of construction products, the feasibility of construction projects is analysed in depth through intelligent platforms, taking into full consideration site conditions, environmental factors and user needs, which can effectively avoid rework and resource loss in the construction process. For example, the use of digital simulation technology to simulate and analyse the lighting, ventilation and energy consumption of the building, optimize the building design scheme, reduce energy waste and later operating costs.

In the procurement and supply of raw materials, with the help of an intelligent platform to realise information sharing and collaborative cooperation with suppliers, the procurement and distribution of materials are accurately arranged according to the progr

ess of construction to avoid material backlogs and wastage. At the same time, through the market price monitoring and analysis system, the timing of procurement is accurately controlled, and combined with the Internet of Things technology to realise the fine management of materials to ensure that the supply of materials matches the construction demand, and to reduce the wastage of materials due to their expiry, damage or idleness.

During the construction process, lean construction emphasises the improvement of construction efficiency and quality by optimising the construction techniques and processes and reducing unnecessary work processes and operations. In addition, by rationally arranging the operating time and tasks of construction personnel and mechanical equipment, it avoids idling of personnel and equipment and improves resource utilisation.

In the operation and maintenance phase of building products, lean construction focuses on real-time monitoring and optimisation of equipment operation and energy consumption of buildings through intelligent equipment management systems and energy management

systems to optimise the efficiency of equipment operation, realise energy saving and consumption reduction, and prolong the use cycle. For example, the use of intelligent sensors to monitor the operating status of building equipment, timely detection of equipment failures and predictive maintenance, to avoid downtime and increased maintenance costs caused by sudden equipment failure. Lean construction can also scientifically configure building energy supply, adapt to seasonal and demand changes, and improve energy efficiency. By applying lean concepts and intelligent tools to the entire life cycle of a building product from design to demolition, lean construction can intervene in all aspects to streamline redundant consumption of resources, enhance the resource efficiency and economic returns of the construction industry, and at the same time play a positive role in environmental protection and promote the sustainable development of the construction industry.

## 4. Problems of Engineering Quality Management at the Present Stage

### 4.1 Lack of Awareness of Integrated Management of the Whole Process of Construction Projects

At present, most of China's construction enterprises are constantly improving the quality management system of engineering projects. Project construction is a systematic project, which needs to be closely linked from preliminary planning, research and demonstration to design and construction, completion and maintenance. However, in practice, the quality management carried out by the construction unit in the various stages of construction is an autonomous system, and they do not interfere with each other and do not interfere with each other. At the same time, there will be some formal quality management, and there will even be stages that should be considered but are not considered for the quality of the project. Therefore, the concept of quality management must be implemented throughout the whole process of the construction of engineering projects. However, there are still many enterprises that only carry out standardised quality management for a certain project stage or a certain department, without thinking from the perspective of the whole process. In addition, project quality management

is more of an afterthought, yet numerous cases have warned construction units that they should change their passive management thinking and establish a long-term mechanism for quality management. Through the prevention and control, process optimisation and experience summary, to achieve the continuous improvement of engineering quality.

#### **4.2 Inadequate Quality Assurance System**

In the process of engineering construction, a crisis that cannot be ignored is emerging: the lack of quality consciousness of site operators and management. This lack of quality concept has penetrated into all aspects of engineering construction, seriously restricting the improvement of engineering quality and efficiency.

First of all, in the field of engineering construction, design, supervision, construction and other participating units should be the guardian of the quality of the project, but are often driven by interests and make choices that deviate from professional ethics. They seek short-term gains by lowering the quality standards, which is manifested in the formulation of loose quality specifications, ignoring the long-term use of the project value and safety. Secondly, even if the corresponding standards are formulated, there are serious problems in the implementation process, and lax implementation of standards has become a common phenomenon. Furthermore, the enthusiasm of participating units to establish quality assurance system is generally low. They do not recognise the importance of the quality assurance system for the quality of the project, and believe that the establishment and maintenance of the quality assurance system requires a lot of manpower, material and financial resources, but they cannot get the economic benefits quickly. Therefore, in practice, often just perfunctory, failed to really establish an effective quality assurance system.

Moreover, the quality accountability system has not been effectively implemented. When quality problems occur, due to the unclear division of responsibilities or the existence of mutual shirking of responsibilities, the real responsible persons have not been duly punished. This has further indulged some units and individuals in the quality problem of fluke, making the quality problem repeated. In addition, some management departments or executives are

seriously negligent in quality management; they lack understanding of the situation on the construction site, focusing only on the progress and economic benefits of the project, while neglecting the key factor of quality. At the same time, most of the on-site construction personnel have not received higher education and lack systematic professional training, and they pay more attention to whether the construction project can be completed according to the construction schedule during the construction process, while they do not have enough knowledge about the importance of product quality. They may not understand some key quality control points in the construction process, nor master the correct construction techniques and methods, which inadvertently leads to quality problems.

In the face of such a status quo, this is an urgent need to establish a sound, advanced quality assurance system to ensure the quality and smooth completion of the project.

The lack of a rigorous and systematic quality management model is not conducive to the formation of a quality mindset among employees and the improvement of product quality. In the absence of clear quality standards and strict management requirements, employees may gradually develop a habit and mindset of not paying attention to quality. They may think that quality problems can be tolerated as long as they can complete their tasks. Once formed, this way of thinking will spread throughout the construction team, leading to a decline in overall quality awareness. At the same time, product quality will be directly affected. A project with substandard quality will not only affect its function and life span, but may also pose a threat to the life and property safety of the users.

#### **4.3 Management Methods not Adapted to the Current State of Development**

Under the wave of new technological revolution, innovative technologies such as big data and cloud computing are accelerating the penetration of various industries. The construction industry has achieved intelligent upgrading with the help of technological empowerment, but the transformation from traditional management mode to digitalisation still faces many challenges. In the current development pattern of China's construction industry, there are still a considerable number of building construction enterprises are still using the traditional

management mode. These enterprises in the management concepts and methods failed to keep pace with the times, failed to fully understand the modern technology for the construction industry to change the huge role in promoting. In today's era of rapid development of digitalisation and intelligence, big data, cloud computing and other advanced technologies have shown a strong influence and application value in many fields, but these building construction enterprises have not effectively integrated and docked the traditional management mode with these advanced technologies.

In the whole process of engineering project construction, there is a lack of application of big data technology from the planning and design stage of the project. Construction companies tend to plan only on the basis of experience and limited market research, resulting in a project design that may be unreasonable and unable to fully meet market demand and adapt to future development changes. The advantages of cloud computing technology are also not fully utilised during the construction phase. These enterprises that follow the traditional management model often rely on manual experience and cumbersome paper documentation records in resource management, leading to untimely and unreasonable resource deployment, which is prone to waste or shortage of resources, thus affecting the construction progress and quality. In the quality management of the project, the same lack of advanced technology support. Enterprises under the traditional management mode have relatively backward quality testing means and limited data collection and analysis capabilities, making it difficult to achieve comprehensive and accurate management of quality, increasing the risk of quality problems in the project. In terms of safety management, enterprises have not combined traditional management with advanced technology, and the safety management of construction sites mainly relies on manual inspection, with regulatory loopholes and lagging, unable to detect and eliminate hidden safety hazards in a timely manner, bringing potential threats to the life safety of construction personnel and the smooth progress of the project.

In summary, these large number of building construction enterprises in China that follow the traditional management mode, due to the lack of big data, cloud computing and other related

advanced technologies in the construction process of the project, in all aspects of the project are faced with a number of problems and challenges, which seriously restricts the development of the enterprise and the overall progress of the construction industry, there is an urgent need to carry out the innovation of the management mode and the upgrading of the application of technology.

## **5. Quality Management Measures for Engineering Projects Based on Lean Construction Methodology**

### **5.1 Implementation of Total Quality Management**

Total quality management in the field of construction has a crucial position and far-reaching significance [5], it is not only limited to the construction materials, equipment and personnel of the routine management, more in-depth requirements for the construction of building products throughout the construction process of comprehensive, detailed and strict management, in order to ensure that the project proposal from the pre-preparation stage of the careful preparation of the feasibility of the study has been dealt with in-depth in the process of every single The construction quality of each link can meet the high standard requirements.

In the process of advancing the construction project, it covers a number of key stages from the design and planning, construction to the approval of the project and even the later maintenance, and so on, each link is closely linked, interlocked, any one link of the loosening of the quality of the entire project may have a serious impact [6]. Therefore, each process of construction must be subject to rigorous quality audits. In the design stage, the design scheme should be repeatedly demonstrated and optimised to ensure that it complies with the building code and user requirements, while taking into full account the feasibility and economy of construction. In the construction process, it is even more important to closely monitor and inspect each process. From the excavation and pouring of the foundation works, to the construction of the main structure, to the decoration and furnishing and other aspects, all should be operated in accordance with the established construction specifications and quality standards. Construction personnel should have professional

skills and a high degree of responsibility, and strictly comply with the construction process to ensure the stability and consistency of construction quality.

At the same time, it is necessary to establish a sound quality inspection system, equipped with professional quality inspectors and advanced testing equipment, to carry out real-time testing and analysis of various quality indicators in the construction process. Once problems are found, effective measures are taken immediately to solve them, and problems are never allowed to be left to the next process, so as to ensure the quality and quality of civil construction products. Through such strict quality control, the appearance of unqualified construction products can be effectively avoided, and the overall quality and safety of construction projects can be guaranteed.

In order to better achieve effective control of overall quality, lean construction support techniques such as Kanban management and last-minute planning systems can be flexibly applied [7]. Kanban management clearly displays various information during the construction process, such as material supply, construction progress, quality inspection results, etc., through visualisation, so that the relevant personnel can understand the real-time status of the project at a glance. In this way, not only can the timely detection of material supply problems, such as material shortages or backlogs, so as to make effective adjustments and optimisation, to ensure the smooth progress of the construction; but also through the monitoring of the construction progress, timely detection of lagging progress, and analyse the reasons for the adoption of appropriate measures to improve, to ensure that the project is completed on time. At the same time, for quality problems can also be timely feedback and processing, improve the efficiency and transparency of quality management.

In addition, the end-planning system is a very effective quality control tool. It can coordinate the difference between expectation and reality in time by comparing and analysing the actual progress of the project with the expected goal. In the process of project implementation, the last-place planning system constantly adjusts and optimises the plan according to the actual construction situation to ensure that the project is always moving towards the predetermined quality goals. For example, when the actual

construction progress is found to be inconsistent with the planned progress, the system can analyse the reasons, such as unreasonable resource allocation, construction process problems, etc., and timely adjust the resource allocation and optimise the construction plan to ensure that the construction progress and quality are not affected. In this way, it can enable the project to maintain a good state of quality control in the face of a variety of complexities and uncertainties, ensure that the construction products ultimately meet high-quality delivery standards, and provide users with safe, reliable and comfortable architectural space, as well as establish a good reputation and market competitiveness for construction companies.

## **5.2 Conduct 6S Construction Site Management**

Lean construction theory takes cost reduction and efficiency as the core, eliminates waste and achieves quality improvement through systematic management methods [8]. For the problem of resource waste in engineering construction, the 6S management concept can be used to optimise the quality control system [6]. If we want to promote 6S management scientifically and effectively, we must first set up a professional management team. This team should be composed of a group of elite talents with rich engineering management experience and profound professional knowledge, they can deeply understand the 6S management concept of the profound connotation and specific requirements, and cleverly combine it with the actual situation of engineering construction. The management team should shoulder the responsibility of developing a detailed and comprehensive 6S management plan and practical implementation programme, clear objectives and specific tasks at all stages, to ensure that the 6S management work can be methodical and progressive progress.

At the same time, the establishment of a clear and precise responsibility system and job description is also a top priority. To accurately and precisely define each department and each position in the 6S management of specific responsibilities and detailed work content, so that every employee clearly and thoroughly know their role in the 6S management and the tasks undertaken. For example, the construction site materials management personnel should be responsible for the careful arrangement of



materials and orderly reorganisation, to ensure that the classification of materials stored scientifically, clearly marked, easy to access and efficient management; equipment maintenance personnel to take up the cleaning and regular maintenance of equipment, to ensure that the normal and stable operation of the equipment; quality inspection personnel should be on the construction process of all aspects and final product quality to carry out Quality inspection personnel should carry out strict and meticulous inspection of all aspects of the construction process and final product quality to ensure full compliance with the quality standards and strict requirements of 6S management.

Combined with monthly, quarterly and annual plans to carry out regular publicity and inspection work, is to ensure that the 6S management concept is deeply rooted in people's hearts and get effective implementation of the key measures. Through the regular organisation of a variety of publicity and education activities, such as holding professional 6S management knowledge lectures, posting eye-catching slogans in prominent positions on the construction site, and carrying out case studies of practical significance, etc., we have popularised the significance of the 6S management and the specific implementation methods to all the staff, and continuously strengthened their awareness of environmental equipment management. So that employees deeply understand that a clean, orderly, safe working environment can not only greatly improve work efficiency and product quality, but also to effectively protect their own safety and health. At the same time, we must vigorously strengthen the supervision and inspection of the implementation of 6S management, the establishment of a sound and perfect supervision mechanism, regular construction sites, office areas and other places to carry out detailed and comprehensive inspection and evaluation, timely and keen to find problems and quickly urge rectification and implementation. Good implementation of departments and individuals to give public recognition and generous rewards, the implementation of ineffective serious criticism and corresponding penalties, the formation of effective incentives and constraints mechanism, and effectively promote the 6S management work to continue to carry out in-depth, solid and effective.

Focusing on personnel quality is one of the core

points of lean construction theory. Improving and strengthening the quality of construction products must start from the overall improvement of personnel quality. On the one hand, the professional skills training of construction personnel should be greatly strengthened, and the technical level and practical operation ability of construction personnel should be continuously improved through carrying out systematic technical training courses, demonstrating on-site operation, establishing the mechanism of teacher and apprentice, etc., so as to make sure that they can skillfully and accurately master the construction process and technical requirements, and carry out the construction operation in strict accordance with the standards and norms to ensure the quality of construction products. The quality of construction products. On the other hand, we should actively and enthusiastically carry out production safety training, so that every employee is deeply aware of the extreme importance of production safety, and always respect for the safety of life and protection of property safety in the first place. Through the production safety training, the employees will have a comprehensive understanding of the production safety knowledge and operating procedures, be proficient in safety prevention skills and emergency treatment methods, and continuously improve their safety awareness and self-protection ability. During the construction process, they strictly abide by the rules and regulations of production safety, strengthen safety management and supervision, and ensure the safety of the construction site is foolproof. At the same time, the significant improvement of safety production awareness also helps employees pay more attention to the construction quality, because safety accidents often have serious negative impacts on the construction quality. Only under the solid premise of ensuring safety can we better improve product quality, realise the ambitious goal of lean construction, create more brilliant performance for construction enterprises, and dedicate more high-quality construction projects to the society.

### **5.3 Strengthening the Engineering Quality Assurance System**

The quality of the project is the key to the entire project construction, and the quality of the project is directly related to the economic

interests of all parties, and the unqualified project may not be a big problem in the early stage. However, after the accident, rectifying the problems that arise after the completion of the project may require the relevant units to invest more money and time, and may even damage the company's reputation. At the same time, substandard construction products will pose a certain threat to human life, health and safety, for this reason, it is necessary to take the following specific measures to strengthen the construction of engineering quality assurance system.

Firstly, to raise awareness of technical quality among stakeholders. Whether it is the pre-preparation of project proposals and feasibility studies, design, construction, commissioning, or even project maintenance, each stage is done by people. Because awareness drives human behaviour, safeguarding technical quality depends on human behaviour. So improving employees' awareness of quality and safety is an important part of the project quality assurance system. Construction companies improve the quality awareness of their employees through activities that can be carried out such as safety education quiz activities and sharing of engineering quality cases.

Secondly, before the project is put into construction, the project construction unit should strengthen its communication with the project unit and the construction unit, so as to fully understand the project intention and technical regulations, as well as the specific requirements of the project unit for the project. Propose defect rectification programmes, discuss quality problems that may arise during the construction process, and make reasonable suggestions for the construction organization.

Finally, construction companies can carry out on-site follow-up inspections throughout the process, and many quality problems are discovered through on-site follow-up inspections, which shows that problem detection cannot rely solely on the intelligent big data platform, and it is not enough to rely on the intelligent big data platform alone. Let the construction unit carry out inspections to discover the actual problems not found by the platform, do a good job of on-site inspections, and rectify the problems that affect the quality of the project. However, quality problems should be handled with the aim of solving the problems and preventing them from recurring, and should not just be blamed or

given severe penalties. The unit can discuss the problem and solve the problem with the construction personnel after finding the problem, or make a correct operation demonstration to the on-site construction personnel.

## **5.4 Standardised Construction Quality Management System**

**5.4.1 Laws and regulations, standards and norms**  
The introduction of building regulations can enable the participating units to clarify their respective responsibilities and obligations in terms of quality, so as to avoid quality problems. The establishment of the construction project guarantee and damage compensation system can also limit the illegal behaviours to a certain extent. Therefore, in order to fight for their own interests, construction enterprises should keep abreast of the laws, regulations and standards related to their quality production. Construction according to standards can not only be bound by the law, but also protect themselves according to the law. When rights and legal interests are violated, appropriate measures are taken in time to protect personal rights. Some laws, regulations and other requirements for quality production of works should also be communicated to operators in time, so that every employee can comply with the laws, regulations, standards and provisions related to quality production and implement them in their work.

### **5.4.2 Regulations**

The role of laws and regulations on the quality constraints of engineering construction enterprises can not allow them to achieve comprehensive quality control. Enterprises must take into account the actual situation and formulate internal quality management system in order to effectively ensure the quality of the project [9]. This requires the management to use rich practical experience and professional ability, in-depth analysis of the current situation of the enterprise, the establishment of a practical specification system, and through all levels of review and orderly implementation to the grass-roots positions. Communicate with employees in a timely manner, with superiors taking the lead and allowing all employees to work together to formulate rules and regulations. This will not only regulate the operation process with professional standards and prevent quality problems, but also improve the execution of the system through employee participation. A complete system should cover core areas such as

document management, risk prevention and control, personnel training, special operations and equipment maintenance.

#### 5.4.3 Operating procedures

In the field of construction, in order to ensure that the quality of construction projects can meet high standards and strict requirements, so as to ensure that the entire project can be carried out smoothly and achieve safe and reliable use in the later stage, it is necessary to formulate the corresponding operating procedures. These operating procedures in the implementation of the construction process plays a crucial role in guiding to ensure that the work is carried out in an orderly manner, and ultimately achieve the goal of high-quality construction.

The main purpose of the operating procedures is to clearly define the specific operating requirements in the manufacturing and construction process [10]. In the manufacturing process, whether it is the production of building materials or the processing of components, there is a need for detailed operating procedures to regulate each production step. For example, in the manufacturing process of concrete, the operating procedures should accurately specify the selection criteria of raw materials, including cement varieties, standard, sand and gravel particle size, grading, as well as the type and amount of additives. At the same time, the mixing time, mixing speed and feeding order during the mixing process should also have strict requirements to ensure that the quality of concrete is uniform and stable and reaches the designed strength and performance indexes. In the processing and manufacturing of reinforcing steel, the operating procedures should specify the operation methods and parameters of the straightening, cutting, bending and other processes of reinforcing steel to ensure that the dimensional accuracy and mechanical properties of reinforcing steel meet the engineering requirements.

In the construction process, the operating procedures even cover the specific requirements of many aspects. Starting from the construction of foundation works, such as the depth and slope control of earth excavation, the way and construction sequence of foundation pit support, etc., all of them need to be operated in strict accordance with the operating procedures to ensure the stability and safety of the foundation. In the main structure construction stage, for the installation and dismantling of templates, the

binding and connection of steel bars, the pouring and vibration of concrete and other processes, the operating procedures should make detailed provisions. In the decoration project, the operating procedures are equally important, including wall plastering, floor paving, door and window installation and other processes should have a clear operating specification to ensure that the decorative effect and the use of function. In short, these specific operational requirements in the manufacturing and construction process are the key to ensuring the quality of construction works and must be strictly implemented and observed.

## 6. Conclusion

In the development pattern of today's construction industry, lean construction has become a key initiative to improve the quality of construction products, which has an importance and far-reaching significance that cannot be ignored. With its unique concepts and methods, it brings all-round enhancement and optimisation to construction enterprises, which can effectively and efficiently help them stand out in the complex and changing market environment and fierce competition, and achieve sustainable development.

In view of the excellent performance of lean construction in reducing waste, lowering cost, ensuring quality and controlling progress, it should be further widely promoted and implemented in the construction industry. The purpose of this paper is to deeply integrate lean thinking with engineering project quality management theory, give full play to the advantages of both, and provide construction enterprises with more scientific and effective quality management methods and tools. Through the use of lean construction assistance technology, the enterprise in the construction process of some quality problems for in-depth analysis and targeted solutions. At the same time, this paper is also committed to helping construction enterprises to improve construction technology and construction capacity. Through technical training and exchange activities, the advanced technology and concepts of lean construction are taught to construction personnel to improve their technical level and innovation ability. Encourage construction enterprises to actively introduce and apply advanced construction equipment and techniques, such as assembly building technology and 3D printing

technology, to improve construction efficiency and quality and reduce construction costs. In addition, through the establishment of a perfect quality management system and incentive mechanism, construction enterprises and construction personnel will be motivated and proactive in the continuous pursuit of excellent construction quality and technical level, contributing more quality projects and innovations to the development of the construction industry.

In conclusion, lean construction, as an advanced construction management concept and method, plays an important role in improving the quality of construction products and promoting the development of the construction industry. By further promoting the implementation of lean construction, combining lean thinking with the theory of project quality management, and using lean construction assistive technology to solve enterprise quality problems and improve construction technology and capability, the construction industry will be able to achieve higher quality, more efficient and effective development, and create more high-quality construction products and value for society.

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