Research Article

The Risk Management Mode of Construction Project Management in the Multimedia Environment of Internet of Things

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The construction industry is the pillar industry of China’s national economy. According to the statistics of the National Bureau of Statistics, the GDP in 2016 was 744.127 billion yuan, while the total construction output value was 193.567 billion yuan, accounting for 6.5 percent of China’s GDP. The construction industry has played a pivotal role in promoting social development. Construction projects have always belonged to typical high-risk industries, and they will be affected by many factors, and these factors are mostly from the social environment and the natural environment, which makes it difficult to realize the expected construction period, cost, quality, safety, etc., of the construction project. The objectives, especially for large- and medium-sized construction projects, involve a lot of specialties, a wide range, a long construction period, and a huge amount of investment. Once the risks appear, the consequences are unimaginable. In addition, construction projects will be affected by accidental factors during the implementation process. If not handled in time, it will seriously affect the normal operation of construction projects. In view of the above problems, this article aims to study the risk management research of construction project management under the multimedia environment of the Internet of Things. Combining the characteristics of mobile construction projects, various problems are analyzed in the construction process of construction projects. This paper proposes a multimedia-based construction project management system, construction project quality management objectives and principles, and schedule risk prediction. The experimental results of this paper show that taking the construction project under the multimedia environment as an example, the communication management and quality control management of the construction project under the multimedia environment are studied. Through the combination of theory and practice, the work of construction projects under the multimedia environment of the Internet of Things is guaranteed to be completed on time and with high quality.

1. Introduction

In the whole life cycle of a construction project, the risk problem has always been difficult to solve, which will not only affect the construction quality of the construction project, but also have a greater effect on the operation effect of the construction project [1]. The diversity of production and the complexity of buildings make the probability of project construction risk factors and risk events greater, often resulting in more serious consequences. Due to the large amount of construction engineering projects, a large number of units and factors will be involved, resulting in problems such as schedule risk, decision risk, operational risk, technical risk, and safety risk of the entire construction project. If not handled in time, it is inevitable. It will have a greater impact on its overall implementation effect. It can be seen that strengthening the risk management of construction projects is particularly important, mainly reflected in the following three points [2–5]:

(1) Through risk management of construction projects, it is beneficial to improve the risk control ability of project managers. No matter what type of risk occurs, project managers can make correct decisions in the first time, and minimize the risk [6].
(2) Through the risk management of construction projects, it is conducive to the resolution of various unfavorable factors and has a good promotion effect on the normal operation of construction projects [7, 8].

(3) Through risk management of construction projects, it is conducive to reducing social nonperforming assets and can significantly promote the sustainable development of China’s social economy [9, 10].

"Risk management" was first proposed by the Germans after "World War I," and American scholars began to study "risk management" in the 1930s, and then continued to develop. "Risk management" officially became a professional discipline in the 1950s. In turn, the ongoing drive by the American College of Insurance Professionals is making growth more deliberate and complex [11–13]. In 1987, the American Project Management Association began to publish the project management knowledge system, which is also the world's first project management knowledge system, which indicates that risk management has become an important part of project management [14]. British scholars have also achieved fruitful results in risk management. Some scholars believe that project risk management is not only a scientific management theory, but also a project management theory, which is closely related to the operation and management level of the project, and is also a decision that the project manager must master [15–17]. The British applied the risk analysis method in the oil pipeline project of Beihai Oilfield, which not only improved the safety of the project but also reduced the project cost. At the same time, the establishment of the British Chartered Insurance Institute and the British Risk Management Association was very large. To a certain extent, it promotes the development of risk management in the UK [18]. American scholars and British scholars have their own characteristics in project risk management and have strong complementarities. In addition, the French are the first people in the world to apply risk management ideas to the business management system, and most of them conduct research risk management from the management level. From the current point of view, risk management theory has been widely applied to engineering construction organization, engineering construction, engineering design, project feasibility analysis, and other fields. The project risk management system has been basically established and improved [19].

Risk management came to China in 1985, introduced by Dr. Duan Kailing, and the publication of Risk Analysis and Decision-making (Professor Guo Zhongwei) marked the formal study of risk management in China as a professional discipline [20]. With the accelerating process of China’s reform and opening up, a large number of foreign advanced risk theories have been introduced and applied to the Guangzhou Metro Construction Project, the Three Gorges Project Construction Project, and the Gezhouba Hydropower Project Construction Project, which have achieved better application results. "Engineering Project Risk Management — Theory, Method and Application" (Wang Zhuoyu) carried out a comprehensive and in-depth analysis of the methods and theories of project risk management [21]. Hao introduced the method of risk identification comprehensively and also proposed a series of risk prevention measures based on the perspective of transferring risks, reducing risks, and avoiding risks [22]. Hao, Shen, etc., proposed a series of management methods, countermeasures, and evasive strategies to effectively control project risks, avoid adverse effects, and achieve the overall goal of the project with the least cost [23–25]. These studies provide some reference for the research in this paper, but there are some shortcomings in the study due to too little time and insufficient sample size.

The article discusses in detail the application of construction project risk management in order to provide experience for similar projects. Construction projects have always belonged to typical high-risk industries, and they will be affected by many factors, and these factors are mostly from the social environment and the natural environment, which makes it difficult to realize the expected construction period, cost, quality, safety, etc., of the construction project. The objectives, especially for large- and medium-sized construction projects, involve a lot of specialties, a wide range, a long construction period, and a huge amount of investment. Once the risks appear, the consequences are unimaginable. In addition, construction projects will be affected by accidental factors during the implementation process. If not handled in time, it will seriously affect the normal operation of construction projects. In view of the above problems, this paper proposes a risk management model for building project management in a multimedia environment, controlling the construction period and managing risks through multimedia technology.

2. Construction Project Risk Management

2.1. Construction Project Management Theory.

Construction project management is mainly to use scientific knowledge, technical means, tools, and other operations to manage the project. Management is generally carried out through the processes of organization, planning, leadership, coordination, scheduling, and control. The project management requirements clarify the management organization, organizational functions, role positioning, scope of duties, etc., rationally optimize resource allocation, and complete management objectives within the specified time limit and cost range [26]. Project management covers a wide range of topics, including project time, scope, cost, schedule, communication, risk, human resources, procurement, contracts, information, machinery and equipment, and on-site management. The purpose of comprehensive project management is to achieve the project objectives within the contract period and meet the expectations and requirements of all stakeholders. The project management content is not single, and the various elements are intertwined, which constitutes the project management scope intricately. Coordinating various management factors and making it operate scientifically and orderly is the effect that project management should achieve. Project management involves the life cycle of the
project. The life cycle of the project refers to the whole process from project planning and implementation to acceptance. The life cycle of a project varies with the size of the project and the length of the cycle. The life cycle of the project varies from several months to several years. Regardless of the length of the project life cycle, the project management process that is experienced generally has commonalities and must be organized. Planning, coordination, control, and other processes must use scientific and technological means and advanced management methods to achieve the ultimate goal of management.

2.1.1. Definition and Characteristics of Project Risks. Generally speaking, risk refers to the possibility of an unfavorable event. It is an uncertain loss that can predict the probability and consequences of its occurrence. Project risk is an uncertain factor that deviates from the project objectives and affects the project implementation process. It may have certain obstacles to the realization of a certain part of the project’s target process and may also cause significant losses to the project’s revenue. The risk research is also to reduce the impact of uncertain events on the project plan. Most of the risks are predictable, identifiable, and controlled, with the following characteristics [27, 28].

First, project risks are objective. The project risk does not depend on manpower’s will; it is existed objectively. The quantum of risk and the likelihood of happening are different for different combinations of risk in different risk factors. Project risk occurs as a result of a combination of environmental, economic, technological, policy, and cultural factors, which allows managers to control the occurrence of risks. Therefore, project risks have an objective existence [29].

Second, project risks are relative. The relative risk is mainly reflected in the degree of influence of the same risk on different projects. The risk factors that have a significant impact on one project may have the opposite effect on the other project; the project risk exists objectively, but the manager can pass certain means reduce or transfer risk.

Third, project risks are deformable. The risks at each stage of the project are different and will change with management. This change may be beneficial or unfavorable. The risk changes in large projects will be more obvious because of the large risk factors of large projects.

Fourth, the diversity and predictability of project risks. Different types of projects, different cycle lengths, and different management factors, the existing risks are diverse.

Fifth, the predictability of project risks. Project managers can predict the source of risk, the amount of risk and the probability of occurrence by scientifically analyzing data, etc., and formulate effective measures to prevent and reduce risks.

2.1.2. Risk Evaluation. The probability of the risk analysis result determines the order in which it is dealt with. A high probability indicates that the risk is likely to occur, and countermeasures should be taken first. To achieve this goal, run the risk analysis module to obtain the probability of occurrence of risk information, match the data with the preset risk level, and divide the level according to the standard.

2.1.3. Risk Prevention. Project risk prevention is a measure to reduce the probability and impact of risk based on the results of risk identification and assessment. The ultimate goal is to ensure the maximum benefit of relevant parties. The choice of risk prevention methods should be based on the actual situation of the project. The same project may use several methodologies; different courses of the same work may use different methodologies, with the overriding goal of reducing their losses due to exposures.

2.2. Risk Management

2.2.1. Risk Management Overview. There are different risk management mechanisms in various industries in the real society, and of course they will show different characteristics in each industry. Risk management is mainly composed of risk control managers and potential objective risks. Therefore, in some more complex production environments, professional risk control managers must be present to ensure the smooth progress of the project. Risk management needs to go through a series of complicated supervision, management, and approval processes before it can be implemented. Therefore, these processes are particularly important. Only by controlling all the identification, quantification, evaluation, control, and supervision processes in between can they be implemented. Achieve effective control of risks, so as to ensure the smooth progress of production activities.

2.2.2. Risk Identification. Risk identification is the first step in the risk management process. Many potential risks may be encountered in the various work processes of the project. They must be judged and summarized according to their different characteristics. They would have to be judged and conclude according to their diverse characteristics. The ultimate goal of risk recognition is to find the item. That is to find the incentives that cause the risk and reduce its impact on the subsequent operation of the project.

2.3. Construction Project Risk of Construction Progress. Due to the long production cycle, large-scale, and complicated management process of construction projects, in the actual construction, there is obvious uncertainty in the event. Therefore, the risk events brought about to some extent affect the completion of the planned progress of the construction progress. There are five aspects to the project construction schedule risk.

2.3.1. Objective Search and Universality. Whether it is a natural disaster or a conflict in economic and social development, it is an objective risk. In fact, there are many types of risks and great harm. The implementation of
construction project management can only reduce the probability of occurrence of risks and reduce losses through management methods and technical methods, but it cannot eliminate risks objectively.

2.3.2. Uncertainty and Measurability. The uncertainty of construction schedule risk is reflected in four aspects: probability, time, resulting result, and loss. According to the relevant literature and the experience of the relevant construction personnel on the site, it is often possible to calculate the construction schedule risk probability and consequences and theoretically realize the prediction and measurement.

2.3.3. Relativity

(1) The risk subject is relative. But the individual behavior is different and the method is different; the loss and the consequence are also different. Construction scheduling risk incidents are therefore only meaningful relative to the relevant acting physical entity. The similarly risky event may not have any damage or loss relative to other solid parties.

(2) The magnitude of the risk is relative. The size of the risk is based on the affordability of the agent. In terms of construction progress risk, the ability to withstand includes the following aspects. (1) The size of the income: the higher the construction schedule risk loss, the greater the expected value of the risk event. That is to say, the benefits and affordability can be positively correlated. (2) The size of the input: the greater the human resources and economic resources invested in the construction schedule management, the higher the possibility that the construction progress will proceed smoothly, and the less willingness of the subject to bear the risk. In the actual project construction case, when the premise investment is relatively small, the behavior subject is often willing to accept a larger risk, even if the probability of success is low; and as the input increases gradually, the behavior subject begins to change. The more cautious behavior decisions are often conservative. (3) Resource ownership: in the construction progress, the actors with more resources have stronger risk tolerance.

2.3.4. Risk Events in Variability Construction Are in Dynamic Development. Every process and every factor in the construction is constantly changing. The variability of the progress risk is mainly reflected in the nature, consequences and type.

2.3.5. Phased

(1) The stage of potential risk: it refers to the construction schedule risk factors that have existed objectively, but have not yet occurred, and have not caused direct economic losses and social impacts on the project but may deteriorate.

(2) The stage of risk occurrence: it means that the construction schedule risk has already occurred, and the project economic loss and madness influence are taking shape. However, due to the unfinished construction schedule risk, if no effective measures are taken, it will start to cause economic loss and social impact of the project. In the actual situation, the duration of the event is very short.

(3) Stages of consequences: it refers to the stage in which certain project economic losses and madness have been formed. Often the consequences of project formation are irreparable, but effective measures can be used to reduce the extent of losses and control the consequences of project formation.

3. Application of Multimedia Technology in Construction Project Management

3.1. Shortcomings of the Internet of Things Multimedia Technology in the Application of Construction Engineering

3.1.1. The Internet of Things Multimedia Technology Is Immature and the Software Is Narrow. My country’s construction engineering management informationization time is very short, and my country’s multimedia technology is still very backward and immature. Construction engineering multimedia software is still in its infancy, and there is still a big gap compared with foreign countries. A lot of construction companies do not fully understand the multimedia technology adoption. Due to the overall lack of a plan for multimedia software development, the theme is the same, and lead to a lot of low-level repeated development. Multimedia software development should be familiar with the internal management details of construction companies in the short term, excessively pursue multimedia software development projects, and pursue market profits.

3.1.2. Management System Defects. In the management of construction projects, the management methods are weak, the multimedia technology management level is not high enough, the management mode is not diversified, the project management is chaotic, and there is no corresponding system support, which ultimately leads to the lack of implementation and progress of the multimedia system. Without system support, especially the functions and skills of some professional management software, it is difficult to fully understand. The application of most multimedia technologies in construction companies only stays in the preparation plan. There is no effective management method for the adjustment of the regulatory plan.

3.1.3. Multimedia Technology Gaps in Different Regions. Some large-scale high-level enterprises have reached the forefront of the country, established local area networks, and realized resource sharing among employees within the
enterprise. Employees can query and obtain various materials through the local area network established by the company. While acquiring data, it also ensures data security, which plays an important role in improving the work efficiency of all units of the enterprise [30]. In some economically developed areas, due to abundant information sources, construction project managers have a deeper understanding of information management than other units, while construction project managers in economically underdeveloped areas or remote areas have a weaker understanding of multimedia technology. And the promotion and application of multimedia technology in municipal construction projects is the worst. The development of multimedia technology in different regions has opened a huge gap.

3.2. Quality Management Objectives and Principles of Construction Engineering in Multimedia Environment. Quality management objectives of construction engineering in a multimedia environment: ensure that the new multimedia system can normally cut access network operation within a predetermined period of time, without affecting the normal use of multimedia by users. Quality management principles for construction engineering in a multimedia environment: during the construction period, it does not affect any other business on the live network. Features of mobile communication multimedia software include the following.

3.2.1. Complex Multimedia Technology. The construction project management system in the multimedia environment consists of the host device, the data communication device, and the storage device. The operating system includes the Windows operating system, the Solaris operating system, and the SUSE operating system. The construction project management system in the multimedia environment is a system engineering, a project that only a multidisciplinary engineer can work together to complete.

3.2.2. Short Construction Period and Complicated Process. Operators generally require the completion of the construction of the construction project under the new multimedia environment within 3 months, and the mobile company has strict access system in and out of the building and computer room. The construction project management equipment and the existing network operation equipment in the multimedia environment are believed, the operational process.

3.2.3. Strict Testing. In the multimedia environment, there is a strict test manual before the construction project management is put into operation. After passing the functional verification test and service test of the multimedia technology system of the Internet of Things, the new system can be cut over.

For the characteristics of construction under multimedia environment, we use the “brainstorming” method to discuss and propose solutions to the quality of people, equipment, process system, and environment of the building construction under multimedia information business environment through the knowledge of construction project management that we have been learned, as shown in Figure 1.

4. Construction Project Management under Multimedia Environment

4.1. Multimedia-Based Construction Project Management System. As shown in Figure 2, the multimedia-based construction project management system mainly includes quality inspection management, emergency call, unified portal, statistical report, video telephony, architectural design, progress inquiry, process design, intermediate software, task notification, CTI middleware, and unified handover. It is made of several parts. It covers basically all segments of the construction project administration field, such as design, execution, inquiry, handover, notification, and oversight, and adds features such as video call, emergency call and other communication services.

4.2. Architectural Design and Construction Schedule Management in a Multimedia Environment

4.2.1. Architectural Design in a Multimedia Environment. Visibility of the 3D building structure is an essential application of interactive technology in engineering. The three-dimensional structure obtained by using software technology is compared with the traditional CAD two-dimensional template drawing. The two have different levels of essence. The latter has the following drawbacks: first, it has certain deficiency and cannot transmit the structural information of the building to the building. Maintenance software, construction management software, etc., when using building maintenance and construction management software, it is necessary to repattern and increase the workload; second, there is no spatial expression ability; the construction drawing lacks height direction data and requires designers to exert their own space imagination. With the support of space imagination, the model is restored. This method has a high error rate when drawing some architectural drawings with complex shapes. Moreover, there are still structural heights of the building beams that cannot be used in 2D drawings. The drawbacks reflected in the process are prone to a large number of rework of construction drawings, which ultimately affects the progress and quality of the entire project. Revit software modeling can solve the above problems: First, the Revit structural model, as an effective carrier of parameterized information, can provide great convenience and improve work efficiency when downstream software reads 3D geometric information, reducing the workload. Secondly, Revit software can fully realize the functions of 3D visualization and color differentiation and can realize "visual management." Perform well-targeted inspection in the process of switching preset view templates. The task of the 3D model: the 3D building model is shown in Figure 3.
4.2.2. Engineering Progress Management of Construction Projects in Multimedia Environment. Develop a project schedule management mechanism to determine the progress of the project through a scientific assessment of the progress of the project in the construction project, and then compare it with the expected progress, as shown in Figure 4.

4.2.3. Progress Risk Prediction. According to the assessment of the schedule, adopt tailor-made risk surveillance and response measures for the predicted schedule rises to mitigate and avoid the adverse effect of schedule risks and form a project progress risk management schedule. The forecast of schedule risk is shown in Table 1 and Figure 5. Figure 5 shows the degree of project schedule risk by different colors.
5. Conclusions

(1) This article discusses the theory and method of construction project management and risk pipeline based on the multimedia technology of the Internet of Things and combines the characteristics of mobile construction project to analyze various problems in the construction process of construction. Taking the construction project in the multimedia environment as an example, the focus is on the progress management and quality control management of engineering construction projects in the multimedia environment. Through the combination of theory and practice, the work of the construction project under the multimedia environment is guaranteed to be completed on time and in good quality.

(2) For the management of construction projects, based on the schedule, the risk factors should be identified regularly, the schedule risk list should be established, and the risks should be qualitatively and quantitatively evaluated. The probability of occurrence and the impact on the construction period should be carried out to carry out project planning management and project time optimization. Adopt risk control measures, timely monitor of risk evolution, and mitigate or circumvent the impact of risk incidents on project target, so as to achieve active management of project risks and active schedule control.

(3) With the continuous development of engineering and construction enterprises, the project risk management theory is continuously innovated, the engineering technology is increasingly perfect, the quality of personnel is continuously improved, and the project managers pay more and more attention to the risk of the project, and the project risk identification is clearer. The project risk assessment is more accurate, the project risk response strategy is more active and effective, and relevant measures are more complete. The probability of project risk is reduced, the project risk is more controllable, the impact area caused by project risk is reduced, and the loss caused by project risk is further reduced, thereby improving the internal operation efficiency of the engineering construction enterprise and strengthening the internal enterprise. Control, improve the construction process, make the construction process more rigorous, and be able to respond more effectively to risk resistance. In the future, not only will the research on risk management of engineering projects be more comprehensive, systematic and effective, but also extend to other risk management fields, so that more effective and scientific project risk management methods will emerge, and enterprises will be provided with a more rigorous process operation system. In order to improve the management level of enterprises, we should contribute to the ability to deal with risks.

Data Availability

This article does not cover data research. No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest regarding the publication of this study.
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