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Research Article

Construction Project Claim Management under the Background of Wireless Communication and Artificial Intelligence

Yan Li[1,2]

[1]*College of Civil Engineering, Lanzhou Jiaotong University, Lanzhou 730070, China*
[2]*Dothink Group, Hangzhou 310000, China*

Correspondence should be addressed to Yan Li; liyan_vip@outlook.com

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At this stage, construction projects involve more and more aspects, and the market environment they face is also increasingly complex. The application of wireless communication and artificial intelligence technology provides convenient conditions for the establishment of construction engineering claim management system. Based on this, this paper conducts research on the subject of construction engineering claim management under the background of wireless communication and artificial intelligence. This paper first briefly introduces the classification of construction engineering claims, designs the construction engineering claim management system, and analyzes the relevant functional requirements and functional modules of the system. In terms of grasping the current situation of relevant people's cognition of construction engineering claims, the research adopts the method of questionnaire survey, then summarizes the existing problems according to the questionnaire data, and finally combines the predesigned functional modules to solve these problems. *Systematic Recommendations*. The survey data shows that in the case of 400 concurrent users, the transaction volume of the system reached 17.13 T/s, and the system transaction operations were all successful. These experiments demonstrate that the availability and adaptability of the preset functional modules are very high.

1. Introduction

With the development of wireless communication and artificial intelligence, the use of modern information technology for construction project management has become a major trend in the development of the construction industry [1, 2]. The benefits of this technological advancement for project management are obvious. [3, 4]. With the increasingly fierce competition in the engineering contracting market, the role and importance of claims become more and more obvious and prominent [5]. Wireless communication and artificial intelligence technology can enable managers to grasp the details of engineering projects more scientifically and accurately and provide strong support for claims' work. Therefore, in order to improve the efficiency of claim work, it becomes urgent and important to establish a construction engineering claim management system [6].

Regarding the research on construction engineering claims, many scholars have carried out multiangle discussions. For example, Firios and Dharmananda have studied construction disputes as treaty claims [7] and carried out research [8]; Cohn studied the impact mechanism of extended statement on claim interpretation [9]; Yusuwan et al. studied the claim method of construction engineering through the improved Delphi method [10]. Therefore, the research on construction engineering claim management under the background of wireless communication and artificial intelligence has important practical significance [11–13].

At first, this paper briefly introduces the classification of construction engineering claims from the aspects of purpose, scope, and nature, then designs a construction engineering claim management system, and analyzes the system's related functional requirements and system function modules. Finally, the key success factors of construction engineering

claims are analyzed through a questionnaire survey, and the strategies and skills of contractors for construction engineering cost claims are put forward.

2. Construction Project Claim Management under the Background of Wireless Communication and Artificial Intelligence

2.1. Classification of Construction Project Claims. A claim refers to a claim for damages by the party who suffered the loss to the party in breach of the contract in accordance with the content of the established contract. With the improvement of my country's legal system, construction engineering claims have a more solid legal guarantee. The subcategories in the field of engineering claims continue to grow. From the current situation, it can be roughly divided into the following categories, as shown in Table 1:

From Table 1, we can see the main types and main contents of claims for construction projects at this stage.

2.2. Functional Analysis of the Construction Project Claim Management System

2.2.1. Daily Management Functions. The daily management functions of claims mainly include tracking the claim process, displaying claim-related information, and downloading claim reports.

2.2.2. Analyze the Relevant Clauses and Determine the Responsible Party. The determination of the responsible party is one of the focuses of the claim work. Before the start of the claim work, the management system can be used to retrieve the matters related to the claim through the analysis of the contract terms and calculate the liability ratio of each party according to the relevant laws, so that the claimant can better carry out Work. It is directly related to the later calculation work and provides the basis for its implementation.

2.2.3. Manage-Related Documents. At this stage, my country's management of construction claims is increasingly perfect and rigorous. This requires that every detail of the claim work has a crucial impact on the final result. Almost every claim document has to undergo several corrections and revisions. A standardized document management system can greatly improve the normative and standardization of claim documents. Only then can a true and complete retrospective and display of the claims be made.

2.2.4. Calculation of Relevant Claim Expenses. The determination of the claim cost is directly related to the economic interests of all parties and also determines the success or failure of the claim work to a large extent. Different related formulas are entered in the system to calculate the claim fee. And each formula can be adjusted for each parameter according to the actual situation, which greatly improves the accuracy and fairness of claim calculation. Since the cost is based on the proportion of each party's responsibility in the accident, it is easier to be accepted by all parties.

2.2.5. Manage-Related Claim Cases. Although almost every claim case has its own unique characteristics, there are many lessons to be learned. In this module, many representative cases in the field of engineering project claims are collected, as well as the analysis of these cases by professional legal practitioners [14]. And through the establishment of keywords, the cases are classified, stored, and managed. Of course, it is impossible to store all cases. It enables managers to check the notices of relevant cases within time through the system retrieval when they generate the willingness to claim, to learn from them, and to improve the probability of successful claims [15, 16]. The case similarity measure in the system adopts CBR similarity calculation, as shown in formula (1):

$$F(x_i, x_j) = 1 - d(x_i, x_j). \tag{1}$$

In formula (1), $F(x_i, x_j)$ represents the similarity between cases x_i andx_j, and d_{ij} represents the distance between x_i and x_j. The commonly used typical distance definitions are as follows:

(1) Absolute distance (Manhattan): the calculation method of absolute distance is shown in formula (2):

$$d_{ij} = \sum_{i=1}^{n} |x_i - x_j|. \tag{2}$$

(2) McCawsky distance: the calculation method is shown in formula (3):

$$d_{ij} = \left[\sum_{\alpha=1}^{n} |x_{i\alpha} - x_{j\alpha}|^{\mu} \right]^{\frac{1}{\mu}}. \tag{3}$$

The absolute distance and Euclidean distance are the distances when $\mu = 1$ and $\mu = 2$, respectively.

2.3. Functional Modules of the Construction Project Claim Management System

2.3.1. Claim Management Module. Claim Application Management. When a claim event occurs, the relevant personnel must first submit a claim application to the company's claim person in charge, and the claim procedure can only be started after the application is approved.

The claim management module of the construction engineering claim system is convenient for users to manage claim applications. First, this function allows the user to enter a claim application including personal information and claim transaction information. The system will then automatically number the application for the claim. Once the claim application is successfully saved, the system will mark the application with status information, namely,

Table 1: Classification of construction project claims.

Classification by the purpose of the claim	Duration claims, cost claim
Classified according to the scope of the claim	Claims in the contract, claims outside the contract, moral claim
Classified by claim processing method	Single claim, comprehensive claim
Classification by claim initiative	Claim, counter claim
Classified by the nature of the claim event	Project delay claims, project change claims, forced termination claims, project acceleration claims, unforeseen factors claims, other claims

Submitted, Passed, and Failed. After the initial submission, the "Submit" status is displayed.

Secondly, this function allows users to modify, query, and withdraw claim applications. When the application has been submitted but not yet approved, if the applicant finds that there is a problem with the application, he can withdraw the application amendment and resubmit the application. If an application has already been approved, it cannot be withdrawn.

Claim Approval Management. After submitting a claim application to the system, the debtor section of the claim will approve and manage the application. First, the person in charge of the claim can query the application information, including the time of the application, the name, and type of the claim transaction, and can view the application information in different states.

Second, the person in charge of the claim can approve and process the application. After the user finds the application, he can view the detailed information of the application, and if the application information is correct, he can click the corresponding approval button to approve it. When the system approves, it first receives the application number and then obtains the personal information of the current approver and the approval result. After the application is completed, the system modifies the status of the application, from the "Submitted" status to the "Approved" status.

Claim Data Entry. Once the claim is approved, data information about the claim can be entered. Claim data is the most important data in the system, and the statistical analysis function of the system is given to this data; so, it is necessary to ensure the accuracy of the claim data. In order to ensure the accuracy of the claim data, before the system saves the database, it is necessary to compare the entered data with the applied data.

When entering data, in addition to the basic information of the claim, it is also necessary to enter the number of the claim application. Before the system stores the data, the information of the claim will be obtained by the number of the claim, and then the information of the claim will be compared with the main data of the claim. The main content of comparison is amount, claimant, time, claim affairs, and so on. Information can only be stored in the database after the system has compared the data to be accurate.

Claim Data Query. The staff can realize the function of querying historical claim records through the construction engineering claim system. When querying, the staff can query the claim data by combining multiple conditions such as time, claim transaction, and claimant.

Table 2: Respondent information.

Claim experience	Quantity	Percentage (%)
1 ~ 3 times	113	23.94
4 ~ 6 times	143	29.84
7 ~ 9 times	112	23.73
10 times and above	108	22.49
Total	476	100

2.3.2. Statistical Analysis Module. The statistical analysis module of the construction engineering claim system can provide a large amount of statistical analysis data for the person in charge of the enterprise, which is beneficial to improve the product quality of the enterprise and reduce the cost of claim.

Claim Data Statistic Function. The claim data statistic function of the construction engineering claim system can realize the graphic representation of claim data. Before statistics, users need to select the conditions of statistics and click the "Statistic" button, and the system will automatically complete the statistics and display the results in the form of graphs. The statistics of claim data include statistics on the number of claims and statistics on the amount of claims.

Statistics: count the number of claims for different types of construction projects within a period of time, the number of claims in different months, and the number of claims by different personnel.

Statistical amount: it is to count the amount of claims for different types of construction projects within a period of time, the amount of claims for different months, and the amount of claims for different personnel.

Claim Report Generation Function. The construction engineering claim system is designed with the function of automatic generation of claim analysis report. Through this function, the construction project claim system can automatically generate a PDF version of the claim statistical analysis report, which is convenient for the person in charge of the construction project to understand the claim situation more intuitively.

There are four types of claim statistical analysis reports: monthly report, quarterly report, semiannual report, and annual report. The user only needs to select the type of report, the construction engineering claim system will automatically generate the report, and the user can download the report to the local computer.

Table 3: Results of exploratory factor analysis.

Factor	Serial number	Related institutional factors	Claimant factor	Project environmental factors
Complete project data preservation	1	0.649	0.461	0.102
The evidence in the claim report is sufficient and true	2	0.838	0.072	0.264
Issue a claim report in time within the contractual time limit	3	0.853	0.283	0.189
The claimants are more aware of claims	4	0.251	0.918	0.757
Communicate adequately with the owner and continue to follow up the claim approval process	5	0.188	0.802	0.848
Use negotiation strategies and skills to create a more friendly negotiation atmosphere	6	0.354	0.651	0.726

2.4. Construction Engineering Claim Strategies and Skills

2.4.1. Clarify the Claim Objective. Contractors must identify in a timely manner what needs to be achieved in construction claims [17]. The construction project involves a very wide range, and the amount of the claim fluctuates greatly. It is very important to predict the psychological price of the compensation party and determine a scientific claim target for a successful claim [18]. It can be seen from the monitoring of the functional modules that the more reasonable the claim and the clearer the claim target, the higher the probability of success.

For the claimed items, try to choose those contents that clearly define the responsible party in the contract of both parties, so as to avoid expanding the claimed items [19, 20]. At the same time, it is necessary to shorten the time limit for the implementation of the compensation content as much as possible, which can not only reduce the probability of changes but also better achieve the goal of returning funds.

2.4.2. Properly Proceed from the Interests of the Indemnifying Party. Carrying out the claim work is a kind of compensatory behavior for the engineering accident. It has caused certain economic losses to both the owner and the construction side [21]. If this kind of loss is simply added to one of the parties, it will inevitably affect the subsequent cooperation between the two parties.

According to the analysis and calculation of the functional modules, if appropriate concessions are made in terms of the amount and time limit of the claim in the interest of the indemnifying party during the claim work, the atmosphere of cooperation between the two parties can be greatly eased, which is more conducive to the claim work. The continuation of the promotion and follow-up cooperation [22, 23]: practice has shown that, within the range acceptable to both parties, the more concessions, the smoother the claim settlement work will be.

3. Investigation on the Key Success Factors of Construction Project Claims

3.1. Design of the Questionnaire. In order to verify the scientificity of the functional modules in practice, after many demonstrations, a set of questionnaires about factors affecting the success rate of claims were designed. There is no right or wrong about the design of the answer, just a survey of its experience in using some functions of the module, as well as perfect suggestions for the module. In other words, the crux of the questionnaire is to ask respondents to select the key success factors and collect their suggestions on the key success factors.

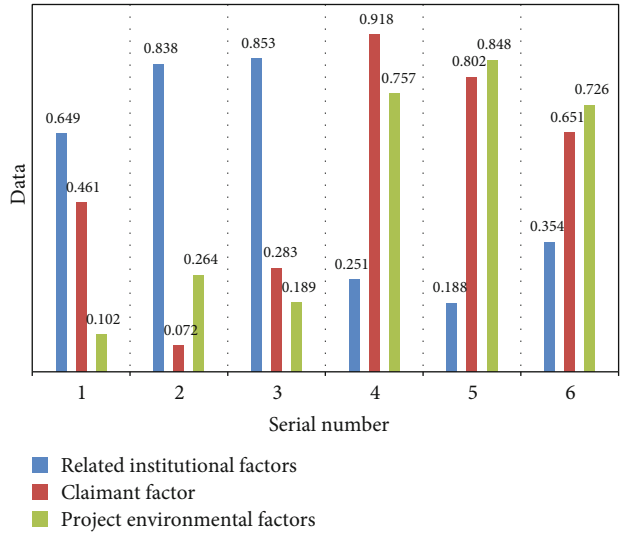

Figure 1: Results of exploratory factor analysis.

3.2. Data Collection. The questionnaires were distributed in the form of online surveys, and the objects of the questionnaires were the participants in the claim work of 4 construction projects under construction in Tonghua City, Jilin Province. Questionnaires are sent by e-mail, QQ, WeChat, etc. and are eliminated through preestablished standards after recycling. The standards mainly include engaging in work in the field of claims and the rationality of answering the questionnaire. A total of 634 questionnaires were distributed, and 579 were recovered, with a recovery rate of 90.005%. After screening the invalid questionnaires, 476 valid questionnaires were retained, with an effective rate of 82.21%.

3.3. Respondent Information. After sorting out, the interviewee's information about claim experience is shown in Table 2.

Table 4: Survey results of key success factors for claim pairs.

Rank	Factor	Number of people	Percentage (%)
1	Complete project data preservation	338	70.81
2	The evidence in the claim report is sufficient and true	251	52.93
3	Issue a claim report in time within the contractual time limit	219	45.81
4	The claimants are more aware of claims	211	43.93
5	Communicate adequately with the owner and continue to follow up the claim approval process	187	39.89
6	Use negotiation strategies and skills to create a more friendly negotiation atmosphere	184	38.26

It can be seen from Table 2 that among the people who filled out the questionnaire, those with 4-6 claims experience are the highest, and the least are more than 10 times, but the difference in each group is within 10%.

4. Survey Results and Analysis

4.1. Analysis of Questionnaire Validity. Through exploratory factor analysis, the questionnaire items are divided into three factors, which are related system factors, claimant factors, and project environmental factors. The variance calculation is performed on them, and the results are shown in Table 3.

It can be seen from Table 3 and Figure 1 that the percentages of the variance explained by the three factors have reached more than 10%, and the results of the questionnaire analysis are acceptable.

4.2. Analysis of Critical Success Factors for Claim Pairs. Collected statistics on all the questionnaire data collected this time sorted according to their importance, and the results are shown in Table 4: 337 people think that "preservation of project data" is very important, accounting for 70.8%. There are 252 people who believe that "sufficient and true report evidence" is important, accounting for 52.94%; there are 218 people who believe that "promptly issuing a claim report within the contractual time limit" is important, accounting for 45.80%.

Looking at Table 4 and Figure 2, it can be found that the top three key success factors are as follows: the project data is kept intact, the claim evidence is sufficient and true, and the claim report is issued in a timely manner within the contractual time limit.

4.3. System Compression Test Results and Analysis. The compressive test results of the system are shown in Figure 3:

It can be found from Figure 3 that under the condition of 400 concurrent users, the transaction volume of this system reached 17.15 T/s, the storage time was 7.85 s, and the system transaction operations were all successful.

4.4. System Performance Test Results. The performance test of the system is mainly the response time test. The response time for some functional operations is shown in Figure 4.

Observing Figure 4, we can see that the system can perform various functions within the standard time, and the system has a good response speed and can be put into use.

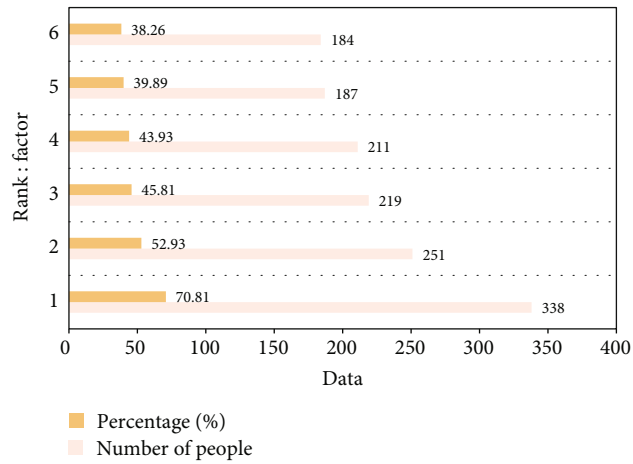

Figure 2: Survey results of key success factors for claim pairs.

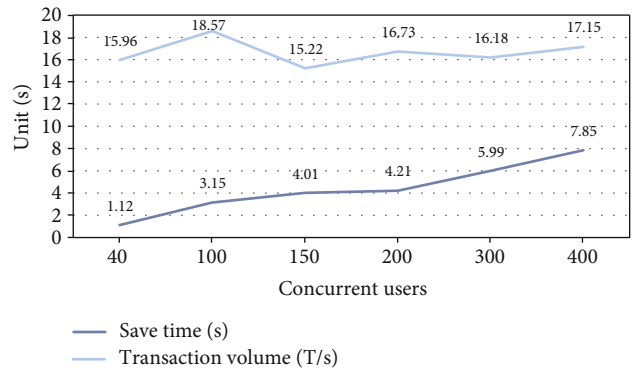

Figure 3: Compressive test results.

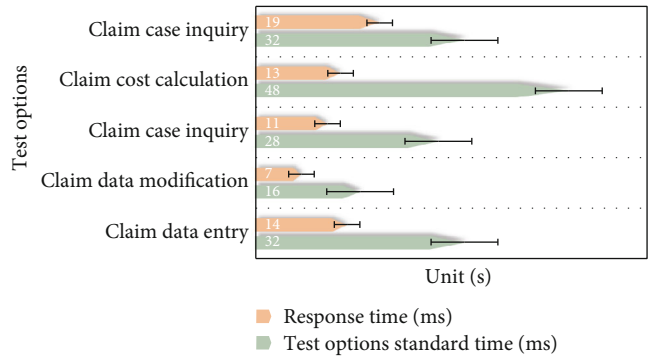

Figure 4: System performance test results.

5. Conclusions

The development of wireless communication and artificial intelligence technology provides a good hardware environment support for the application of the construction project claim system. Through research, this paper has completed the following tasks: introduced the classification of construction project claims, designed the construction project claim management system, analyzed the relevant functional requirements and system function modules of the system, investigated and analyzed the key success factors of construction project claims, and put forward the contractor's strategy and skills for the construction project cost claim. In the following research, I will further combine the application of this functional module in specific claim cases to explore more practical values.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interest

It is declared by the author that this article is free of conflict of interest.

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