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The Nexus Between Construction Contract Risk Assessment and Big Data in China

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ABSTRACT

The construction market in China is currently showing an increasing trend in terms of project size, complexity, and technical difficulty. With large initial investments and long capital payback periods, construction projects are vulnerable to the external environment during development and risk control is particularly important. Contracts are at the heart of project management and every step of project development revolves around the content of the contract signed by the contractor. Signing contracts to protect the rights of both parties has become the most effective way of controlling project risk. And with big data technology being rapidly developed and widely used, and the amount of data created and accumulated by the internet growing exponentially, big data has the potential to be used for analysis, forecasting and decision making in the construction industry. The aim of this study is therefore to develop a risk identification list for construction project contracts in China, to score the risks within the list according to their incidence and importance, and to find practical applications of big data technology in contract risk assessment. To achieve this goal, this study used qualitative research and in-depth interviews with experts within the Chinese construction engineering industry. The results of this study form a list of risks in Chinese construction contracts, indicating that late payment and government intervention are the most important risks in Chinese construction contracts. This study also identifies TianYanCha, a commonly used big data enterprise risk identification platform in China, which provides big data support in three areas: evaluating owner integrity, enterprise risk identification, and owner relationship knowledge. At the practical level, this study helps contractors to assess project risks and improve contractual contents during the preparation phase of construction projects, thus improving the success rate of projects. At the theoretical level, this study fills the gap in contractual risk assessment for construction projects in China and provides insights for subsequent risk assessment of construction projects based on the contractor's perspective.

1. Introduction

At present, the project scale, complexity, and technical difficulty of China's construction industry market are showing a growing trend [1]. The initial investment of the construction project is large, the return on capital is long, the project is easily affected by the external environment during the

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development process, and the risks existing in the project are increasing, which shows the importance of the risk control. Contract can be described as the core of project management [2], every step of the project development revolves around the content of the contract signed by the contractor and signing the contract to protect the rights and interests of both parties has become the most effective way to control project risks. However, when the actual housing construction project is carried out, the owner is in an advantageous position, and the contractor often covers most of the risks of the project to obtain the winning bid [3]. Therefore, the ability of the contractor to evaluate the contract risk is very important to them as it is directly related to the survival and development of the enterprise [4].

The term "risk" was first used in the seventeenth century to describe uncertainty in capitalist business. And now risk is given a much broader connotation. In general, risk has positive and negative trends and is not specific to a particular direction. Risk is affected by events and other factors, fluctuates and varies from expectations, and the extent of this variance reflects the degree of risk [5]. The original meaning of risk only emphasizes the uncertainty of loss after the risk is generated, and the meaning is closer to the possible danger, emphasizing the outcome of the event, and biasing towards the bad result. Academics generally consider risk to be uncertainty that occurs in future unpredictable events that have a potentially adverse effect on the interests or objectives of various participants [6].

Big data refers to the use of large-scale information to capture, manage, process, and organize information within a reasonable period for the purpose of helping businesses make more positive decisions [7]. Big Data does not use shortcuts such as stochastic analysis but uses all data for analysis and processing [8]. Big data enables risk prediction and helps to avoid and control risk [9]. Big data allows for risk modelling and data visualization in management [10], and credit ratings through big data can lead to better procurement planning and budget management for contractors [11].

As part of risk management theory, scholars pay attention to the protection of the legitimate rights and interests of contract stakeholders and focus on practice and application in combination with enterprise management and contract design [12]. Scholars from outside China pay attention to the theoretical level of research, lack of in- depth discussion on the characteristics of Chinese society [13]. Chinese scholars pay more attention to methods and case studies and provide specific risk response methods or macro guidance from the perspective of project management or enterprise management [14]. Most of the existing studies start from project management theories to improve the risk management capabilities of project managers. Risk assessment is an indispensable part of contract risk management. Most of the research has developed the method of risk assessment from theoretical and qualitative assessment to more emphasis on quantitative assessment of contract risk combined with mathematical methods [15]. In addition, the contract risk assessment is usually combined with cases, and the assessment results are obtained according to the specific case practice [16]. To improve the anti-risk ability of the contract parties, the corresponding solutions or policies are proposed to the risk control subjects, to make the contract risk assessment method more convenient and practical. However, most methods of contract risk assessment only evaluate the risk from the single operational level of the contract, or only from the overall risk control level of the project contract, without realizing that the project contract risk that the contractor needs to solve needs to be evaluated together with these two levels [17]. At the same time, the existing articles on the risk assessment of construction contracts in China focused on the risk assessment of a specific project or project type and lack of the discussion on the risk of construction contracts under the social situation with Chinese characteristics, and there is no comprehensive study combining the risk coefficient and probability [18]. Therefore, to fill the shortcomings of the existing research, this study will adopt a qualitative research method to comprehensively evaluate the risk of project contracts in

terms of both the specific risk and the overall risk of the project contract, combined with the probability of risk occurrence. It also identifies the nexus between big data and risk assessment of construction contracts in China and determines a big data platform and its applications that are widely used for risk assessment of construction contracts in China.

2. Methodology

2.1 Design of the Study

This study adopted a qualitative research methodology and collected data through semi-structured interviews. The scope of this study is in China and the interviewees were selected as professionals in the construction industry in China to answer the questions of the study. A total of nine interviewees were selected from different regions of China to reflect the comprehensiveness of the findings.

2.2 Data Collection

23 articles from qualitative studies were selected and their sample sizes and saturation levels were assessed in a study by Hennink and Kaiser [19], who found that qualitative studies could reach saturation with smaller sample sizes, their results showed that 9 to 17 interviews or 4 to 8 focus group interviews can saturate the data. Boddy [20] found that in qualitative research, the determination of sample size is context-specific and partly dependent on the scientific paradigm on which the investigation is based, and that sample sizes involving individual cases in management research can be informative and significant. Nine respondents were selected as the sample size for this study so that the data collected could be carefully and meticulously analysed, which in turn revealed rich, diverse, and meaningful insights.

2.3 Statistical Analysis

During the analyses presented in Figure 1, the data collected from the interviews were manually transcribed and analysed using Nvivo. The interview data were analysed and coded through thematic analysis to identify the main risks of construction contracts in China, to decipher the associations in the data, and to identify the application of big data platforms in the risk assessment of construction contracts.

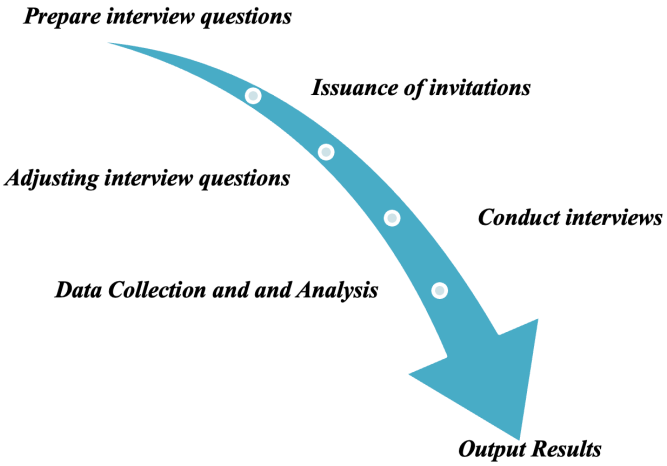

Fig. 1. Data collection and analysis process

2.4 Reliability Analysis

When triangulating in qualitative research, Carter *et al*., [21] found multiple perspectives and data sources can be used to validate and strengthen the credibility and validity of the findings. After arriving at a list of construction contract risks in China, the contents of the list were compared with the risks summarized in Chapter 2 based on the references and were found to be in good agreement. Konecki [22] summarizes the concept of triangulation verification and found that the degree of overlap between the study findings and the literature review could provide a clue to support and strengthen the findings. The results of the analysis and the thematic summaries were also fed back to the interviewees and the responses indicated that the findings were consistent with the views of the interviewees. The analysis process is shown in Figure 2.

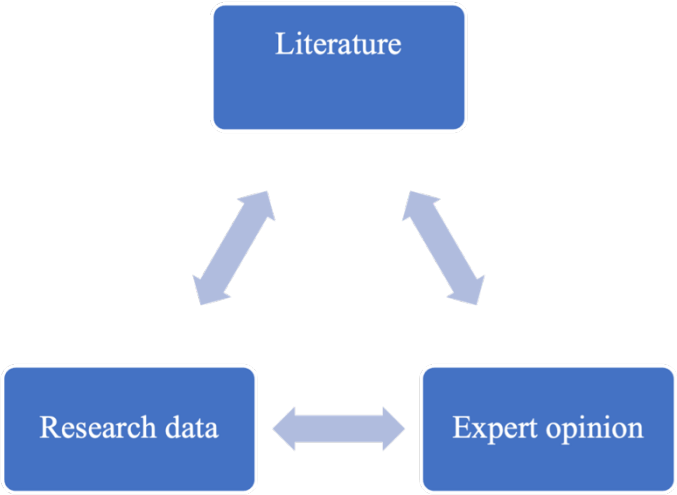

Fig. 2. Triangular validation process

3. Results

Table 1 presents the background information of the respondents of this study. The number of projects refers to the interviewee's full involvement in hosting projects as a project manager, and all projects are filed with the China Housing and Urban-Rural Planning Bureau.

Among the respondent groups in this study, 22% had a PhD, 78% met four of all the interview criteria, and 66% had more than 20 years of experience, all respondents have a registered builder's certificate and bachelor's degree or above, which provided sufficient data to support this study. After coding using NVivo and cross-comparing the content of the different nodes to see the links and commonalities in the data, it was shown that the data had a good degree of saturation.

In the risk assessment section, the data provided by the respondents was summarised and the text analysed. Respondents' perceptions of the incidence and severity of different risks were summarised and categorised into low, medium and high levels of number 1, 2 and 3. The incidence and severity scores were summed to produce a risk rating. Table 2 shows the risk ratings for the sum of the incidence and severity of the risks. A score of 2 is considered low risk, a score of 3 is considered medium risk, a score of 4 is considered high risk, and scores of 5 and 6 are considered very high risk.

Table 1
Background of respondents

Respondent	More than 10 years of professional experience in the construction industry	Have senior engineer title in China	Have a bachelor's degree or above	Project site management personnel	Registered builder or other related professionals
A	/	/	/	/	/
B	/	/	/		/
C	/		/	/	/
D	/		/	/	/
E	/	/	/		/
F	/		/		/
G	/		/		/
H	/		/	/	/
I	/		/	/	/

Table 2
Risk Classification of Construction Contracts in China

Rank	**Risk**	**Incidence**	**Severity**	**Rating**
Very High	Deferred payment	3	3	6
	Compulsory government intervention	3	2	5
High	Increase in raw material prices	2	2	4
	Project design changes	2	2	4
	Safety incidents	2	2	4
	Failure to reconcile quantities of work on time	2	2	4
	Epidemics	1	3	4
	Natural disasters	1	3	4
Medium	Unfavorable geography of the construction site	1	2	3
	Construction techniques are challenging	1	2	3
	Construction equipment price increases	2	1	3
	Outdated contract terms	1	2	3
	Unlawful contract terms	1	2	3
	Ambiguity in contract content	1	2	3
	Quality not up to standard	2	1	3
Low	Cultural differences	1	1	2
	Rising labor prices	1	1	2

Respondent mentioned that the TianYanCha platform is widely used in construction projects in China, and Respondent A mentioned that he would use TianYanCha to initially screen a company's size and business status during the bidding stage of a project to reduce his workload. Respondent D mentioned that the TianYanCha big data platform has the function of real-time updating, which can be completed within 24 hours to a week after a company has been sued or the legal person has changed. Based on summarising and analysing all the respondents' responses and conducting thematic analysis, it was found that the TianYanCha big data platform provides the most important big data support in identifying the risks of construction contracts in China, and the three specific aspects are shown in Table 3.

Table 3
Nexus and applications of big data in contract risk identification

Nexus	Clarification
Assessing Owner Integrity	Identify the creditworthiness of the owner company's legal entity, e.g. debt non-payment, being counted in financial or social blacklists.
Enterprise Risk Identification	Identify corporate justice risks, including credit reports, own risk, perimeter risk, early warning risk, and historical risk.
Government Relationship Identification	Identify the company's shareholding structure, tenure information, and percentage of government participation.

4. Discussion

In this study, delayed payment and mandatory government intervention were found to be the most significant risks of construction contracts in China. Delayed payment refers to the owner's failure to pay the contractor in full and on time as agreed, and government mandatory intervention refers to the unforeseen risks faced by the project as a result of temporary policies proposed by the governmental departments involved in the construction project. This is in high agreement with existing studies that have found policy-political risk, legal risk, and financial risk as the main risks in China's construction industry [23]. This study also found that big data has a general application in Chinese construction contracts. And TianYanCha is the most important big data platform that can provide big data support to contractors in three aspects: identifying owner's integrity, identifying business risks, and identifying government relations. Liu *et al*., [24] found that big data can predict business bankruptcies. Wang *et al*., [25] found in his study that TianYanCha can identify corporate risks. These studies support the findings of this study well and this study innovatively found the application of big data in identifying business-government relations. Meanwhile, this study is highly connected to the identification of construction contract risks and the application of big data. The function of big data in assessing business risk and owner's reputation can help contractors to identify the risk of owner's delayed payment, while the function of big data in identifying government relationship can help contractors to identify the risk of government's mandatory intervention, which makes this study highly relevant to practice.

This study did not fully consider the regionalized differences in China in the selection of interviewees, omitting the selection of interviewees with experience in construction work in the Northwest, and the number of studies was not extensive enough, the survey was not comprehensive enough, and the coverage of contractual risks was limited. In addition, the selection of interviewees

focused on qualifications in the field of construction engineering and lacked the selection of IT experts. In future research, the selection of sample size can be expanded to widely cover different regions of China, and interviews can be conducted dynamically to avoid the subjective influence on respondents in special periods. And the research direction can be focused on the combination of contract risk evaluation with other information technologies, such as artificial intelligence.

4. Conclusions

The objective of this study is to identify the top risks of construction contracts in China and the application of big data platforms in construction contract risk identification. The study found that delayed payment and mandatory government intervention are the top risks of construction contracts in China, while the TianyYanCha platform provides big data support for identifying construction contract risks by identifying the owner's integrity and the company's business status as well as government relations. Contractors can judge the credibility of the owner company's legal representative, analyse the owner company's business risk and identify its risk of delayed payment through the TianYanCha platform. The governmental relationship of the owner company is analysed through the TianYanCha platform to identify the risk of governmental forced intervention. Meanwhile, the empirical and theoretical significance of this paper contributes to the development of this research field and provides a risk identification list for contractors.

The limitation of this study is the limited sample size of respondents. Future studies should choose a wider sample size to give better reliability to the findings. There could also be a focus on linking construction contract risk assessment to other industries such as artificial intelligence.

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