

Research on Credit Evaluation of Engineering Supervision Enterprises Based on AHP Analysis

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Keywords: Engineering supervision enterprise; credit evaluation; core competitiveness

Abstract. There are in the current project supervision enterprises a lot of bid-rigging, vicious competition, malicious low-priced bid winning and Yin-Yang contract and other disorderly phenomena. At the same time, the economic and social development requires a higher level of the project supervision, how to effectively improve the service capacity and level of project supervision is crucial. Through exploring and constructing a better comprehensive credit evaluation model of supervision enterprise, this paper reflects the state of credit with scientific method and standard, and improves the current market order. It makes the supervision enterprises realize the importance of credit, cultivate the habit of self-consciously honest management, and truly propose to raise supervision service level and enhance the core competitiveness of enterprises.

1. Introduction

After three decades of development, the project supervision has been playing a big role in standardizing the construction behavior of the participating parties, improving the scientific level of investment decisions, ensuring the quality and safety of the construction projects and realizing the maximum benefit. In 2017, the number of statistical construction supervision enterprises in China reached 7945; the number of employees reached 1071780, among which the formally employed staff accounted for 71.06% and temporarily employed staff accounted for 28.94%; the operating income of project supervision enterprises was 328.172 billion yuan, an increase of 21.74% compared with 2016, of which 20 enterprises' income exceeded 300 million yuan, 50 enterprises exceeded 200 million yuan, and 174 enterprises exceeded 100 million yuan. Therefore, from the perspective of the number of enterprises, the size of employees, operating income and other aspects, the industry has reached a new height. However, in the development of some engineering supervision enterprises, due to the lack of strict supervision and punishment system, the behavior of dishonesty is common, and a large number of disharmonious phenomena have also appeared, such as illegal recruitment, bid-rigging, low-priced bid-winning, Yin and Yang contract, monopoly protection and vicious competition and so on. Between 2012 and 2016, there were six companies in Inner Mongolia that carried out more than 100 dishonest practices; in 2017, more than 10 had a credit rating of less than 60 points in Jinan, Shandong Province. At the same time, due to the current lack of credit supervision and imperfect credit evaluation system, problems emerge endlessly. By means of literature retrieval and expert consultation, this paper tries to construct a better comprehensive credit evaluation model of supervision enterprises, and puts forward some countermeasures to perfect the credit evaluation system of engineering supervision enterprises by scientific methods and standard norms. The next step is how to establish an efficient credit system, set up a good social image, improve the core competitiveness level of supervision enterprises, and provide a reference for the construction unit to choose the supervision honest enterprise with standard management and good service, and for the government to build regulatory system of supervision enterprises and ensure the healthy development of supervision industry, which will fundamentally change the current construction supervision market

disorder, serious discredit behavior, promoting the standard, healthy, orderly development for the supervision industry.

2. Construction of credit evaluation indicators system for engineering supervision enterprises

2.1 The conceptual model of project supervision enterprise credit

After a literature search on the previous studies of the relevant supervision enterprises, combined with consulting with experts and scholars of the construction competent departments, construction units, supervision enterprises, construction contractors and institutions of higher learning, the important factors affecting the credit evaluation of engineering supervision enterprises having been comprehensively analyzed, the consensus is reached on the formation of seven primary objectives. It is represented in two sides. One is supervision enterprise basic quality, a kind of comprehensive characteristic which means the enterprise each essential factor unifies mutually, including not only the enterprise own quality, but the enterprise internal staff quality. A enterprise comprehensive quality level not only depends on its scale, but also depends on its internal quality. The other is the behavior of bidding credit: at present, in the process of bidding, many engineering supervision enterprises have the behaviors of bid-rigging, abandoning bid and malicious bidding at a low price. The illegal acquisition of bidding have many damages. It not only damages the interests of the owner and other stakeholders, but also disturbs the market order. Third, it is related to supervision enterprises' faithful performance of the contract. Performance, the meaning of execution, refers to whether the supervision enterprises take the contract as the criterion, strictly implement the contract treaty, and carry out effective management on the construction project, which is the good behavior performance of fulfilling the contract. Fourth, it is concerned with the excellent rate of service in supervision enterprise, mainly including the management of project progress, safety, contract and information, the control of project quality and cost, and the reflection of coordination among the participants of relevant units. Fifth, it is about the customer complaint rate of the supervision enterprise. Customers are always right, which mainly refers to the customer satisfaction with the supervision enterprises. The customer is the supervision on the side of the enterprise. If the complaint rate of the company is low, it reflects the high service level of the company. On the contrary, the supervision enterprise has a low service level and a low credit rate. The customer can select the supervision enterprise through the complaint rate. Sixth, supervision enterprises' financial condition refers to the source of the operating funds and the financial distribution of the enterprise at a certain time, which is mainly reflected by accounts receivable turnover, net profit margin, current ratio, income statement and related enterprise schedules. If the financial situation of the enterprise is good, it shows that the enterprise is running well and indirectly reflects the good credit of the enterprise. If the financial situation of the enterprise is very poor or even there is debt, it shows that the enterprise's operating condition is not good, and then reflects the low level of enterprise's credit. Seventh, it represents the supervision enterprises development prospect, which is the enterprises' development potential and plan.

2.2 Establishment of credit evaluation indicators system

2.2.1 The determination of credit evaluation indicators

On the basis of literature research and expert consultation, according to the principles of hierarchical, scientific and intensive, quantitative analysis and qualitative analysis, the paper proposes a credit evaluation model for engineering supervision enterprises with 7 first class indicators and 23 second class indicators, as is shown in the following Table 2.1.

Table 2.1 Credit evaluation model of supervision enterprises

| | | |
|--|---|---|
| Credit evaluation indicators system of engineering supervision enterprises | Basic qualities of supervisory enterprises B1 | Is supervision qualification true C1 |
| | | Number of registered supervisory engineers C2 |
| | | Position in local supervisory market C3 |
| | | Number of highly educated and professional personnel C4 |
| | | Number of regular and hired staff C5 |
| | Bidding credit act B2 | Whether there is a waiver after winning a bid C6 |
| | | Whether there is a low-priced malicious bid winning C7 |
| | | Is there a record of participation C8 |
| | Excellent and good rate of supervision service B3 | Evaluation of construction units C9 |
| | | Winning rate of supervision project C10 |
| | | General unit evaluation C11 |
| | Corporate customer complaint rate B4 | Complaint rate of owners against quality of works C12 |
| | | Complaint rate of owners against investment control C13 |
| | | Complaint rate of owners against progress of works C14 |
| | Performance of contracts in good faith B5 | Performance of warranty obligations C15 |
| | | Full performance rate of supervision contract C16 |
| | | Licensed employment status of practitioners C17 |
| | Financial situation of enterprises B6 | Financial liquidity ratio C18 |
| | | Net financial capital profit margin C19 |
| | | Turnover of accounts receivable C20 |
| | Enterprise development prospects B7 | Enterprise system construction level C21 |
| | | Forecast market share C22 |
| | | Strategic enterprise development planning C23 |

2.2.2 Data collection and analysis of evaluation indicators

(1) Data identification and collection: Following the five principles of being scientific, comprehensive, representative, comparable and maneuverable, 100 questionnaires have been released to the construction competent departments, construction units and supervision enterprises construction contractors and institutions of higher learning which are familiar with the operation and construction situation of the project supervision enterprises, among which 93 is valid questionnaires. The questionnaire was scored by 1-9 scale method. In order to ensure the reasonableness of the score, the maximum and the lowest extreme values are removed, and then the average score is used as the assignment of the judgment matrix.

(2) Data analysis: seven first-level indicators are collected and the scoring data is analyzed, forming the judgment matrix table 2.2. Through the single ranking of seven first-level indicators and its consistency checking, the total ranking of the seven first-level indicators and the consistency checking, the calculation of total weight and other links, there come the first class indicator weight calculation table 2.3.

Table 2.2 First-level indicator judgement matrix

| | | | | | | | |
|----|-----|-----|-----|-----|-----|-----|----|
| A | B1 | B2 | B3 | B4 | B5 | B6 | B7 |
| B1 | 1 | 1/2 | 1/5 | 1/4 | 1/3 | 2 | 3 |
| B2 | 2 | 1 | 1/5 | 1/3 | 3 | 4 | 5 |
| B3 | 5 | 5 | 1 | 2 | 3 | 4 | 5 |
| B4 | 4 | 3 | 1/2 | 1 | 2 | 4 | 5 |
| B5 | 3 | 1/3 | 1/3 | 1/2 | 1 | 3 | 3 |
| B6 | 1/2 | 1/4 | 1/4 | 1/4 | 1/3 | 1 | 3 |
| B7 | 1/3 | 1/5 | 1/5 | 1/5 | 1/3 | 1/3 | 1 |

Table 2.3 First-level indicator judgement matrix

| Overall objective | B1 | B2 | B3 | B4 | B5 | B6 | B7 | W_i | Consistency check | |
|-------------------|--------|--------|--------|--------|--------|--------|--------|--------|-------------------|--------|
| | | | | | | | | | λ_{max} | CR |
| B1 | 1.0000 | 0.5000 | 0.2000 | 0.2500 | 0.3333 | 2.0000 | 3.0000 | 0.0683 | 7.6048 | 0.0741 |
| B2 | 2.0000 | 1.0000 | 0.2000 | 0.3333 | 3.0000 | 4.0000 | 5.0000 | 0.1529 | | |
| B3 | 5.0000 | 5.0000 | 1.0000 | 2.0000 | 3.0000 | 4.0000 | 5.0000 | 0.3472 | | |
| B4 | 4.0000 | 3.0000 | 0.5000 | 1.0000 | 2.0000 | 4.0000 | 5.0000 | 0.2300 | | |
| B5 | 3.0000 | 0.3333 | 0.3333 | 0.5000 | 1.0000 | 3.0000 | 3.0000 | 0.1137 | | |
| B6 | 0.5000 | 0.2500 | 0.2500 | 0.2500 | 0.3333 | 1.0000 | 3.0000 | 0.0540 | | |
| B7 | 0.3333 | 0.2000 | 0.2000 | 0.2000 | 0.3333 | 0.3333 | 1.0000 | 0.0340 | | |

We collect and summarize 23 sub-indicator scoring data to form judgment matrix of B1-B7 (from table 2.4.1 to table 2.4.7). By sorting and the consistency checking of 23 second-level indicators, total hierarchical ranking and consistency checking, calculation of the total weight and other links, there exists a secondary indicator weight calculation table 2.5.

2.4.1 Table for calculating the weights of secondary indicators

| B1 | C1 | C2 | C3 | C4 | C5 | W_i | Consistency checking | |
|----|--------|--------|--------|--------|--------|--------|----------------------|--------|
| | | | | | | | λ_{max} | CR |
| C1 | 1.0000 | 0.3333 | 0.2000 | 2.0000 | 0.3333 | 0.0927 | 5.3840 | 0.0857 |
| C2 | 3.0000 | 1.0000 | 0.3333 | 2.0000 | 0.3333 | 0.1559 | | |
| C3 | 5.0000 | 3.0000 | 1.0000 | 2.0000 | 2.0000 | 0.3813 | | |
| C4 | 0.5000 | 0.5000 | 0.5000 | 1.0000 | 0.3333 | 0.0929 | | |
| C5 | 3.0000 | 3.0000 | 0.5000 | 3.0000 | 1.0000 | 0.2772 | | |

2.4.2 Table for calculating the weights of secondary indicators

| B2 | C6 | C7 | C8 | W_i | Consistency checking | |
|----|--------|--------|--------|--------|----------------------|--------|
| | | | | | λ_{max} | CR |
| C6 | 1.0000 | 2.0000 | 3.0000 | 0.5278 | 3.0536 | 0.0516 |
| C7 | 0.5000 | 1.0000 | 3.0000 | 0.3325 | | |
| C8 | 0.3333 | 0.3333 | 1.0000 | 0.1396 | | |

2.4.3 Table for calculating the weights of secondary indicators

| B3 | C9 | C10 | C11 | W_i | Consistency checking | |
|-----|--------|--------|--------|--------|----------------------|--------|
| | | | | | λ_{max} | CR |
| C9 | 1.0000 | 0.3333 | 0.3333 | 0.1396 | 0.0516 | 3.0536 |
| C10 | 3.0000 | 1.0000 | 2.0000 | 0.5278 | | |
| C11 | 3.0000 | 0.5000 | 1.0000 | 0.3325 | | |

2.4.4 Table for calculating the weights of secondary indicators

| B4 | C12 | C13 | C14 | W_i | Consistency checking | |
|-----|--------|--------|--------|--------|----------------------|--------|
| | | | | | λ_{max} | CR |
| C12 | 1.0000 | 3.0000 | 2.0000 | 0.5396 | 3.0092 | 0.0088 |
| C13 | 0.3333 | 1.0000 | 0.5000 | 0.1634 | | |
| C14 | 0.5000 | 2.0000 | 1.0000 | 0.2970 | | |

2.4.5 Table for calculating the weights of secondary indicators

| B5 | C15 | C16 | C17 | W_i | Consistency checking | |
|-----|--------|--------|--------|--------|----------------------|--------|
| | | | | | λ_{max} | CR |
| C15 | 1.0000 | 0.5000 | 1.0000 | 0.2500 | 3.0000 | 0.0000 |
| C16 | 2.0000 | 1.0000 | 2.0000 | 0.5000 | | |
| C17 | 1.0000 | 0.5000 | 1.0000 | 0.2500 | | |

2.4.6 Table for calculating the weights of secondary indicators

| B6 | C18 | C19 | C20 | W_i | Consistency checking | |
|-----|--------|--------|--------|--------|----------------------|--------|
| | | | | | λ_{max} | CR |
| C18 | 1.0000 | 2.0000 | 3.0000 | 0.5396 | 0.0088 | 3.0092 |
| C19 | 0.5000 | 1.0000 | 2.0000 | 0.2970 | | |
| C20 | 0.3333 | 0.5000 | 1.0000 | 0.1634 | | |

2.4.7 Table for calculating the weights of secondary indicators

| B7 | C21 | C22 | C23 | W_i | Consistency checking | |
|-----|--------|--------|--------|--------|----------------------|--------|
| | | | | | λ_{max} | CR |
| C21 | 1.0000 | 0.5000 | 0.3333 | 0.1692 | 0.0176 | 3.0183 |
| C22 | 2.0000 | 1.0000 | 1.0000 | 0.3874 | | |
| C23 | 3.0000 | 1.0000 | 1.0000 | 0.4434 | | |

2.5 Table for calculating the weights of secondary indicators

| Secondary indicator code | W_i |
|--------------------------|--------|
| C1 | 0.0063 |
| C2 | 0.0107 |
| C3 | 0.0261 |
| C4 | 0.0063 |
| C5 | 0.0189 |
| C6 | 0.0807 |
| C7 | 0.0508 |
| C8 | 0.0213 |
| C9 | 0.0485 |
| C10 | 0.1832 |
| C11 | 0.1154 |
| C12 | 0.1241 |
| C13 | 0.0376 |
| C14 | 0.0683 |
| C15 | 0.0284 |
| C16 | 0.0568 |
| C17 | 0.0284 |
| C18 | 0.0291 |
| C19 | 0.016 |
| C20 | 0.0088 |
| C21 | 0.0058 |
| C22 | 0.0132 |
| C23 | 0.0151 |

(3) Forming a summary table of the influencing factors of the first-level indicators and second-level indicators. For the convenience of analysis and summary, I work out a table 2.6: a summary table of the weight of the influencing factors of the first and second level indicators for the convenience of analysis and summary.

Table 2.6 Summary of the weight of the influencing factors of the first and second levels of indicators

| First-level indicators | Weight | Sorting | Second-level indicators | Weight | Sorting |
|--|--------|---------|--|--------|---------|
| The basic quality of Supervision Enterprises | 0.0683 | 5 | Whether supervision qualification is true or not | 0.0063 | 21 |
| | | | Number of supervisory engineers in enterprises | 0.0107 | 19 |
| | | | The market position of supervision enterprises in local areas | 0.0261 | 13 |
| | | | Number of persons with high academic qualifications and professional titles in enterprises | 0.0063 | 21 |
| | | | Number of registered supervisory engineers in enterprises | 0.0189 | 15 |
| Bidding credit | 0.1529 | 3 | Whether there is the behavior of abandoning the | 0.0807 | 4 |

| | | | | | |
|---|--------|---|--|--------|----|
| behavior | | | bid after winning the bid | | |
| | | | Is there any malicious bid winning at a low price | 0.0508 | 7 |
| | | | Whether or not to participate in the bid-rigging | 0.0213 | 14 |
| Excellent and good rate of supervision service | 0.3472 | 1 | Construction unit evaluation | 0.0485 | 8 |
| | | | Winning rate of supervision project | 0.1832 | 1 |
| | | | Total unit evaluation | 0.1154 | 3 |
| Enterprise customer complaint rate | 0.2300 | 2 | Owners' complaints about the quality of the works | 0.1241 | 2 |
| | | | Rate of complaints by owners about investment controls | 0.0376 | 9 |
| | | | Rate of complaints by owners about progress of works | 0.0683 | 5 |
| The good faith behavior of contract performance | 0.1137 | 4 | Warranty obligation performance | 0.0284 | 11 |
| | | | Contract performance rate | 0.0568 | 6 |
| | | | Licensed employment of practitioners | 0.0284 | 11 |
| Financial situation of enterprises | 0.0540 | 6 | Financial current ratio | 0.0291 | 10 |
| | | | Financial net profit margin | 0.016 | 16 |
| | | | Credit turnover rate | 0.0088 | 20 |
| Enterprise development prospect | 0.0340 | 7 | System construction level | 0.0058 | 23 |
| | | | Market share | 0.0132 | 18 |
| | | | Enterprise development strategic planning | 0.0151 | 17 |

(4) Conclusion.

According to the calculation of the first-level indicators weight table of the influencing factors of supervision enterprises' credit, the order of influencing factors is as follows: excellent rate of supervision service, accounting for 34.72%; complaints rate of enterprise customers, accounting for 23%; the behavior of bidding credit, accounting for 15.29%; the honest behavior of contract performance, accounting for 11.37%; the basic quality of supervising enterprises, accounting for 6.83%; the financial situation of enterprises, accounting for 5.4% and the prospect of enterprise development, accounting for 3.4%. First of all, the excellent rate of supervision service is the most important factor affecting the credit of supervision enterprise, and the order of important factors in the excellent rate of supervision service is the winning rate of supervision project, the evaluation of total unit and the evaluation of construction unit. Secondly, the enterprise customer complaint rate is an important factors affecting the supervision enterprises. In the enterprise customer complaint rate, the importance rises in the order of the owner's complaint rate about the project quality, the owner's complaint rate about the investment control and the owner's complaint rate about the progress of the project. Finally, bidding credit behavior is also an important factor affecting the credit of supervision enterprises. In the bidding credit behavior, whether there is the behavior of abandoning bid after winning a bid or not, and whether there is a malicious act of winning a bid at a low price, The importance of these factors decreased in turn. Obviously, the basic qualities of supervision enterprises and the development prospects of enterprises are less important than other factors, but in order to achieve a better credit status of supervision enterprises, the influence of these can't be neglected.

3. The countermeasures of perfecting the construction of credit evaluation system in engineering supervision enterprises

3.1 To improve credit laws and regulations and strengthen law enforcement

With the continuous development of engineering supervision enterprises, credit supervision has become one standard practice. At present, the credit evaluation of supervision enterprises in our country is still in the developing stage. Although such provinces as Fujian, Zhejiang and Shandong have already started the credit evaluation system of supervision enterprises, the relevant laws and regulations are not perfect, and there are still many loopholes. This gives many enterprises a chance to take risks. It is not clear what corresponding legal responsibility the supervision enterprises and supervisors should bear after violating the credit laws and regulations, and the punishment is not

strong enough. Therefore, only by perfecting the laws and regulations in supervision enterprises and individual practice, can the construction engineering supervision enterprises develop healthily. Only when there are laws to be followed, laws must be strictly enforced, and violations of the law must be investigated can the construction engineering supervision enterprises develop healthily. At the same time, we should strengthen the law enforcement, carry out dynamic examination for the honest enterprise, increase the frequency and ratio of random check, and severely punish the dishonest behavior, punishing, deducting the score, and even expelling the serious ones from the construction project supervision market.

3.2 To promote credit information disclosure and construct credit archives

The development of supervision enterprise credit is related to the healthy development of supervision enterprise in our country. The discredit behavior of supervision enterprise is a common occurrence, which seriously restricts the development of enterprises in some areas. It is urgent to develop the credit supervision system and it is certain to have a long way to go. The credit supervision consciousness in many provinces of our country is relatively weak, and some even do not realize the importance of this problem. In order to strengthen and develop the enterprise, we should pay attention to the importance of enterprise culture and cultivate the principle of credit supervision in every enterprise, so that the employees can, motivated by the strong corporate culture, learn and abide by the credit supervision. On the other hand, the competent departments and trade associations of provinces and cities should supervise the credit database, count the credit problems of supervision enterprises, and gradually open the credit files to the public and gradually form a credit construction information platform throughout the country, realizing the mutual communication, interaction and mutual recognition of the credit information within the system and announcing it to the society in time. It is desirable to establish the norms and standards of honesty and credit of relevant construction market subjects, record the credit information of the participants dynamically, improve the information release and inquiry mechanism, and announce the credit results, rewards and punishments to the whole society in time. This can not only bring warning to enterprises, but also restrain the recurrence of credit problems of supervision enterprises.

3.3 To implement credit restriction and reward mechanism and strengthen the use of results

The credit database should include two aspects: first, it should record the situation of the enterprise's previous breach of trust and set up obstacles for them to enter the market, which will serve as a warning to the enterprise itself, and as a guide for the construction unit and the individuals to choose the enterprises. We should take measures to restrain the enterprises with poor credit evaluation grade, strengthen daily supervision, increase the frequency of law enforcement inspection, and include them in the supervision object list of special inspection if necessary. For the enterprises with poor credit rating in two consecutive evaluation periods, it is suggested that the project construction units in the administrative region of this city should be prudent and careful in their choices. Second, it is necessary to record the incentives given to enterprises on credit issues, and to give preferential policies to enterprises with good credit. For example, in the event of debt occurrence, it is advisable to provide preferential qualifications for loans to enterprises with good credit. In the project bidding, it is desirable to set bonus point, which has an incentive effect on all aspects of the enterprise. These policies can improve the social image of the enterprise, enhance the reputation of the enterprise, drive the better development of the enterprise with high credit and promote the low credit enterprises to turn into the high credit enterprises. In order to make the information more accurate, we should share the information among the departments and strengthen the contact and cooperation among the departments.

3.4 To strengthen the construction of integrity system in supervision enterprises and create a good atmosphere

Strengthening the construction of enterprise credit system requires all-around actions of society, government, enterprises and supervision practitioners. First of all, the concept of good faith should be established in the society, believing integrity honorable while discredit shameful. Secondly, the construction competent department should establish and perfect the system of laws and regulations and the corresponding management measures in the aspect of supervising the integrity of enterprises, so that the laws must be followed strictly according to the law. In addition, the disclosure of enterprises with bad credit will undoubtedly damage the corporate image of the region, as well as the interests of various departments and regions. In order to safeguard their own interests, many regions will take various measures to prevent the disclosure of information, thus keeping the credit system from playing its role. All regions should strengthen self-restraint, put an end to the phenomenon of local protection, and severely crack down on discredit enterprises, in order to create a good market environment and healthily developed enterprises. Finally, the supervision enterprise and the supervision professionals should establish the good faith supervision concept in their minds, set up the credit management department and the personnel inside the supervision enterprises, increase the fund support, establish and perfect the enterprise internal credit management mechanism. Supervisors should strengthen the construction of professional ethics, register in the practice record of strengthen the continuing education and training for those who carried out dishonest practice.

4. Conclusion

Based on the healthy and sustainable development of engineering construction supervision industry in China, this paper designs the enterprise credit evaluation system, in combination with literature retrieval, expert consultation and questionnaire survey. This paper analyzes the first and second level indicators that affect the healthy development of construction supervision enterprises in China, and puts forward some countermeasures for perfecting the credit evaluation of engineering supervision enterprises and promoting the development of high quality in the industry. However, the selection of evaluation indicators, especially the dynamic and interrelated considerations, is not perfect. Meanwhile, honesty and credit construction is a synthesis of factors involving social and economic development, people's consciousness and ideas and other aspects, which means great difficulty in making a clear understanding.

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