Application on credit evaluation and supervision of highway construction enterprise in China

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Abstract. The credit evaluation of highway construction enterprise is the core of highway construction market credit system, and an important part of building the new credit-based highway construction market supervision mechanism. Because of not only some problems in the current credit evaluation of highway construction enterprise, but also the latest national policy requirement and the actual need of highway construction market, some new improvements were put forward in the thesis. Firstly the new credit evaluation framework system of evaluation of highway construction enterprise was introduced, and then the credit evaluation contents and standards were rein, then the credit evaluation procedure and method were improved in the next part. Finally we put forward the credit classification and supervision measures. An example was showed that the new credit evaluation system was applied on the highway construction enterprise in X province. The results have an important decision-making reference value and practical significance on strengthening the credit evaluation and management of highway construction market, and that will further standardize and create an honest trustworthy market environment, and advance the modernization of highway construction market governance system and governance capacity.

1. Introduction
Since 2007, the Ministry of Transport of the People’s Republic of China had formulated credit evaluation rules about highway construction enterprise, which established the credit evaluation mechanism covering the whole activity process for highway construction enterprise, and credit evaluations were carried out every year. The evaluation results had been used widely in bidding, qualification management and other fields, which played an important role on continuously advancing the highway construction market environment and creating a favourable business environment. Recently, with the continuous development of the highway construction market, the requirements are the higher to regulate the order of the highway construction market environment. In the process of carrying out the credit evaluation and supervision application of the highway construction market, some problems are exposed gradually. About the evaluation target and orientation, the current system used the point deduction system, which does not consider the bonus items and lacks the positive guidance effect. About evaluation method, the inverse weight method is adopted, which could mean that a project of low evaluation score would have the larger contribution to the integrated evaluation result, then that is not conducive to encourage construction enterprises to do more and well projects. About the evaluation object, the differences about the evaluation object scale and difficulty are not considered, which is inconsistent with the hierarchy and classification implementation of credit evaluation management. About evaluation criteria, the evaluation criteria about bidding behavior and performance behavior dishonesty are only concerned about, but no another related dishonesty behavior, for example publishing...
false information. About evaluation application, rewards and punishments need been strengthened based on credit evaluation, and should promote the mutual recognition of evaluation results among different management apartments, and would expand the evaluation application scenarios[1-4].

According to the requirements about “Guiding Opinions on Accelerating the Construction of a Social Credit System and Constructing a New Credit-based Supervision Mechanism”, which was issued by the State Council in July 2019, and the main problems about the current highway construction market credit evaluation, it is put forward that the new credit evaluation framework system of highway construction enterprise, and refines the evaluation contents and standards, and improves the evaluation procedures and methods, and presents evaluation classification and supervision measures, and shows out the evaluation application. Results play an important role on further standardizing the highway construction market order, and creating an honest trustworthy market environment, and promoting the modernization of the highway construction market governance system and governance capacity.

2. Evaluation framework system

Highway construction market credit evaluation is a systematic evaluation on the evaluation object, which included bidding behavior, performance behavior and other related credit behavior, according to regulated credit evaluation rules and methods. The main apartments in the evaluation framework system include evaluation subject, evaluation object, evaluation rules and methods, evaluation contents and standards, evaluation results and application, etc.

![Credit evaluation framework system of highway construction market](image)

**Figure 1. Credit evaluation framework system of highway construction market**

2.1. Evaluation subject

Bidding behavior shall be evaluated by the tenderer. The performance shall be evaluated by the project legal person. Other behaviors shall be evaluated by the transportation manager which is responsible for project supervision. The evaluation subject shall confirm and be responsible for the evaluation results.

2.2. Evaluation object

Evaluation object means the basic evaluation unit. About bidding behavior, the basic evaluation unit is the single bidding project. About performance behavior, the basic evaluation unit is the project contract section. Because highway projects have great different from the investment scale and importance, it is put forward to evaluate project credit on classification management in this paper, which will divide highway construction projects into key projects and general projects. Key projects refer to construction projects such as expressways and the common national or provincial trunk lines, with the weight of 0.8. General projects refer to other highway construction projects except key projects, with the weight of 0.2.

2.3. Evaluation contents and standards

Except for bidding behavior, performance behavior, evaluation contents also include some other dishonest behavior, such as the punishment of the unit by the judicial organ, malicious default in arrears, fraud in the process of qualification application, fraud in credit rating, etc. Credit evaluation of other behavior shall be included in the total score of enterprise credit evaluation. The evaluation criteria are detailed in Section 3.
2.4. Evaluation rules and methods
We classify and weight different credit behaviors. When the evaluation object has both bidding behavior and performance behavior, the evaluation weight of bidding behavior is 0.2, and the evaluation weight of performance behavior is 0.8. The current scoring method adopts the cumulative point deduction system, i.e. points are deducted due to the dishonesty or non-compliance of bidding or performance. But this method can't reflect the credit "incentive of keeping faith, punishment of breaking faith". Therefore, this article puts forward the idea of adding points for good credit. Enterprises receiving special awards, such as provincial and ministerial level safe construction site and quality engineering, can get credit bonus points to reflect the positive incentive and guidance role of credit.

2.5. Evaluation results and application
Credit evaluation results used for implementing graded. National comprehensive credit evaluation results are applied to the national highway construction market. If there is no national comprehensive credit evaluation result, the provincial credit evaluation result of the working area shall be used. If the employer is a consortium, its credit rating shall be determined according to the party with the lowest credit rating among the members of the consortium. This article proposes that the results of credit evaluation should be widely used in bidding, market access, qualification application and review, daily inspection and other aspects to improve the market supervision system of highway construction.

3. Evaluation contents and standards
Enterprise credit evaluation includes three parts: bidding behavior, performance behavior and other credit behavior. Other credit behavior refers to the credit bonus or credit deduction behavior not limited to a specific evaluation unit. According to the principle of SMART [5-6], this study aims to be comprehensive, focused, practical, accurate and reliable. Next, the specific evaluation index and scoring standard of highway construction enterprise credit evaluation are explained.

3.1. Credit evaluation standard of bidding behavior
The cumulative scoring system is applied to the credit evaluation of bidding behavior, and the initial score of one evaluation cycle is 100 points. When an enterprise violates the provisions of relevant laws, regulations, rules and standards, or is subject to administrative punishment or criticism by the competent department of transportation or the supervision department of the government at or above the county level, or practices fraud or violates commitments, it shall deduct points one by one according to the standards until the deduction is completed. In particular, if the enterprise has serious bid dishonesty, it will be directly listed as the lowest level of credit. The specific evaluation system of bidding behavior is shown in Table 1.

| Target layer          | Index level                       | Evaluation criterion                      |
|-----------------------|-----------------------------------|-------------------------------------------|
| Serious dishonesty    | Fraud of bidding qualification    | Directly set as the lowest level          |
|                       | Illegal bidding                   | Directly set as the lowest level          |
|                       | False materials winning the bid   | Directly set as the lowest level          |
|                       | False materials fail to win the bid | 30 points / times                         |
| Other dishonesty      | Give up winning the bid without proper reason | 30 points / time after winning the bid and 20 points / time before winning the bid |
|                       | Unreasonable delay of contract    | 20 points / time                          |
|                       | Other acts                        | 5-30 points                               |

3.2. Credit evaluation standard for performance
The cumulative scoring system is applied to the credit evaluation of performance behavior, and the initial score of one evaluation cycle is 100 points. In case of any dishonesty in personnel and equipment
management, quality progress management, financial management, safety production management, and social responsibility, the enterprise shall deduct points according to the standard until the deduction is completed. In particular, if the enterprise has serious bid dishonesty, it will be directly listed as the lowest level of credit. The specific evaluation system of performance behavior is shown in Table 2.

Table 2. Credit evaluation system of performance behavior of construction enterprise

| Target layer                      | Index level                              | Evaluation criterion                      |
|-----------------------------------|------------------------------------------|------------------------------------------|
| Serious dishonesty                | Subcontracting or illegal of the winning contract subcontracting | Directly set as the lowest level         |
|                                   | Major safety and quality problems        | Directly set as the lowest level         |
|                                   | Serious damage to the environment        | Directly set as the lowest level         |
| Personnel and equipment in place  | No entry for no reason                   | 2 points / 10 days delay                 |
| (full score 10)                   | Person in charge not in place            | 3 points /person                         |
|                                   | Other personnel or equipment not in place| 0.5 points / person or set                |
|                                   | Work without certificate                  | 1 points / person                        |
| Quality progress management       | Imperfect system                         | 5 points                                 |
| (full score 40)                   | Unqualified building materials            | 10 points / time                         |
|                                   | Construction not in accordance with regulations | 8 points / time                      |
|                                   | Not approved by the supervisor            | 3 points / time                          |
|                                   | Construction accident                     | 15 points / time                         |
|                                   | Delay in construction period              | 1 points / 10 days delay                 |
|                                   | Irregular site management                 | 3 points / time                          |
|                                   | Delay warranty                            | 12 points                                |
| Financial management              | Imperfect financial system                | 5 points / time                          |
| (full score 10)                   | False measurement                        | 10 points / time                         |
|                                   | Misappropriation of security expenses     | 2 points / time                          |
|                                   | Misappropriation of project funds         | 10 points / time                         |
| Safety production                 | Imperfect rules and regulations on work safety | 5 points                                |
| (full score 20)                   | Safety production license qualification does not meet the requirements | 15 points / time                      |
|                                   | Noncompliance of safety signs and firefighting equipment | 2 points / time                   |
|                                   | Unreasonable use of safety personnel      | 3 points / time                          |
|                                   | Safety production in violation of regulations | 5 points / time                      |
|                                   | General safety accident                   | 8 points / time                          |
|                                   | Inadequate safety rectification           | 10 points / time                         |
| Social responsibility             | Destroy the ecological environment        | 3-5 points / time                        |
| (full score 10)                   | Illegal occupation of land                | 4 points / time                          |
|                                   | Poor external environment of construction  | 3 points / time                          |
| Other dishonest behaviors          | Other breach of contract                  |                                         |
| (full score 10)                   |                                          |                                         |

3.3. Credit evaluation standards for other behaviors

Other behavior credit evaluation is a comprehensive evaluation of a construction enterprise in the area of province. It refers to the credit information of an employer as a whole rather than an evaluation unit. The evaluation includes the behavior of credit deduction and credit bonus. Other behavior credit evaluation system is shown in Table 3.
Table 3. Credit evaluation system of other behaviors of construction enterprise

| Target layer       | Index level           | Evaluation criterion          |
|--------------------|-----------------------|--------------------------------|
| Dishonest behavior | Punished by judicial authorities | Directly set as the lowest level |
|                    | Practice fraud        | 10 points / time               |
|                    | Malicious arrears     | Directly set as the lowest level |
|                    | Be criticized, etc.   | 3-8 points / time              |
| Credit bonus       | Project awarded       | 10 points / time               |
|                    | Receive other commendations or awards | 3-8 points / time |

4. Evaluation procedures and methods
The credit evaluation of highway construction enterprise is a cumulative and integrated evaluation process from single behavior (bidding behavior, performance behavior) to the whole entity (including other dishonest deduction and credit bonus behavior), from a specific project to a provincial region and then to the national region. The specific evaluation procedure is to carry out unit evaluation first, then provincial regional evaluation, and then national credit evaluation.

4.1. Unit evaluation
Unit evaluation is the basic work of enterprise credit evaluation, including the evaluation of bidding behavior and performance behavior.

4.1.1. Evaluation of bidding behavior
After the completion of each bidding, the competent department of transportation or the tenderer shall evaluate the bidding behavior of the construction enterprise and record it into the credit management account. The employer’s credit evaluation score of bidding behavior is $t$:

$$t = 100 - \sum_{i=1}^{m} A_i$$  

Note: $m$ is the number of bad behaviors in the bidding, $A_i$ is the corresponding deduction standard of bad behaviors, and the scoring deduction standard refers to the relevant content in Section 3 of this article.

4.1.2. Performance evaluation
Combined with the daily construction management, the competent department of transportation or the project legal person shall evaluate the performance of the construction enterprise in the current year, and record it into the credit management account. The credit evaluation score of performance behavior is $l$:

$$l = 100 - \sum_{i=1}^{n} B_i$$

Note: $n$ is the number of bad performance, $B_i$ is the corresponding deduction standard for bad performance, and the performance score deduction standard refers to section 3 of this article.

4.2. Provincial evaluation
The provincial competent department of transportation evaluates the credit behavior of construction enterprise in its own administrative region, calculates the provincial credit evaluation scores, and determines the credit rating according to the scores. After publicity, the credit evaluation results shall be reported to the Ministry of Transport as required. The credit evaluation calculation process and formula of construction enterprise in a province are as follows:

4.2.1. Evaluation of bidding behavior in the province
In a province, the credit evaluation score of bidding behavior of construction enterprise is $T$:

$$T = \sum_{j=1}^{p} (t_j W_j) / \sum_{j=1}^{p} W_j$$
Note: $p$ is the number of units for evaluation of bidding behavior in a province, $t_j$ is the credit evaluation score of a bidding behavior, $W_j$ is the weight of a bidding project, in which the weight coefficient of key projects is 0.8, and the weight coefficient of general projects is 0.2.

If a construction enterprise has a subordinate enterprise with independent legal person status, one of its subordinate enterprises is regarded as a key project, and $t_j$ is the total score of bidding behavior of subordinate enterprises.

4.2.2. Evaluation of provincial performance

In a province, the credit evaluation score of construction enterprise's performance behavior is $L$:

$$L = \frac{\sum_{j=1}^{q} (l_j W_j)}{\sum_{j=1}^{q} W_j}$$  \hspace{1cm} (4)

Note: $q$ is the number of units for evaluation of performance behavior in a province, $l_j$ is the credit evaluation score of a performance behavior, $W_j$ is the weight of a performance project, in which the weight coefficient of key projects is 0.8, and the weight coefficient of general projects is 0.2.

If a construction enterprise has a subordinate enterprise with independent legal person status, one of its subordinate enterprise is regarded as a key project, and $l_j$ is the total score of performance behavior of subordinate enterprise.

4.2.3. Comprehensive evaluation of provincial credit

In a province, the credit evaluation score of construction enterprise is $C$:

$$C = \alpha T + \beta L + \sum_{k=1}^{o} Q_k$$  \hspace{1cm} (5)

Note: $C$ is the evaluation score of bidding behavior in the province, $L$ is the evaluation score of performance behavior, $Q_k$ is the corresponding credit deduction (negative value) or bonus (positive value) standard of other behaviors, and $o$ is the number of deduction or bonus units of other behaviors.

When there is only bidding behavior evaluation in a province in the evaluation period, $\alpha = 1$ and $\beta = 0$. When there is only performance evaluation in a province, $\alpha = 0$ and $\beta = 1$. When a construction enterprise has both evaluation of bidding behavior and performance behavior in a province, $\alpha = 0.2$ and $\beta = 0.8$.

The total amount control shall be implemented for other behaviors of construction enterprise. If the total credit evaluation score $C$ in the province exceeds 100, it will be counted as 100 points.

4.3. National comprehensive evaluation

According to the evaluation results reported by the provincial transportation authorities, the Ministry of Transport calculates the national comprehensive credit evaluation score of construction enterprise on the basis of summary and analysis. The comprehensive credit evaluation score is $X$. The credit rating shall be determined according to the scores, and the national credit evaluation results shall be publicized and announced.

$$X = \sum_{i=1}^{s} C_i$$  \hspace{1cm} (6)

Note: $C_i$ is the comprehensive credit evaluation score of construction enterprise in a province, and $s$ is the number of provinces in which the construction enterprise conducts credit evaluation of highway construction nationwide.

5. Evaluation classification and supervision

Evaluation is the foundation and application is the ultimate goal. It is the key to strengthen the effect of credit evaluation and create a credit environment to further classify the results of credit evaluation and apply them to practice. Only through the application, we can further test and improve the methods and standards of credit evaluation, and can constantly consolidate the effect of credit evaluation.
5.1. Evaluation classification
According to the division principle put forward in *Several Opinions on Strengthening the Construction of Credit System in Transportation Industry*, the credit evaluation of highway construction enterprise can be divided into five grades: AA, A, B, C and D. The corresponding score $x$ of each credit rating is:
- AA: $x \geq 95$ points, good credit;
- A: $85 \leq x < 95$, good credit;
- B: $75 \leq x < 85$, general credit;
- C: $60 \leq x < 75$, poor credit;
- D: $x < 60$, or serious dishonesty, poor credit.

5.2. Application of evaluation results
We will implement classified management on the evaluation and classification results, then establish an incentive mechanism for construction enterprise with high credit rating (such as AA) and a disciplinary mechanism for construction enterprise with low credit rating (such as C or D), and gradually form a new credit-based market supervision mechanism in the highway construction market.

5.2.1. Incentives for Integrity.
Incentive measures mainly include: In the process of administrative approval of highway construction market and engineering construction, preferential policies such as credit commitment system and acceptance of shortage tolerance shall be implemented; In the bidding process of transportation projects invested by the government and cooperation projects between the government and social capital, preferential policies such as lowering the proportion of bidding, performance, quality guarantee, increasing the proportion of project advance payment, and credit-abiding rewards shall be given, and the same conditions shall be given priority. In the bid qualification examination or bid evaluation, appropriate extra points shall be given, etc.

5.2.2. Discipline for dishonesty.
Disciplinary measures mainly include: Strengthen daily key supervision, increase inspection frequency and strengthen on-site inspection; Limit participation in the commendation and reward activities organized by the competent departments of transportation at all levels; Restrictions on access to various government preferential policies such as financial subsidies, etc.

6. Application and Prospect of evaluation
Carry out credit evaluation for construction enterprise participating in highway construction in X Province in 2018. There are 155 highway construction enterprise, which have carried out 352 evaluation units (including civil engineering, mechanical and electrical engineering, traffic safety engineering and service area housing construction). The results show that 29, 82, 43, 1 and 0 enterprises have obtained the annual credit rating of AA, A, B, C and D respectively. The results show that the overall credit evaluation of highway construction enterprise in the province is relatively high, as shown in Figure 2.
The highway construction market is an organic and unified whole, so the credit evaluation and application of highway construction market should be based on the overall situation. The collection, standard, evaluation and application of credit information of national highway construction enterprise should be unified and standardized, and more measures should be taken to continuously strengthen the application of credit evaluation results in production practice. In this way, we can better play the role of credit, and truly build a new credit-based highway construction market supervision mechanism.

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