Research Article

An Evolutionary Game Analysis of Contractor’s Green Construction Behavior with Government Supervision and WeMedia’s Influence

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The promotion of green construction is an important approach to achieve high-quality and sustainable development of China’s construction industry. In China, the government supervises contractors’ green construction behavior. However, due to factors such as high cost and immature construction technology, the contractor often does not have a strong interest to adopt green construction behavior. An evolutionary game model is constructed based on the interactive relationship between government and contractor under bounded rationality conditions. As the best way for public opinion to function, WeMedia mechanism is considered in the evolutionary game model from the perspective of public participation. The evolutionary game process of the two players is simulated by system dynamics. The results show that without the influence of WeMedia, the stability of the system evolution depends on two factors. One is the government’s penalty for contractor’s nongreen construction behavior and the other is government’s supervision performance brought from contractor’s green construction behavior. With the influence of WeMedia, when WeMedia’s willingness to positively propagandize the contractor’s green construction behavior strengthens, it can significantly promote the system to converge to the ideal stable strategy. While WeMedia’s capability to negatively expose the contractor’s nongreen construction behavior strengthens, it can also significantly promote the system to converge to the ideal stable strategy. Even if the government takes excessive penalties for the contractor’s nongreen construction behavior, the system can still converge to the ideal stable strategy, by adjusting the willingness of propaganda or the capability of exposure from WeMedia reasonably. With the influence of WeMedia in the green construction supervision game, this study analyzes how the positive propaganda and negative exposure of WeMedia influence the strategic choice of the game between the two parties, to provide suggestions on how the government can efficiently use the WeMedia to promote contractor’s green construction behavior.

1. Introduction

Construction projects consume a lot of resources and energy during the construction period and produce a lot of construction waste, which directly affects the environment through dust, noise, sewage, etc. [1]. Green construction refers to the premise of meeting the basic requirements of quality and safety, maximizing the conservation of resources, and reducing construction activities, which will produce a negative impact on the environment [2]. The goal of “energy saving, land saving, water saving, material saving, and environmental protection” is completed by scientific management and technological progress [3]. Obviously, construction is not only a process of producing a qualified building product but also be fully considered how to minimize its negative impact on the environment. How to promote the transformation of traditional construction to green construction has important theoretical and practical significance for winning the battle against air pollution [4] and even for the transformation of China’s construction industry to the direction of sustainable construction.
At present, many scholars have carried out studies about green construction. Green construction believed the inheritance and development of traditional civilization construction, but it is a much more complex system engineering [5]. Then, scholars proposed that green construction is a construction technology and management measure to achieve resource recycling and harmonious development of the ecological environment [6]. In the assessment of green construction, Wang et al. established the evaluation index system of green construction of deep foundation pit with pressure-state-response (PSR) frame model and gave the green construction evaluation method of improving the vague similarity summary method [7]. Yao et al. then constructed a green construction evaluation model with an improved attribute identification model by combining the main construction control nodes [8]. Moreover, there are studies on the assessment of railway green construction grades considering the fragile ecological environment in cold and arid areas [9] and the green construction project bidding assessment model that introduces BIM and ontology-based approach [10]. In addition to discovering the problems of green construction through assessment and adopting targeted strategies to address them, some scholars also try to analyze green construction from the subjective behavior of contractor. The study found that employees' ability in green behavior directly affects green construction performance [11]. Li et al. considered the context of green development in the construction industry and analyzed the influencing factors of the green technology innovation behavior [12]. The impact of the government’s reward and punishment mechanism is an important factor to promote construction workers to adopt green behavior [13].

The above studies only consider the contribution of green construction to reduce greenhouse gas emissions and reduce resource consumption and environmental protection. However, these studies ignore the negative incentive that the resulting incremental costs may bring to the contractor. Government supervision and policy support are needed to accelerate green construction promotion [14]. Green construction incentive is an important means to promote the development of green construction [15]. The lack of supervision by local government, protection of professional technical knowledge, and protection of developers' interests are the three major barriers to the development of green construction at present [16]. Obviously, the government’s incentive and supervision have an important influence on contractor’s choice of green construction behavior [17]. In engineering practice, due to the higher cost expenditure of green construction, the contractor in pursuit of profit may treat green construction behavior negatively, while the government for economic development sometimes can be "blind" to contractor's nongreen construction behavior [18]. Obviously, in the face of complex and changeable conditions, it takes a long-term evolutionary process for contractor to switch from traditional method to green construction, which cannot be accomplished overnight. Game theory refers to the development of mathematical models to help the different parties in an interaction predict the outcome of their actions [19]. In the game framework, there are four elements: game individual (at least two), strategy set, payoff matrix, and behavior orders. In a given situation, each participant will follow the goal of maximizing their own payoff and adopt the corresponding strategy [20]. However, the main disadvantage of classical game theory is that it requires the participants to be “fully rational,” which is difficult to achieve in practice [21]. Evolutionary game theory compensates for this shortcoming by assuming that the participants have “limited rationality” and will continue to evolve according to the changes in conditions [22]. In evolutionary games, over time, participants learn from each other, constantly find the best strategies for their own benefit [23], and will eventually choose a relatively advantageous strategy—the evolutionary stable strategy (ESS). Evolutionary game theory has been widely used in the fields of public emergency management [24], e-commerce platform [25], and drug safety supervision [26]. What is more, against the background of the current climate warming, evolutionary games are gradually applied to the study of green behavior, such as construction and demolition waste recycling units’ green behavior [27] and green agricultural product supply chain financing system [28]. With the rapid development of WeMedia such as microblog and public accounts of WeChat (such as Twitter and Facebook in China), the online public opinion awareness continues to increase, and social issues such as environmental pollution caused by traditional construction methods have received increasing attention. Under WeMedia circumstances, the public can use the public opinion platform to give real-time feedback on the contractor’s nongreen construction behavior. So, public opinion will inevitably have a great effect on the behavior strategy choices of both contractor and government. Thus, the promotion of green construction requires the joint efforts of the government, the contractor, and the public. Meanwhile, the best way for public to influence contractor’s green construction behavior is WeMedia [29], while the rapid development of cloud computing, big data, and other information technologies provides strong support for giving full play to the role of WeMedia. Zou et al. used a tripartite game to introduce the effect of online media into government supervision and made corresponding suggestions [30]. Liu et al. further clarified that the use of WeMedia supervision functions can more effectively promote the supervision functions of government [31]. To strike a lot of attention, WeMedia tends to report and discuss negative news. To regulate the right to speak from the media, the capability to expose from WeMedia should be reasonably restricted, and the willingness to propagandize should be appropriately strengthened.

In view of this, three steps will be conducted to analyze contractor’s green construction behavior with the government supervision and WeMedia’s influence. First, we set up an evolutionary game model among government supervision and contractor’s green construction behavior to establish the payoff matrix. We then calculate the dynamic equations and analyze the stability evolution process, in addition to using system dynamic (SD) simulation to analyze the steady state and convergence of each evolutionary
equilibrium solution in different situations. Second, WeMedia’s influence is incorporated into the original evolutionary game model. An expanded evolutionary game model is established for government supervision, WeMedia’s influence, and contractor’s green construction behavior selection. Finally, sensitivity analysis is performed for different parameters in this model, and the influence of the parameters on the strategic choices of the two players is discussed. The policy recommendations for promoting green construction are put forward based on the results.

2. Evolutionary Game Model without WeMedia’s Influence

2.1. Evolutionary Game Model

(1) Game Players and the Assumptions about Strategy: there are two players in the game, the government (construction authorities that are in charge of supervision over construction behavior) and the contractor (undertaking the project). There are two strategic choices for both the government and the construction, respectively: (supervise, not supervise) and (green construction, nongreen construction). By constantly adapting to the external environment, the strategic choices of both players in the game gradually tend to stable strategy choices. Probability \( x (0 \leq x \leq 1) \) represents that the government supervises the contractor to adopt or not adopt green construction behavior. \( x \) represents the supervision attitude of the government. \( x = 0 \) represents that the government does not supervise whether the contractor has adopted green construction behavior. \( x = 1 \) represents that the government supervises the contractor’s construction behavior. Probability \( y (0 \leq y \leq 1) \) represents that the contractor adopts green construction behavior. \( y = 0 \) represents that the contractor adopts nongreen construction behavior. \( y = 1 \) represents that the contractor adopts green construction behavior.

(2) Assumptions about Other Variables: when the contractor chooses green construction strategy and the government chooses to supervise, the interests of both players are, respectively, \( Q_1 + l, G_1 - e \). Among them, \( Q_1 \) represents the project interest when the contractor chooses green construction strategy. \( l \) represents the extra reward for contractor’s green construction behavior when the government chooses to supervise. For example, in standardizing and strengthening the contractor’s technical management innovation for green construction, the government will set up special awards based on supervision results. Because green construction behavior reduces the negative effect of the project on the surrounding environment and citizens and improves public satisfaction and government credibility, the increased supervision performance of government is \( G_1 \). It needs to pay supervision costs \( e \) when it carefully supervises. Similarly, when the contractor chooses green construction strategy and the government does not choose to supervise, \( Q_1 \) represents the contractor’s interest at this time. The government cannot transform the effect of green construction behavior into its supervision performance if it does not choose to supervise, so there is no increased interest.

(3) The, respectively, interests are \( Q_2 - C - f \) and \( C - e - G_2 \) when the contractor chooses nongreen construction strategy and the government chooses to supervise. Among them, \( Q_2 \) represents the project interest when the contractor chooses nongreen construction. When the government chooses to supervise and finds out that the contractor is polluting the environment through construction, \( C \) represents that the contractor will be penalized by the government. At the same time, \( G_2 \), respectively, represents the negative effect on the image of the government brought by nongreen construction behavior. \( f \) represents the potential interest of the contractor. For example, failure to adopt effective green construction measures may affect the contractor’s bid score for future similar projects. Therefore, when the government chooses not to supervise, \( Q_2 - f \) and \( -G_2 \), respectively, represent the interests of the contractor and the government. The symbols of relevant parameters in the model and their meanings are shown in Table 1.

Based on the above assumptions and parameters, the government’s and contractor’s game payoff matrix is shown in Table 2.

2.2. Evolutionary Stable Strategy

2.2.1. Stability Analysis of the Government Supervision Strategy. According to Table 2, the expected revenue and average expected revenue of the government chooses to supervise and does not choose to supervise are, respectively, \( u_0^1, u_0^2 \), and \( \bar{u}_0 \). The equations are as follows:

\[
\begin{align*}
    u_0^1 &= y(G_1 - e) + (1 - y)(C - e - G_2), \\
    u_0^2 &= y \times 0 + (1 - y)(-G_2) = G_2(y - 1), \\
    \bar{u}_0 &= xu_0^1 + (1 - x)u_0^2.
\end{align*}
\]

The evolutionary game uses the replication dynamic equation to show both players’ strategy adjustments. According to the Malthusian equation, based on equations (1) to (3), the replication dynamic equation of the government choosing to supervise probability is as follows:

\[
F(x) = \frac{dx}{dt} = x(u_0^1 - \bar{u}_0) = x(1 - x)[C - e - y(C - G_1)].
\]

When \( F(x) = 0 \) is made, the learning speed of the player is zero, and the game reaches a relatively stable equilibrium state, so \( x^* = 0, x^* = 1, y^* = (C - e)/(C - G_1) \) can be obtained. The
replication dynamic equation calculates the partial derivative of $x$ as follows:

$$F'(x) = (1 - 2x)[C - e - y(C - G_1)].$$  \hfill (5)

When $y = y^*$, any $x \in [0, 1]$ satisfied $F(x) = 0$, and all $x$ is in a stable state. When $y \neq y^*$, whether $x^* = 0$ and $x^* = 1$ can become stable equilibrium points is related to the positive and negative conditions of $C - e - y(C - G_1)$. When $y < y^*$, if $C - e - y(C - G_1) > 0$, makes $x^* = 1$ can obtain $F'(x^*) < 0$, the only evolutionary stable strategy is that the government chooses to supervise. When $y > y^*$, if $C - e - y(C - G_1) < 0$, makes $x^* = 0$ can obtain $F'(x^*) < 0$, the only evolutionary stable strategy is that the government does not choose to supervise.

2.2.2. Stability Analysis of the Contractor’s Green Construction Strategy. Similarly, the replication dynamic equation of whether the contractor chooses green construction strategy is as follows:

$$F(y) = \frac{dy}{dt} = y(1 - y)[Q_1 - Q_2 + f + x(C + l)].$$ \hfill (6)

Makes $F(y) = 0$ can obtain $y^* = 0, y^* = 1$, and $x^* = (Q_1 - Q_2 + f)/(C + l)$.

The replication dynamic equation calculates the partial derivative of $y$ as follows:

$$F'(y) = (1 - 2y)[Q_1 - Q_2 + f + x(C + l)].$$ \hfill (7)

When $x = x^*$, any $y \in [0, 1]$ satisfied $F(y) = 0$, and all $y$ is in a stable state. When $x \neq x^*$, whether $y^* = 0$ and $y^* = 1$ can become stable equilibrium points is related to the positive and negative conditions of $Q_1 - Q_2 + f + x(C + l)$. When $x > x^*$, if $Q_1 - Q_2 + f + x(C + l) > 0$, makes $y^* = 1$ can obtain $F'(y^*) < 0$, the only evolutionary stable strategy is that the contractor chooses green construction behavior. When $x < x^*$, if $Q_1 - Q_2 + f + x(C + l) > 0$, makes $y^* = 0$ can obtain $F'(y^*) < 0$, the only evolutionary stable strategy is that the contractor chooses nongreen construction behavior. According to the replication dynamic equations of the government and the contractor, the system replication dynamic phase diagram is shown in Figures 1 and 2.

When the government chooses to supervise, the penalty for contractor’s nongreen construction behavior is greater than the value of the government’s supervision performance due to contractor’s green construction behavior ($C > G_1$). As shown in Figure 1, the system does not converge to any point in the end. This indicates that the evolutionary game system of the government and the contractor is always unstable. Because when the government imposes an excessive penalty on the contractor for nongreen construction behavior, the interests they receive from the penalty will exceed the rewards from contractor’s green construction behavior. Thus, it will reduce government’s motivation of encouraging the contractor to adopt green construction behavior. Obviously, it will obstruct the promotion of green construction and harm the public welfare. Therefore, the government should increase incentives for contractor’s green construction behavior, so that the rewards are greater than the penalties. In addition, the government cannot use penalty as the only means to monitor whether the contractor adopts green construction behavior. On the contrary, as is shown in Figure 1 ($C > G_1$), the system finally converges to points, $(0, 0)$ and $(1, 1)$, which indicates that the government and the contractor are, respectively, converging to choose (not supervise, nongreen construction) and (supervise, green construction).

Obviously, the evolution process of the system and the stable state are related to the position of the saddle point ($x^*, y^*$). When the saddle point moves to the low-left part in Figure 2, the system evolutionary stability strategy finally converges with a greater probability to (supervise, green construction), but in fact, the saddle point that moves to the low-left part will lower $x^*$ and $y^*$. Obviously, changing parameters such as negative effect on the potential interests of nongreen construction behavior, nongreen construction behavior’s penalty, extra reward to the contractor’s green construction behavior’s penalty, extra reward to the contractor’s green

Table 1: Description of symbols in the model.

| Symbols | Description of symbols |
|---------|------------------------|
| $Q_1$  | Project interest of contractor in choosing green construction |
| $Q_2$  | Project interest of contractor in choosing nongreen construction |
| $G_1$  | Increased supervision performance of government due to contractor’s green construction behavior |
| $G_2$  | Negative effect on the image of the government due to contractor’s nongreen construction behavior |
| $C$    | Contractor’s penalty payoff to the government from choosing nongreen construction |
| $f$    | Negative effect of contractor’s potential interests from choosing nongreen construction |
| $l$    | Extra reward of contractor in choosing green construction under government supervision |
| $e$    | Supervision cost to the government |

Table 2: Payoff matrix of the contractor’s green construction behavior under the government supervision.

| Strategy                  | Supervise   | Government |
|---------------------------|-------------|-------------|
| Contractor                |             |             |
| Green construction        | $Q_1 + l, G_1 - e$ | $Q_1, 0$    |
| Nongreen construction     | $Q_2 - C - f, C - e - G_2$ | $Q_2 - f, -G_2$ |


process of the government and contractor’s willingness to choose strategies is simulated. At this time, $C < G_1$ should be satisfied. According to the above stability analysis, the government and the contractor finally converge to choose (not supervise, nongreen construction) and (supervise, green construction). The evolution direction is related to the position of the saddle point $(x^*, y^*)$. According to $(\partial x^*/\partial C) < 0$, and $(\partial y^*/\partial C) < 0$, a gradual increase in $C$ is likely to change the evolutionary direction of the system, so a further analysis of the sensitivity of $C$ is made.

According to Figure 4, when $C = 4$, the strategy selection between the government and the contractor is still (not supervise, nongreen construction), but when $C = 5$, the two players of the game evolved into opposite strategies (supervise, green construction), which validates the above analysis. Similarly, other parameters can also be validated through sensitivity analysis. There no longer be shown due to limited space. According to the simulation results, the following enlightenment is obtained:

1. From the Government Perspective. Increasing the intensity of the penalty to nongreen construction behavior can significantly promote both players to choose (supervise, green construction), but it is necessary to control the amount of the penalty and not to blindly seek larger ones. Otherwise, this situation will not be able to maintain long-term stability. It is not conducive to promoting green construction. In addition, the government is rewarded for the outstanding green construction supervision performance. The government reduces supervision costs, such as introducing information technology means to smart construction sites. These can also promote both players to choose (supervise, green construction), but the sensitivity is much smaller and requires continuous investment to have an effect.

2. From the Contractor Perspective. Reducing the contractor’s nongreen construction behavior interest ($\Delta Q$) can significantly promote both players to choose (supervise, green construction). A contractor can take some measures, such as on-site waste recovery, reducing the cost of green construction technology. In addition, increasing negative effect on the contractor of nongreen construction behavior ($f$), such as limiting their opportunities to bid on similar projects in the future or lowering their bid scores, and increasing extra rewards for green construction behavior can significantly promote both players to choose (supervise, green construction), but the effect will take more effort or longer to manifest.

3. Evolutionary Game Model with WeMedia’s Influence

Whether the contractor adopts green construction behavior is related to the public interest and social welfare, so the public also has the motivation to express interest appeals [32]. In the traditional project construction process, the public was constrained by their knowledge and abilities. The
public did not have superior WeMedia conditions for expressing views. It is difficult to provide direct feedback on the contractor’s construction behavior. However, with the popularity of interactive WeMedia platforms, the public has gradually changed from being a "spectator" to "participant" in information disclosure in the era of information explosion [33]. The public opinion has become an important influencing factor in the formulation and implementation of government regulatory policies. Although the public is not a direct participant in the game, they can effectively interact with the government by the condition created by WeMedia. By this means, WeMedia will indirectly influence the contractor’s green construction behavior. Thus, it is necessary to make a further study on how the WeMedia mechanism influences the stability of the system equilibrium point and the evolutionary result of both players of the game to find the evolutionary law of WeMedia’s influence and feedback on the contractor’s green construction behavior selection.

3.1. Evolutionary Game Model with WeMedia’s Influence.

(1) When the contractor chooses green construction behavior and the government chooses to supervise, in addition to the relevant parameters analyzed earlier, it should be considered that the public plays a certain role in green construction supervision through WeMedia. Since the contractor adopts green construction behavior, it will reduce the negative effect on the environment around the construction site, which is recognized by the public. \( \alpha \) represents the positive propaganda willingness from the WeMedia. \( Q_3 \) represents the extra rewards that the contractor obtains due to the improvement of its positive image. At this time, because of the propaganda from WeMedia, the government supervises the contractor’s green construction behavior, which will also improve its reputation. Therefore, the interests of the contractor and the government are, respectively,

\[
Q_1 - e + \alpha_1 Q_3 \quad \text{and} \quad G_1 - e + \alpha_1 Q_4.
\]

Similarly, when the contractor chooses green construction behavior and the government chooses not to supervise. Since the contractor is consciously choosing green construction behavior and the government chooses not to supervise, the public plays a certain role in green construction supervision through WeMedia. Since the contractor adopts green construction behavior, it will reduce the negative effect on the environment around the construction site, which is recognized by the public. \( \alpha \) represents the positive propaganda willingness from the WeMedia. \( Q_3 \) represents the extra rewards that the contractor obtains due to the improvement of its positive image. At this time, because of the propaganda from WeMedia, the government supervises the contractor’s green construction behavior, which will also improve its reputation. Therefore, the interests of the contractor and the government are, respectively,
behavior, the propaganda from the WeMedia can bring more praise, and at this point, the interests are higher than those under the supervision \((Q_3 > Q_5)\). Despite the government does not choose to supervise, its supervision performance can also be improved due to the contractor consciously adopt green construction behavior with WeMedia’s propaganda. \(Q_4\) represents the extra benefit that the government obtained. The meaning of these parameters is shown in Table 3. Therefore, the interests of the contractor and the government are, respectively, \(Q_1 + \alpha_1Q_5\) and \(\alpha_1Q_4\).

(2) When the Contractor Chooses Nongreen Construction Strategy and the Government Chooses to Supervise. As nongreen construction behavior leads to environmental pollution and other management problems, \(\alpha_2\) represents public discussion and exposure capability through WeMedia. As WeMedia attracts the attention of the public, it tends to be more inclined to disclose negative news frequently, so \(\alpha_2 > \alpha_1\). Once nongreen construction behavior is exposed, \(G_4\) represents the negative exposure from WeMedia, which will cause the contractor loss due to the destruction of contractor’s image. When the phenomenon of nongreen construction behavior is exposed, government’s supervision performance still will be deducted due to ineffective supervision even if the government has supervised the contractor’s behavior. So, the deduction is \(G_3\). Therefore, the interests of the contractor and the government are, respectively, \(Q_2 - C - f - \alpha_2G_4\) and \(C - e - G_2 - \alpha_2G_2\). Similarly, when the contractor chooses nongreen construction strategy and the government chooses not to supervise, the contractor will not be penalized for nongreen construction behavior because of a lack of government supervision. With the continuous in-depth reports from WeMedia on the problems caused by the contractor’s nongreen construction behavior, the online public opinion eventually reveals the fact that the government has not supervised indeed. \(G_3\) represents the government being penalized due to not supervising the contractor’s nongreen construction behavior, and this kind of amount is greater than the performance deduction of ineffective supervision \((G_3 > G_2)\). Therefore, the interests of the contractor and the government are, respectively, \(Q_2 - f - \alpha_2G_4\) and \(−G_2 − \alpha_2G_3\).

To express more clearly, the symbols of relevant parameters in the extended model and their meanings are shown in Table 3. Therefore, the evolutionary game payoff matrix with the WeMedia’s influence is shown in Table 4.

### 3.2. Evolutionary Stable Strategy.

Similarly, by solving the game model with WeMedia’s influence, \(x^* = (Q_2 - Q_1 - f - \alpha_2G_4 - \alpha_1Q_2/l + C + \alpha_1Q_3 - \alpha_1Q_5)\) and \(y^* = (e + \alpha_2 (G_3 - G_3) - C/G_1 - C + \alpha_2 ((G_5 - tG_3))\) can be obtained. The following will further discuss the evolutionary promoting effect of \(\alpha_1\) and \(\alpha_2\) in the process of WeMedia’s influence.

When WeMedia negatively exposes the contractor’s nongreen construction behavior, it is obviously impossible for WeMedia to propagandize positively in mean time, so the value of \(\alpha_1\) is zero. Constructing the contractor and the government’s system evolution phase diagram with the influence of WeMedia, the impact on the system can be found of \(\alpha_2\) changes. When \(\alpha_2 > (C - G_1/G_3 - G_2)\), there is no evolutionary stability strategy for both players, as shown in Figure 5. When \(\alpha_2 < (C - G_1/G_3 - G_2)\), the system finally converges to points, \((0,0)\) and \((1,1)\), as shown in Figure 6. When the value of \(\alpha_2\) is large enough, WeMedia has a strong capability to expose negatively on the contractor’s nongreen construction behavior. Thus, the government can use WeMedia as a policy tool. The contractor’s construction behavior can be regulated by means of WeMedia’s discourse right. The government has the motivation to relax the intensity of supervision, because of the “self-interest” thinking. At the same time, the contractor realizes that the intensity of government supervision was gradually weakening. The contractor believes that government supervision depends on the effects of WeMedia. The contractor knows that the government will not take a large penalty amount because the government does not take effective regulatory measures. The contractor may generate speculative mentality to increase profits and adopt nongreen construction behavior. Over time, negative problems caused by nongreen construction behavior will become increasingly prominent. These push the government to strengthen supervision and rectify it, so the system cannot be stable at this time.

The system dynamic simulation is further carried out on the evolutionary game model with WeMedia’s influence, as shown in Figure 7.

The model settings are \(C = 11, G_1 = 8, G_2 = 10, G_3 = 6, G_4 = 3, G_5 = 3, e = 5, Q_1 = 6, Q_2 = 10, Q_3 = 5, Q_4 = 4, Q_5 = 6, f = 3,\) and \(l = 5,\) at this time \((C - G_1/G_3 - G_2) = 1\). To explore the influence of \(\alpha_2\) on the strategic choice of both players, \(0.1, 0.2, \ldots, 0.9\) are substituted into the model, respectively. The simulation results are shown in Figure 8.

According to Figure 8, with the increasing \(\alpha_2\), the government and the contractor will accelerate to converge to choose (supervise, green construction). This conclusion fully validates the above analysis. In addition, an interesting phenomenon can be found. Without the influence of WeMedia, when the government’s penalty amount for contractor’s nongreen construction behavior is too large \((C > G_1)\), the two players of the game do not have a stable strategy. However, with the influence of WeMedia, there still exists an ideal strategy when the government takes irrational and excessive penalties for the contractor’s nongreen construction behavior. Both players finally converge to choose strategy (supervise, green construction), through adjusting reasonably the negative exposure intensity from WeMedia.

Similarly, the influence of the willingness of WeMedia’s positive propaganda \((\alpha_1)\) on both player’s strategic choices is discussed as follows. When WeMedia positively propagandizes the contractor’s green construction behavior, it is
obvious that there is no WeMedia to deliberately discredit the green construction behavior of contractor, so $\alpha_2 = 0$ is obtained. Constructing the system phase diagram, the impact on the system can be found of $\alpha_1$ changes. When $\alpha_1 > (C + l/Q_5 - Q_3)$, there is no evolutionary stability strategy on both players. When $\alpha_1 \leq (C + l/Q_5 - Q_3)$, the system finally converges to points, $(0,0)$ and $(1,1)$. Since WeMedia has strong positive propaganda willingness to the contractor’s green construction behavior, the government can rely on the WeMedia’s influence to effectively regulate the contractor’s green construction behavior at this time. Due to the thought of “lazy work,” the government has the motivation to weaken the intensity of supervision. Once the contractor feels that the intensity of government supervision is decreasing, they may have a speculative mentality and adopt nongreen construction behavior. Over time, as the public interest inevitably be harmed, the government will be forced to strengthen supervision. This requires the contractor to adopt green construction behavior, so the system cannot be stable at this time.

Due to limited space, the detail will not be discussed in Figures 9 and 10. The simulation results of $\alpha_1$ are shown in Figure 11.

According to Figure 11, with the continuously increasing willingness of WeMedia’s positive propaganda, the government and the contractor finally converge to choose (supervise, green construction). It can be obtained from Figures 8 and 11. Compared with the positive propaganda capability of WeMedia, it is obvious that the negative exposure capability can accelerate effectively the evolution of both players in the game converge to choose (supervise, green construction).

According to the above analysis, the influence of WeMedia can effectively promote the government to strengthen supervision and reduce the contractor’s speculation in nongreen construction behavior. When the willingness to positively propagate the contractor’s green construction behavior in WeMedia strengthens, it can significantly promote both players converge to choose.
(supervision, green construction). While the capability to negatively expose the contractor’s nongreen construction behavior in WeMedia strengthens, it can also significantly promote both players converge to choose (supervision, green construction). However, the willingness of this propaganda and the capability of exposure cannot be exaggerated without limitation; otherwise, it may increase the contractor’s resistance, counterproductive. At the same time, due to the...
public’s preference for receiving information, negative exposure is more effective than positive propaganda.

4. Discussion
From the simulation results of $\alpha_2$ and $\alpha_3$, it can be found that the capability of exposure and the willingness of propaganda all have a driving effect on the green construction behavior. The current research only proves the direct impact of WeMedia on government supervision and contractor’s green construction behavior [34, 35]. However, the influence process and mechanism have not been analyzed. Therefore, this study supports the previous research and further discusses the influence mechanism of WeMedia propaganda and exposure.

With the capability to expose WeMedia ($\alpha_2$), the contractor’s nongreen construction behavior is exposed by WeMedia. WeMedia enhances its own influence by gaining public attention. WeMedia tends to expose negative phenomena rather than propagandizing positive behavior [36]. However, the capability of WeMedia to expose negative phenomena cannot be unconstrained. If WeMedia exposure capability is not restricted, the contractor will receive the dual pressure of image loss and government penalty due to nongreen construction behavior. Contractor’s resistance mentality to adopting green construction behavior will strengthen. At the same time, the capability to expose to the media is too strong, which may disrupt normal social order and cognition, resulting in collective misjudgment or superposition of negative energy [37]. For instance, due to the strong exposure of WeMedia to the contractor’s not serious nongreen construction behavior, the contractor may receive severe accusations from the public. However, the nongreen construction behavior of the contractor in the public opinion is far more serious than the actual behavior of the contractor. Thus, the government must restrict the capability of WeMedia exposure and give full play to the advantages of WeMedia.

With the willingness to propagandize WeMedia ($\alpha_1$), the contractor’s green construction behavior is propagandized by WeMedia. The contractor adopts that green construction behavior will gain much benefit under the situation of positive propaganda from WeMedia. Green construction behavior provides the contractor with advantages in contractor image and competitiveness [38], which makes up for the disadvantage of high cost in green construction. These benefits effectively prevent the speculative mentality of contractor to adopt nongreen construction behavior. However, for the purpose of getting the attention of netizens, WeMedia’s willingness to propagandize positively is not so strong as the WeMedia’s capability to expose negatively. Thus, the government needs to properly encourage the willingness of the WeMedia to propagandize such contractor’s positive behavior. As WeMedia’s propaganda will also exaggerate the performance of government supervision to a certain extent, meanwhile, the government cannot always rely too much on WeMedia’s propaganda to influence the contractor’s behavior, which may cause government’s “lazy work” in the process of construction supervision.

5. Conclusions
First, the evolutionary game model with the government and the contractor is constructed, using evolutionary game theory and system dynamic simulation methods. By solving the game equilibrium, the stable strategic choices of both players under different scenarios are obtained. Second, the effect on the stability of the system equilibrium point is analyzed with the influence of WeMedia. The WeMedia’s positive propaganda on green construction behavior and negative exposure of nongreen construction behavior influence on the strategic choices of both players are separately studied. The main conclusions were drawn based on the above analysis.

(1) Without the influence of public opinion, both players can significantly promote to choose (supervise, green construction), by increasing the intensity of penalty and reducing the value-added for contractor’s nongreen construction. The strategy (supervise, green construction) also can be promoted by reducing the cost of supervision and increasing the negative effect of nongreen construction on contractor. This method requires more effort or longer to manifest, and the effect is not significant.

(2) Without the influence of public opinion, only the penalty for nongreen construction is smaller than the value-added of the government’s supervision performance due to contractor’s green construction,
and the system exists evolutionary stable strategy. Therefore, it is necessary for the government to control the intensity of punishment and not blindly seek large intensity. Otherwise, this system will not be able to maintain long-term stability and is not conducive to promoting green construction.

(3) With the influence of WeMedia’s willingness to propagandize contractor’s green construction behavior, both players can significantly be promoted to choose (supervise, green construction), by increasing the WeMedia’s capability of exposure and willingness of propaganda. Moreover, the capability of exposure is more effective than the willingness of propaganda.

(4) With the influence of WeMedia’s capability to expose contractor’s nongreen construction behavior, there still exists an ideal strategy when the government takes excessive penalties for the contractor’s nongreen construction. Both players finally converge to choose strategy (supervise, green construction), through restricting reasonably the negative exposure capability from the WeMedia. WeMedia cannot exaggerate the capability of negative exposure, which must be controlled in a reasonable range. Otherwise, the system will not be able to maintain stability and is not conducive to promote green construction.

Data Availability

The data during this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflicts of interest.

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