GAME ANALYSIS OF INTEREST GROUPS IN POLICY-PROCESSING OF POWER GRID CONSTRUCTION AND RESEARCH ON COMPENSATION MECHANISMS

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ABSTRACT

This paper simulated the game in the policy-processing of grid construction based on the Rubinstein game ideology of bargaining, studied the interaction among main interest groups. The paper also introduced the stakeholder theory to the design of the compensation mechanism, and confirmed the compensation mechanism efficiency through the economic simulation method. This paper points out that in the compensation mechanism based on the stakeholder theory the grid company may use limited fund effectively, balance the profit among interest groups, expand the negotiating space, reach the agreement more quickly among different interest groups in policy-processing of grid construction, so as to reduce the contradictions and conflicts, and thus contribute to the smooth development of grid construction.

1 INTRODUCTION

The policy-processing of grid construction refers to the attainment of agreement between the planner of grid construction and interest groups of external environment. This agreement will guarantee the smooth progress of grid construction. These external environmental factors include: compensation for expropriating civil lands, house relocation and resettlement, compensation for removing attachment on the ground and possible hazard of unearthing underground tubes, compensation for both temporary and restrictive expropriation. The difficulties in policy-processing of grid construction lay in the interest balance among different groups in external environment of grid construction, especially among the grid company、local government and local residents [1].

Hua-jun SHI analyzed the relation among three main interest groups with the theory of three-round game given the incomplete information. He figured out that governments should guarantee the compensation to local residents no lower than legal limit and endow the residents with certain rights to bargain to reduce conflicts [2]. Paper [3]-[4] introduced the current conflict situation of external environment in grid construction and put forward corresponding suggestions from two aspects of working experience and the mechanism designing. However, due to the non-profit character of grid construction, the multiplicity of game among interest groups, the complexity of external environment, there exist too much difficulty in the research on the relation among different interest groups by using the method of positive analysis or traditional game analysis.

In recent years, more and more papers test and analyze the complex adaptation system by using the economic simulation analysis method. Considering that the overall modelling and simulation methods of Smart Unit set up the whole model of complex system by using Agent's part connection rules, functions and part detail models, we can test the effectiveness of the mechanism with the help of computer simulation tools [5]. Xiao-ping YE and Su WU analyzed and forecasted neutral Agent's trend under conflict environment with simulation methods [6]. Zheng LIU and Liang YAN carried on the simulation to electric pricing mechanism, proposed one kind of electric pricing mechanism, and tested the mechanism's effectiveness through simulation [7]. However, there exist not too many literatures which simulate and analyze the interest groups' game behaviours and compensation incentive mechanism in grid construction's external environment by using the method of simulation and setting up model of complex system.

2 ON THE DESCRIPTION OF PROBLEM

As a project of public interest and exhibition of land transfer and governmental imperative force, the policy-processing in grid construction is generally commissioned to local government to negotiate with local residents in terms of compensation for land use. It is the target of the grid company to fulfil its social responsibility and lower construction cost, on condition that the construction project is not affected. The local government aims to coordinate the economic development of the local life with its social equivalent, improve the related infrastructure and performance of government officials (including promotion, transfer, merit and award). Local residents call for a high standard of compensation for grid-construction land expropriation and environmental pursuit. Failure to strike a balance between any two of the three parties will lead to difference in behaviour.

The following is a common process for the grid company and the local government to bargain about the compensation standard for land expropriation: first, the grid project engineer will go to the targeted place to make a revenue-collection of the local product price, salary standard of general workers and related fee, and put forward a compensation standard and a scheme of allocating the compensation package. After accumulation, comparison and certain procedures, some resources will be included in the budget estimation of grid construction in the form of ration. After the proposing of grid company, local government will make a balance the price standard for road-management project and industrial park construction, and publish corresponding standards and methods in the unit of executive counties. Owing to the issue of time-efficiency, there is always some discrepancy between the budget estimation of infrastructure on the

part of the grid company and compensation standards on the part of the local government. These two parties will sign an agreement in cases of interest, or reject in cases of sacrificing interest, in the case of which one party will find it very difficult to agree with the project proposed by another party, and will thus propose its demands and feasible solutions, and the other party will decide to either accept or refuse according to the principle of profit maximization. This round won't end until the satisfaction of both parties. In the round above, the game will naturally come to an end upon the acceptance of project by any party [8]. If the two parties can't reach an agreement within the initial time, another round of negotiation will be necessary, so will the time and energy. Owing to the procrastination of negotiation and consumption of energy, interest of both parties will be consequently compromised.

Similarly, the negotiation of compensation for land expropriation between the local government and local residents are also a game of bargaining. For the part of the local government, each game means a reduction in the gross earnings by a certain proportion. The longer the time of negotiating about compensation for land expropriation, the less profit for the local government, in which case there may be a delay in the completion of related missions concerning land expropriation, failure to carry out the grid construction project, obstruction to the local economy owing to electrical shortage, the invalidation of the commission between grid company and local government, and escalation of conflict. To local residents, they worry about social security and employment besides economic compensation.

Above all, negotiation cost is a quiet important factor in reaching policy-processing agreement among the grid company, local government and local residents. If negotiation base lines appear negative overlapping, negotiation will refuse to compromise so as to seriously influence the construction schedule. With the force involvement of local government, the grid company will construct compulsively which will lead to the upgrade of conflict. Therefore there exists great need to design some effective compensation mechanism to expand negotiation space and psychological base line so as to guide main interest groups to reach agreement as soon as possible.

3 COMPENSATION MECHANISM BASED ON THE STAKEHOLDER THEORY

3.1 Summary of compensation mechanism

The core thought of compensation mechanism based on stakeholder theory is to reduce negotiation space of local government and local residents in power inputting areas and expand negotiation space of those in areas which transmission line passed through. There is one mechanism to adopt. The first step is to raise the electric power price of inputting areas to reduce negotiation space, and then use the gain income to reduce the price in areas which grid construction passed through or carry on crossing subsidy to expand negotiation space.

For ease of mathematics modelling and simulation analysis, we suppose that there was only one grid company existing, local governments divided into governments of inputting area and passing-through area, local residents divided into residents of inputting area and passing-through area. We assume that the grid company could get a certain proportion of compensation fee to use as balancing funds of negotiation space. Compensations in the policy-processing of grid construction are determined by the negotiation among grid companies, local government and local residents. Compensation cost for the electric power inputting areas is negotiated according to basic compensation standards, while compensation cost for passing-through areas is negotiated according to the upper limit, and the compensation space of electric power inputting areas is transmitted to passing-through areas.

Restricted by the length of paper, this paper constructs its decision model by taking local residents as the example and elaborates the validity of compensation mechanism.

3.2 The decision-making model of local residents

Without considering stakeholders, local residents' decision-making model may use the equation below to indicate.

$$\max \quad \pi_{p,i,j} = \mathrm{R}_{p,i,j}(v_{p,i,j}, v_{g,i}) - C_{p,i,j}(v_{p,i,j}) - C'_{p,i,j}(t)$$

$$\begin{cases} \mathrm{R}_{p,i,j}(v_{p,i,j}, v_{p,i,j}) = k_{p,i,j} + \dfrac{v_{p,i,j}}{(v_{p,i,1} + v_{p,i,2} + \cdots + v_{p,i,n})} \\ \qquad \left(1 - \dfrac{v_{g,i}}{v_{g,i} + (v_{g,i,1} + v_{g,i,2} + \cdots + v_{g,i,n})/n}\right) I' \\ C_{p,i,j}(v_{p,i,j}) = a_{p,i,j} + b_{p,i,j} v_{p,i,j}^2 \\ C'_{p,i,j}(t) = c_{p,i,j} + \mathrm{d}_{p,i,j} \mathrm{t}^2 \end{cases} \quad (1)$$

Note that $\pi_{p,i,j}$ indicates the pure profit of local resident j of government i in policy-processing of grid construction. $R_{p,i,j}(v_{p,i,j}, v_{g,i})$ indicates the profit of local resident j of government i in grid construction, $C_{p,i,j}(v_{p,i,j})$ indicates the effort cost which local resident j of government i made in grid construction. $C'_{p,i,j}(t)$ indicates the negotiation cost which local resident j of government i made in grid construction. $k_{p,i,j}$ indicates the initial income local resident j of government i got in grid construction. $v_{p,i,j}$ indicates the effort degree of local resident j of government i in grid construction. I' indicates the bottom line which local government i made in grid construction. n indicates the number of local governments.

Taking stakeholders into consideration, local residents could be classified into two kinds. One group is the local residents of areas where transmission line passed through. The other group is local residents in inputting areas. Local residents of passing-through areas are passive interest counterparts in grid construction. To make sure their negotiation space the same with local residents in inputting areas, grid company usually commissions local government to give bigger negotiation space to them in

policy-processing.

3.2.1 The decision-making model of local residents in passing-through areas

$$\max \quad \pi_{p,i,j} = \mathrm{R}_{p,i,j}(v_{p,i,j}, v_{g,i}) - C_{p,i,j}(v_{p,i,j}) - C'_{p,i,j}(t)$$

$$\begin{cases} \mathrm{R}_{p,i,j}(v_{p,i,j}, v_{p,i,j}) = k_{p,i,j} + \dfrac{v_{p,i,j}}{(v_{p,i,1} + v_{p,i,2} + \cdots + v_{p,i,m})} \\ \qquad \left(1 - \dfrac{v_{g,i}}{v_{g,i} + (v_{g,i,1} + v_{g,i,2} + \cdots + v_{g,i,m})/m}\right) I' \\ C_{p,i,j}(v_{p,i,j}) = a_{p,i,j} + b_{p,i,j} v_{p,i,j}^2 \\ C'_{p,i,j}(t) = c_{p,i,j} + \mathrm{d}_{p,i,j} \mathrm{t}^2 \end{cases} \tag{2}$$

Local residents in passing-through areas only negotiate with local government while grid company's negotiation strategy only aims at local government. In this way, the grid company needs to expand the negotiation space with local government to influence the negotiation between local residents and the local government. As a result, the function is similar to the decision-making model without considering stakeholder. The only difference is the value of negotiation space.

3.2.2 The decision-making model of local residents in inputting areas

$$\max \quad \pi_{p,i,j} = \mathrm{R}_{p,i,j}(v_{p,i,j}, v_{g,i}) - C_{p,i,j}(v_{p,i,j}) - C'_{p,i,j}(t)$$

$$\begin{cases} \mathrm{R}_{p,i,j}(v_{p,i,j}, v_{p,i,j}) = k_{p,i,j} + k^t_{p,i,j}(t) + \\ \qquad \dfrac{v_{p,i,j}}{(v_{p,i,1} + v_{p,i,2} + \cdots + v_{p,i,n})} \\ \qquad \left(1 - \dfrac{v_{g,i}}{v_{g,i} + (v_{p,i,1} + v_{p,i,2} + \cdots + v_{p,i,n})/n}\right) I'' \\ C_{p,i,j}(v_{p,i,j}) = a_{p,i,j} + b_{p,i,j} v_{p,i,j}^2 \\ C'_{p,i,j}(t) = c_{p,i,j} + \mathrm{d}_{p,i,j} \mathrm{t}^2 \\ k^t_{p,i,j}(t) = \alpha_{p,i,j} + \beta_{p,i,j} t \end{cases} \tag{3}$$

Residents in passing-through areas and inputting areas both negotiate with local government, so local residents in different areas exert the same negotiation function. The only difference is that there exists a profit function $k^t_{p,i,j}(t)$ in the function of inputting areas' local residents which is related with the agreement time.

4 SIMULATION ANALYSIS OF THE COMPENSATION MECHANISM

4.1 Initial conditions and related data of simulation

We assume that in policy-processing there are four interest groups involved: one grid company, two local governments which grid construction passed through and one local government which electric power is input into. Suppose each local government of the passing-through area has jurisdiction over 100 local residents who are all beneficiaries of grid construction. We assume that there exists Principal-agent relation between the grid company and the local government. They distribute the policy-processing cost by the way of bargaining. The grid company balances the interest of local government based on the stakeholder theory.

We assume the effort cost function and negotiation cost function of every resident under the jurisdiction of local government to be the same. However, taking the type of local residents of inputting areas into consideration, we add a profit function in its profit model which is inversely related with the negotiation times. We took it as $k_v(1-\arctan(t))$. In the same way, we add a profit function in the local government's function which is $k_g(1-\arctan(t))$. In this equation, t indicates the negotiation times.

We assume the initial value of effort degree of grid company and local government to be 10, that of local residents to be 0.11 and adjusting range to be 0.1. Negotiation space between the grid company and local government is considered to be 100, while that between the local government and local residents is considered to be 900. We distribute 50% of the profit which should be acquired by inputting areas to passing-through areas, i.e. the grid company transfers the profit which should be acquired by local government according to its effort degree to negotiation space of passing-through areas. To each local government, the grid company distributes according to the proportion of effort degree.

4.2 Local residents' profit and cost simulation analysis

The following figures show the changing situation of local residents' profit in the process of game. After considering stakeholders and interest-balancing mechanism, we summarize the following points. First, taking profit which may be brought about by grid construction into consideration, local residents' profit degree increases obviously compared with that without considering stakeholders. Second, because we transfer the negotiation space from inputting areas to passing-through areas, the profit of different groups is balanced and that of passing-through areas increases obviously. Third, to local governments of passing-through areas with strong negotiation ability, their profits would little change. Accordingly, this compensation mechanism reaches the aim of balancing interest of different groups.

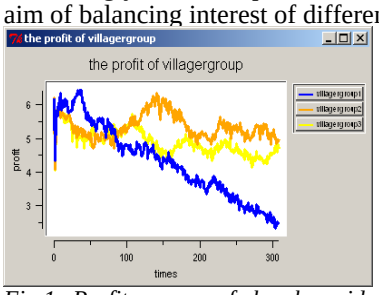

Fig.1 Profit curve of local residents without considering stakeholders

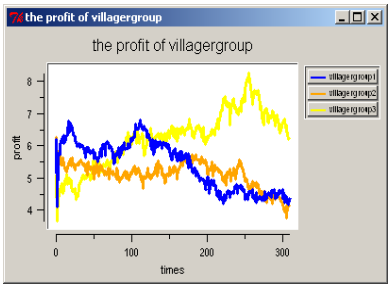

Fig.2 Profit curve of local residents considering stakeholders

Fig.3 and Fig.4 show the changing situation of local residents' effort cost in the process of game. From the two figures we also discover three points. First, the effort cost of inputting areas of grid construction increases because negotiation space decreases after considering stakeholder. Second, local residents' effort degree changes little in passing-through areas. To local residents with strong negotiation ability, their effort cost almost stays the same. Third, local residents with weak negotiation ability in passing-through areas get more marginal gains for expanded negotiation space if they pay more effort.

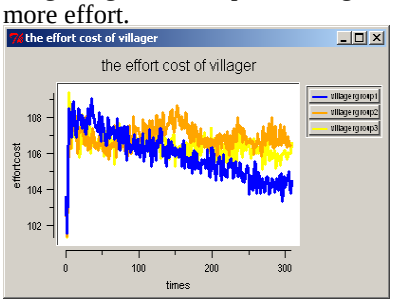

Fig.3 Effort cost curve of local residents without considering stakeholders

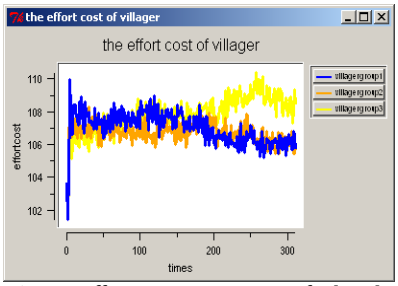

Fig.4 Effort cost curve of local residents considering stakeholders

5 RESEARCH CONCLUSIONS

After the study on game process among main interest groups in the process of grid construction, this paper constructs the compensation mechanism based on stakeholder theory and confirms its efficiency through the economic simulation method. Hereby, this paper get the following conclusions.

Firstly, each interest group would like to make an agreement as soon as possible in the process of negotiation. As regards local residents, because their negotiation cost is lowest, their wish to reach an agreement is relatively weak. Speaking of the grid company, the longer time to negotiate, the more social cost and construction cost are created. Therefore, grid companies would like to reach an agreement quickly. To local governments, because of the particularity of their position they would like to socialize between grid company and local residents and change the status constantly to gain more policy-processing coordination funds and the carrying fund.

Secondly, the compensation mechanism based on the stakeholder theory would be likely to reduce the compensation degree of inputting areas and increase that of passing-through areas to balance their profit. The local government and local residents in inputting areas are the direct beneficiaries of grid construction. Although compensation fees of policy-processing would decrease, their profits would increase indirectly. Therefore, they want to reach the consensus of opinion quickly. The policy-processing funds are transferred from inputting areas to passing-through areas. Increase of their compensation funds would meet their psychological needs to a certain extent. In fact, the grid company's cost doesn't change in this mechanism, but on the other around, this mechanism could make each group reach agreement quickly. Less social cost is consumed and more social profit is gained.

Thirdly, compensation mechanism based on the stakeholder theory can effectively reduce the appearance of deadlock during negotiation. From simulation results, we discover that in the process of negotiation the appearance of minus profit among grid company, local government and local residents would win enough time to reach an agreement. As a result, compensation mechanism based on the stakeholder theory could be an effective way to maintain three groups' interests, hasten the negotiation to reach an agreement, and reduce contradictions and conflicts.

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