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A responsibility assigning method based on social network analysis model for non-profit government investment projects

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ABSTRACT

As non-profit government investment projects(NGIP) develops in china, responsibility problems become more and more serious. NGIP always involving millions of dollars of the taxpayers, so it is significantly important to find out who is to blame when losses happen. To solve the problem, we establish the framework of NGIP responsibility assignment. Previous literatures put emphasis on responsibility mechanism, and little quantitative research concerning this area. To our best knowledge, research on responsibility distribution framework of NGIP has not yet to be found. In the framework, the social network analysis model is built to determine the responsible party through the network diagram and the relationship between matrix. Following this, a case of China is studied, proved the validation and effectiveness of the proposed method. This study provides a new way for NGIP responsibility assignment and a theoretical and methodological reference for the government.

KEYWORDS

Non-profit government investment project; Responsibility investigation; Social network analysis; Responsibility assignment; Chinese case.

INTRODUCTION

Non-profit Government Investment Project(NGIP)is the public project based on social functions, public needs and people's welfare. The agent construction system in NGIP can effectively improve the management level and investment benefits of government investment project, which also has important economic and social significance in function transition of the government. Due to the development of the agent construction system has not yet mature, the position and function of the construction agent in NGIP is not quite clear. When facing problems, the involved parties' responsibility is not easy to distinguish. So under the background of NGIP, this paper discusses the methods to solve the responsibility investigation problem.

From the analysis above, it is vitally important to study on NGIP responsibility. Guo-dong zhou [1]emphasizes on the necessity of responsibility and accountability of NGIP, and discusses on the subject, object and the way of responsibility. Jiaqi[2] studies on the responsibility system under government environmental, mainly analyzing the reposition problem of power and responsibility to and lawsuit system recommended. However, these researches only analyze on institutional aspect, and have not illustrate how to determine those responsibility quantitatively and held accountable. Hence, this article establishes a framework of NGIP responsibility and builds the network analysis model to discuss the responsibility distribution of NGIP; then, a Chinese case is analyzed by the framework; at last, through simulation experiment, the validity of the model is proved.

LITERATURE REVIEW

Bonilla-Priego, Font[3] studies on the establishment of organization form for accountability on related departments and personal. Hersh[4] establishes exposing model to control personal responsibility, and determines responsibility attribution through the corresponding system. Koskela[5] through the case study in Norway, takes project implementation as an important factor in the responsibility mechanism, and obtains concrete conclusion by specific examples in Norway. Corvellec and Macheridis[6] divides the moral responsibility of projects into three aspects: the initial stage, evaluation stage and decision stage; through the three stages, various project responsibility shall be investigated for implemented easy. Ripstein[7] analyzes the role of the project supply chain and the responsibility allocation. Yang and Chen[8] set up incentive pay system. Through the responsibility assignment matrix and fuzzy variables, each person's behavior and the corresponding responsibility is record to quantify everybody's job in the form of remuneration. Hu and Su[9] use the SCP model to study the responsibility of the government investment projects in the form of operating mechanism. Although research on responsibility distribution model of NGIP has not yet to be found, study on these references still lays a good foundation on this research.

FRAMEWORK OF NGIP RESPONSIBILITY DISTRIBUTION

Step 1. Study on the basis of theoretical research, divide NGIP mode. In order to guarantee timing responsibility, this article classifies NGIP projects into three modes according to the scope of responsibility, respectively, project milestones, construction phase and general objective mode. Choose the

Research method according to the characteristics of the three models.

Step 2. Choose the appropriate research methods. This research choose the research method of social network analysis according to the characteristics of construction phase mode. Social network analysis method belongs to the research methods of sociology. This article mainly uses the method to analyze the network of participants.

Step 3. Find out the participants involving in responsibility problems. The article mainly analyzes five participants in NGIP (the government, construction agent, constructor, designer, and the overseer).

Step 4. Find out the construction phase emerging problems, and make five participants mark on the responsibility of the other parties respectively.

Step 5. Construct social network diagram according to the results of the grades by five participants, and use the UCINET software to calculate the indicators of the network diagram such as spot center degrees to find the responsible party. The logical route and the overall framework of this study is shown in Figure 1.
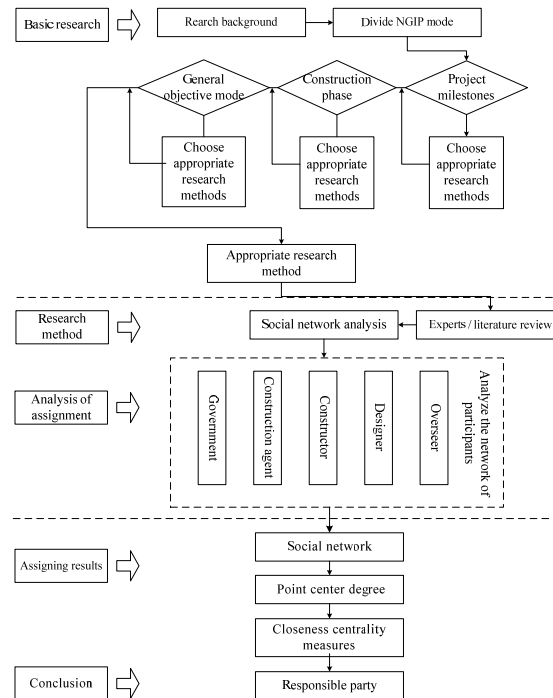

Figure 1 : Logical route and the overall framework of this study

METHODOLOGY

Social network analysis uses charts and means of the matrix calculation to analyze social networks. The method is used to determine the largest factor that influences on the society through studying the relation in society, including the network structure and properties, and so on. Although it has not been used on responsibility roles, it has already been used to determine the social roles, which has much in common[10-12].

(1) Point center index. It is a measurement of the degree of a node linked to another. For a network with g persons, the point center degree of actor i is the total number of the direct contact with other actors, formulized as follows in Eqs.(1),

$$C_D(N_i) = \sum_{J=1}^{g} x_{ij} \ (i \neq j)$$

(1)

$C_D(N_i)$ stands for center degrees of node point i, $\sum_{j=1}^{g} x_{ij} (i \neq j)$ used to compute the direct link between node i and the other nodes.

(2) Closeness centrality index. It is mainly used to reflect a certain proximity degree between one node and another. The closeness centrality degree refers to the reciprocal of the sum of the geodesic distance between actor i and $g-1$ persons, formulized as follows in Eqs.(2),

$$C_C(N_i) = \frac{1}{\left[\sum_{j=1}^{g} d(N_i, N_j) \right]} (i \neq j)$$

(2)

Closeness centrality degrees of isolated points are unable to measure, because the measured value cannot be 0; so when a solitary point emerges, special consideration should be taken according to special circumstances. According to the formula, the numerical value is between 0 ~ 1; the nearer the degree to zero, the more closely the connection is between the actor and the others. On the contrary, when the degree is close to 1,it means the connection is less tight.
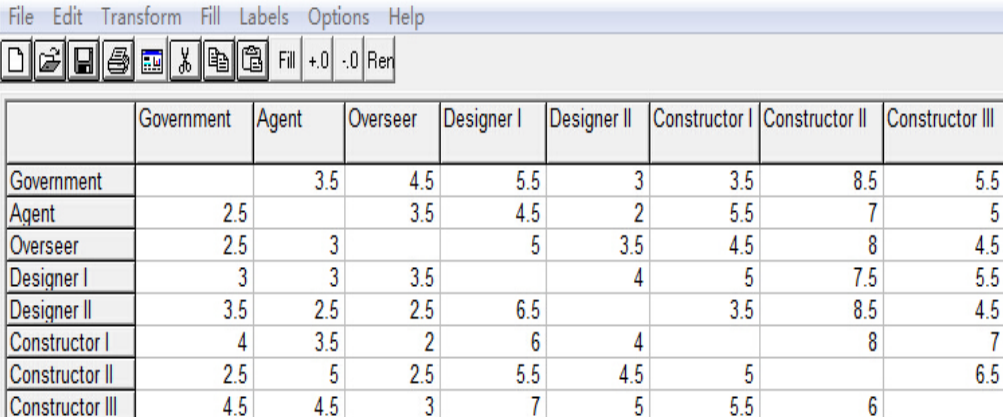
A CASE STUDY OF CHINA

An NGIP emerges some problems on responsibility in the implementation stage. Through analysis, the responsibility participants mainly include: the government, constructor, designer, and the overseer; the regulators decided to investigate responsibility of the parties; as there is no specific provision in the contract to decide responsibility, regulators need to identify the responsible persons and assign responsibility.

First of all, determine the network graph nodes. Social network diagram is2d Figure composed of node and line. In NGIP, five major participants involved in the project can be taken as the nodes of social network graph. The social network diagram is build based on it.

Then determine the relationship in the network diagram. When deciding NGIP responsibility, that is, the unclear responsibility division part in the contract, each participant need to mark on the responsibility of others objectively, namely a participant scores on other participants. In this study, the 10-full-mark method is used. The score data is shown in TABLE 1. Using the data in TABLE 1, the social network diagram can be drawn by UNINET software.

TABLE 1 : Ratings matrix of the participants

File   Edit   Transform   Fill   Labels   Options   Help

	Government	Agent	Overseer	Designer I	Designer II	Constructor I	Constructor II	Constructor III
Government		3.5	4.5	5.5	3	3.5	8.5	5.5
Agent	2.5		3.5	4.5	2	5.5	7	5
Overseer	2.5	3		5	3.5	4.5	8	4.5
Designer I	3	3	3.5		4	5	7.5	5.5
Designer II	3.5	2.5	2.5	6.5		3.5	8.5	4.5
Constructor I	4	3.5	2	6	4		8	7
Constructor II	2.5	5	2.5	5.5	4.5	5		6.5
Constructor III	4.5	4.5	3	7	5	5.5	6	

Build NGIP social network diagram. Through the above data we can map the following network diagram. As shown in Figure 2, the network diagram contains two-way arrows, this is because, for example, the score on the constructor marked by the government is not necessarily the same with the score on the government marked by the constructor, so the arrows are two-way street.
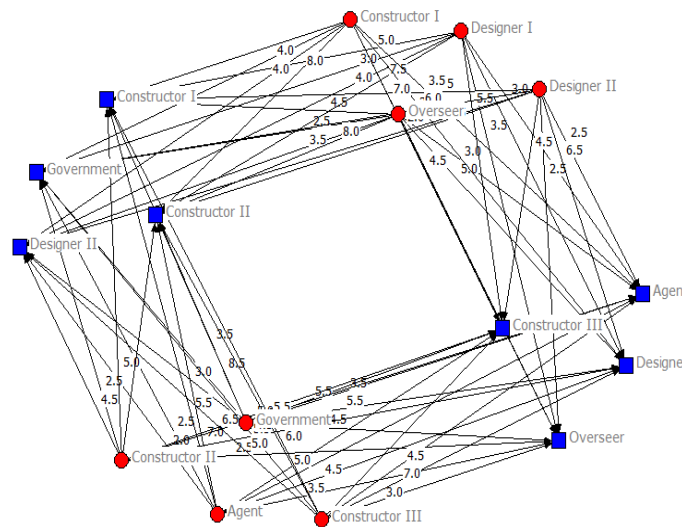
Figure 2 : The social network diagram of NGIP responsibility

At last, the responsibility indexes are analyzed. Based on the network diagram, we calculate point center degrees and closeness centrality degrees by the UCINET software. Calculation results are as follows. Figure 3 shows that the point center degree of the contractor I is 54; the centralization of the entire network is 34.450 %, the heterogeneity of the whole network is 12.89 %, on behalf connection degree of the whole network. Through Figure 4, the closeness centrality degree of responsibility are the same, proved the validity of scoring. Based on the data in the two figures, we can conclude the first responsible person to be the contractor I. The specific responsibility need to determine according to the project contract and the corresponding law.

```
                                    1            2            3
                                 Degree    NrmDegree        Share
                             ------------ ------------ ------------
     7  Constructor II        54.000       90.756        0.175
     4       Designer I       42.000       70.588        0.136
     8 Constructor III        40.500       68.067        0.131
     6    Constructor I       39.000       65.546        0.126
     1      Government        35.000       58.824        0.113
     5      Designer II       33.500       56.303        0.108
     3         Overseer       33.500       56.303        0.108
     2            Agent       31.500       52.941        0.102


DESCRIPTIVE STATISTICS

                                    1            2            3
                                 Degree    NrmDegree        Share
                             ------------ ------------ ------------
     1      Mean             38.625       64.916        0.125
     2   Std Dev             6.781        11.397        0.022
     3       Sum           309.000       519.328        1.000
     4 Variance             45.984       129.890        0.000
     5       SSQ         12303.000     34751.781        0.129
     6     MCSSQ           367.875      1039.121        0.004
     7  Euc Norm           110.919       186.418        0.359
     8   Minimum            31.500        52.941        0.102
     9   Maximum            54.000        90.756        0.175


Network Centralization = 34.45%
Heterogeneity = 12.89%.   Normalized = 0.44%
```

Figure 3 : Point center degrees of NGIP responsibility

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Closeness Centrality Measures

                              1           2           3           4
                          inFarness   outFarness inCloseness outCloseness
                         ----------- ----------- ----------- -----------
     1     Government         7           7          100         100
     2          Agent         7           7          100         100
     3        Overseer        7           7          100         100
     4       Designer I       7           7          100         100
     5      Designer II       7           7          100         100
     6    Constructor I       7           7          100         100
     7   Constructor II       7           7          100         100
     8 Constructor III        7           7          100         100


Statistics

                              1           2           3           4
                          inFarness   outFarness inCloseness outCloseness
                         ----------- ----------- ----------- -----------
     1      Mean           7.000       7.000      100.000     100.000
     2   Std Dev           0.000       0.000        0.000       0.000
     3       Sum          56.000      56.000      800.000     800.000
     4 Variance            0.000       0.000        0.000       0.000
     5       SSQ         392.000     392.000    80000.000   80000.000
     6     MCSSQ           0.000       0.000        0.000       0.000
     7  Euc Norm          19.799      19.799      282.843     282.843
     8   Minimum           7.000       7.000      100.000     100.000
     9   Maximum           7.000       7.000      100.000     100.000


Network in-Centralization = 0.00%
Network out-Centralization = 0.00%
```

Figure 4 : Closeness centrality measures of NGIP responsibility

CONCLUSIONS

This study uses social network analysis method to solve the problem of the responsibility for NGIP in construction phase mode. First, start with the social network data collection and basic methods, and then build social network diagram in accordance with the specific project situation, and calculate data in social network diagram by UCINET. At last, determine the responsible person of the project through the analysis of the relevant indicators, proved the effectiveness of the proposed method.

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