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Study on MSIR Motivation Based on SNA

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Abstract: The lack of social responsibility in megaproject has been frequent in recent years, causing serious waste of resources and posing a huge governance problem for the sustainable development of such projects. In order to solve this governance challenge, an in-depth study of the reasons for the lack of social responsibility is needed. This paper constructs a social responsibility stakeholder network model with "positive" (better fulfillment of social responsibility) and "negative" (lack of social responsibility) dimensions based on five major infrastructure projects, such as the Hong Kong-Zhuhai-Macao Bridge, and analyzes the relationship between stakeholders and accident victims based on the comparison of the two network models. The impact of the stakeholder connection on the accident is examined via a comparison of the two network models. Finally, this study attributes the causes of the lack of social responsibility in large infrastructures to insufficient stakeholder connection, low participation, over-reliance on third parties for information transfer, and being in an information isolation. This study improves the social responsibility governance system for Megaproject.

Keywords: MSIR, Stakeholders, SNA.

1. Introduction

Megaproject social irresponsibility (MSIR) refers to the unfulfilled social responsibilities of megaproject stakeholders, which are primarily related to economic, legal, environmental, political, and ethical responsibilities. Each stakeholder is a link in the chain of accountability. Because most large projects are one-off, unique, and involve huge investments, the impact of an MSIR is far-reaching and irreversible.

In reality, some project stakeholders neglect their social responsibility due to over pursuit of economic benefits, resulting in frequent accidents. Therefore, it has attracted great attention from academia. Based on these features, Lin and zhou et al. constructed an indicator evaluation system for mega-project social responsibility (Lin et al. 2017; Zhou and Mi 2017). Ma's study was centered on the effect of mega-project social responsibility on the performance of participating organizations (Ma et al. 2021). Xie explores how institutional pressures influence socially responsible behavior on large projects (Xie et al. 2022). Xue's analysis from the perspective of incentive contract design provides a theoretical approach and decision basis for mega-project general contractors to encourage subcontractors to be more socially responsible (Xue et al. 2022). Li developed a governance model for large projects to quantify governance during the development and delivery of large projects (Li et al. 2019).

In summary, existing research on social responsibility in large-scale engineering has mainly focused on the construction of indicator evaluation systems, the role on organizational performance, what factors influence it, incentive strategies for stakeholders, and how to quantify the governance status (He et al. 2019; Osei-Kyei et al. 2022), and few studies have focused on the social responsibility deficit motives. This paper provides an in-depth analysis of MSIR motivations and targeted governance of the problems that exist.

SNA is a method used by sociologists to analyze the structural features of relationships between social actors. Social networks of large-scale projects are highly complex, with a large number of participants and a huge impact on society. Therefore, SNA is suitable for assessing the relationships among the stakeholders of them(Ding et al. 2017) .

In this study, we choose positive cases—that is, projects that reasonably uphold social responsibility—and negative cases—that is, projects with MSIR—for analysis, build SNA models of project stakeholders separately, compare various indicators in the two models, and ultimately summarize the driving force behind MSIR. Based on the SNA model, a viral simulation is conducted, and then the corresponding governance measures are explored. The results of the study have important implications for achieving socially responsible behavior management in massive infrastructure projects.

2. Case study and Construction of SNA Model

2.1. Case Sources and Data Gathering

2.1.1. Social Responsibility for Safety in the Hong Kong-Zhuhai-Macao Bridge

The Hong Kong-Zhuhai-Macao Bridge (HZMB) project has been a benchmark in the construction industry for its clear division of labor, mutual assistance and information sharing among stakeholders during the construction period. Therefore, this paper selects the Hong Kong-Zhuhai-Macao Bridge project as a "positive" case (reasonable fulfillment of social responsibility) to research. Since the beginning of the construction of the HZMB, all departments have been highly concerned about safety and environmental protection issues in the construction, and have built a comprehensive HSE management system and regularly reviewed the problems in daily management. The important safeguard measure has laid a solid foundation for the effective implementation of health, safety and environmental protection in the construction of the bridge. This study has compiled 21 phases of the HSE Quarterly Briefing for the HZMB Main Project that have been published on the official website of the HZMB construction period so far. Each issue of the newsletter is divided into 10 tasks, in which the fulfillment of social responsibility by stakeholders in each task is recorded in detail. The 10 stakeholders distilled are HZMB Authority, Technical Expert Group, Construction Unit, Design and Construction General Contractor, Supervision Unit, Investigation Unit, Research Unit, Maritime Bureau, Oceanic Bureau and Security Bureau. Statistically, the number of participation of each stakeholder in the HSE work of 21 phases is shown in Table 1 below.

Table 1. Number of Stakeholder Engagement in HZMB HSE Briefing

Stakeholders	Work deployment	Management System Development	Emergency Management	Pre-control and prevention	Research Promotion	HSE Conference	Supervision Inspection	Training & Education	Specialized work	Cross-border communication
HZMB Authority	4	19	21	11	9	21	19	17	21	15
Technical Expert Group	3	4	2	3	2	2	2	0	1	1
Construction unit	3	4	18	1	6	20	10	17	12	3
Design and construction general contracting units	3	1	18	9	7	20	18	18	19	7
Supervisory unit	2	1	16	11	7	21	19	18	17	6
Investigation Unit	2	1	16	1	6	17	0	15	9	2
Research Units	0	3	16	0	7	17	0	15	9	4
Marine Bureau	0	2	5	8	4	8	3	2	15	0
Oceanic Bureau	1	0	2	0	3	7	6	0	17	9
Security Bureau	0	1	6	0	0	0	13	4	3	2

Source: Summary of 21 HSE quarterly reports on the HZMB website

2.1.2. The Lack of Social Responsibility in Four Typical Production Safety Accidents

Some scholars believe that the lack of social responsibility of stakeholders is one of the important causes of safety accidents in large-scale projects (Wang et al. 2021). Because of the large number of stakeholders involved in large-scale projects, a slight negligence in the decision-making and implementation process may lead to consequences beyond the project itself, which may evolve into a series of serious social problems and induce engineering accidents. In this paper, we extracted the information of the typical production safety accidents in the past five years from the official website of the Ministry of Emergency Management of the People's Republic of China, and studied them as the "opposite" case of social responsibility deficiency. The typical accidents selected in this paper are: 11.24" cooling tower construction platform collapse of Jiangxi Fengcheng power plant a particularly serious accident, "3. 21" Jiangsu Ringshui Tianjiayi Chemical Co.,

3.7" collapse of Xinjia Hotel in Quanzhou City, Fujian Province, 12.20" landslide accident in Guangming New Area, Shenzhen, Guangdong. Stakeholders involved in the accident reports and their social responsibility deficiency behaviors were extracted. A total of 8 stakeholders with social responsibility deficiencies and 15 social responsibility deficiencies are (1) Owners: 1. Confusion in project management, 2. Illegal unapproved construction; (2) Design units: 1. No design qualification but involved in the design of drawings, 2. Drawings do not match the actual; (3) Construction units: 1. Illegal subcontracting, 2. Unqualified reliance, 3. Incomplete safety measures, 4. Rush; (4) Supervision unit: Failure to implement the production safety assessment system; (5) Suppliers: Unqualified material quality; (6) Project management consulting company: 1. Issuing false documents; (7) Government departments: Illegal approval and ineffective supervision and inspection; (8) Media: 1. Inadequate popularization of safety education, 2. Avoiding the exposure of quality and safety issues. The extent of stakeholders' influence on others' MSIR behavior is shown in Table 2 below.

In this study, a questionnaire survey was used to assess the degree of influence of each stakeholder in a typical accident on the MSIR behavior of other stakeholders. A total of 58 experts with engineering and construction experience were invited to participate in this questionnaire survey, and the experts were asked to score the degree of influence on a Likert scale separately, and the average of the scores was taken as shown in Table 2 below. The information of the survey respondents is shown in Table 3 below. 58 experts come from different industries and have experience in the construction industry, which ensures the impartiality and objectivity of the data of this survey to a certain extent.

Table 2. Degree of influence of each stakeholder on the behavior of other stakeholders in MSIR

STKH	(1)1	(1)2	(2)1	(2)2	(3)1	(3)2	(3)3	(3)4	(4)1	(5)1	(6)1	(7)1	(7)2	(8)1	(8)2
(1)	0.00	0.00	2.84	2.71	2.75	2.66	2.86	2.93	2.79	2.55	3.14	2.84	2.64	2.52	2.73
(2)	2.93	2.38	0.00	0.00	1.98	2.22	2.14	2.20	2.14	2.28	1.71	2.11	1.98	2.05	2.09
(3)	2.90	2.64	2.36	2.88	0.00	0.00	0.00	0.00	2.61	2.78	2.71	2.36	2.43	2.59	2.54
(4)	2.57	2.60	2.34	2.89	2.57	2.55	2.88	2.57	0.00	2.73	2.71	2.40	2.45	2.52	2.61
(5)	2.64	1.97	2.00	2.14	2.02	1.97	1.97	2.29	2.04	0.00	2.14	1.97	1.98	2.02	2.18
(6)	2.50	2.38	2.45	2.70	2.34	2.48	2.33	2.41	2.47	2.50	0.00	2.14	2.28	2.29	2.19
(7)	2.64	2.73	2.47	2.50	2.62	2.48	2.50	2.54	2.61	2.43	3.29	0.00	0.00	2.52	2.62
(8)	2.05	1.97	2.02	1.95	1.91	2.02	2.25	2.21	2.19	2.11	2.14	2.14	2.27	0.00	0.00

Source: Questionnaire survey

2.2. Construction of SNA Network Model

This study investigates the stakeholders in the HSE management system during the construction period of HZMB, and constructs a "positive" network model for the reasonable fulfillment of social responsibility. At the same time, a "negative" MSIR network model was constructed to address the problems of stakeholders in typical accidents. The data analysis and relationship network model construction uses social network analysis software Ucinet to analyze network density, centrality and clustering of the relationship matrix of the surveyed relationship data, and Netdraw is used to build and present the analysis results. The nodes in the network model represent stakeholders. The HZMB network model contains 10 nodes and the typical accident network model contains 8 nodes, which are distributed from inside to outside according to their closeness. As shown in (1)(2) in Figure 1 below.

3. MSIR Motivation Study Results

The various indicators of the two SNA models were compared, so as to analyze the impact of different network structures on the phenomenon of social responsibility fulfillment and deficiency.

3.1. Network Density

The results of UCINET software show that the network density of the HZMB safety work stakeholder network model is 0.9778, which is a large density value. The network density of typical accident stakeholders is calculated to be 0.7857, which is lower than the network density of HZMB stakeholders. The data comparison illustrates that the typical accident stakeholders are not closely connected and do not exchange information frequently enough, which may, to some extent, lead to an increase in the probability of MSIR behavior among stakeholders due to information occlusion.

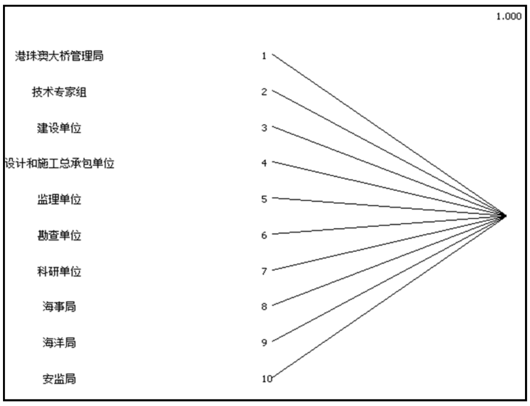
3.2. Centrality Analysis

The specific values of point degree centrality and intermediary centrality of the HZMB and typical accident stakeholder network models can be obtained in UCINET software. For the point centrality, the values of the SNA model for the HZMB range from 31 to 72, and the values of the SNA model for a typical accident range from 16.73 to 19.42. The former values are high, indicating a high degree of involvement of stakeholders in the process of social responsibility. The latter has a low point degree centrality, which implies a low level of stakeholder involvement.

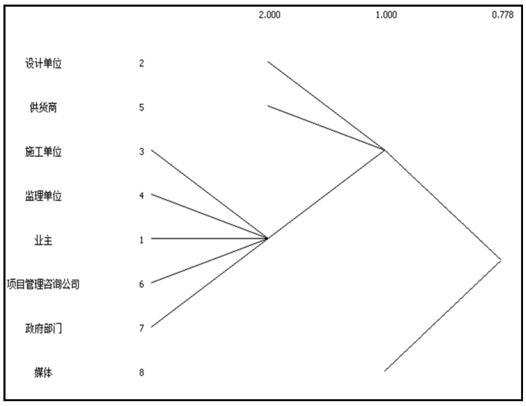
For the intermediary centrality, the maximum value of the SNA model of HZMB is 0.125, and the maximum value of the intermediary centrality of the SNA model of typical accidents is 0.4. The latter is lower, which indicates that the information transfer among the stakeholders in typical accidents is more dependent on the third party. In the typical accident SNA model, once the dereliction of duty occurs in one of the stakeholders, the failure of the remaining stakeholders to detect and stop it in time will lead to further expansion of the error, which in turn will trigger the emergence of MSIR behavior and increase the probability of quality and safety accidents.

3.3. Clustering Analysis

The N-clique in Ucinet is used to cluster analysis of the two network models, and the smallest subgroup value of 3 is selected through multiple validations, and the preset distance n is 1. The cohesive subgroups of the two are obtained as shown in (1)(2) in Figure 1 below.



(1) Hong Kong-Zhuhai-Macao Bridge



(2) Typical accidents

Figure 1. Network cohesion subgroup

From the comparison, it can be seen that there is only one faction in the HZMB network model, there is no information silo, and there is close cooperation and information sharing among the stakeholders, which is a better fulfillment of social responsibility.

There are two cliques in the typical accident network model. The media is isolated by the first clique and is in the position of information silo; the design unit and suppliers are isolated by the second clique. The isolated stakeholders are not involved in the whole project safety management for various reasons, so MSIR behavior occurs. In the first subgroup, the media is isolated from the network of typical accidents, probably because it is not a major participant and does not have reasonable access to public opinion monitoring, so it does not fulfill its social responsibility in its entirety and is isolated from the network. In the second small group, design units and suppliers are isolated outside the typical accident network.

3.4. Summary

In this section, based on the previously constructed SNA models of HZMB and typical accidents, the three indicators of network density, centrality and clustering situation of the two types of SNA models are compared and analyzed, so as to derive the impact of different network structures on the fulfillment and absence of social responsibility, and to summarize the motives of MISR. Based on the above analysis, it can be seen that compared to the indicators in the typical accident SNA model, the network density of the HZMB is greater, the point degree centrality is higher, the intermediary centrality is lower, and there are fewer factions in the clustering analysis. This indicates that the stakeholders in the HZMB project are closely connected and can play their respective roles more effectively, with faster information transfer and more communication. Therefore, they can monitor and motivate each other, and thus better fulfill their social responsibilities. In contrast, the stakeholder network in a typical accident is less dense, with low point degree centrality, high intermediary centrality, and more factions in cluster analysis. In this case there will be little contact and less understanding among the stakeholders; they play little role in their respective positions and even appear to be muddled; the transmission of information mainly relies on third parties, which is inefficient and the error rate of information transmission increases; there are small gangs in the team, which suppress other participants and do not inform the latest information of the project in time, or there are individual stakeholders to seek personal benefits and delayed or false reporting of project information. These factors are all important factors that cause the MSIR phenomenon.

4. Conclusion

In this paper, two types of cases, Hong Kong-Zhuhai-Macao Bridge (HZMB) and four typical accidents, were selected to construct "positive" and "negative" SNA models. By comparing and analyzing the indicators of the two case models, the motivation of MSIR is derived. This study is important for the management of socially responsible behavior in large-scale infrastructure projects.

By comparing the indicators of typical accidents and the SNA model of HZMB, it can be concluded that in large infrastructure projects, MSIR is motivated by the following aspects: First, the stakeholders are not closely enough connected, do not cooperate well enough, and know less about each other. This hinders the communication of information to detect the emergence of MSIR behaviors and take corrective measures in a timely manner. Second, the participation of various stakeholders in the project is low, and they cannot fulfill their own social responsibilities with due diligence. Third, information transfer is too dependent on third parties, which is slow and inefficient and also increases the probability of misinformation. Fourth, there is no coordination among stakeholders, and individual stakeholders are in information silos and cannot get the latest information of the project in time. Individual stakeholders delay or falsely report project information for personal gain.

Based on the comparative analysis of cases and simulation, this paper indicates the motivation of MSIR and proposes some effective governance measures to reduce the negative impact caused by MSIR. The article is still inadequate, due to limited contacts and resources, the field of questionnaire respondents in this article does not cover all stakeholders of the project. In future research, if conditions are available, we hope to collect the views and opinions of workers in various fields on the motivation of MSIR, so that the conclusions of the article can be more authoritative.

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