Dynamics model of NIMBY risk diffusion system in ‘The Belt and Road’ energy investment

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Abstract. Through the analysis of the interaction among various influencing factors in the ‘NIMBY’ risk diffusion system, the boundary of NIMBY risk diffusion system in ‘The Belt and Road’ energy investment is determined, and the basic assumptions of the system dynamics model are made. On this basis, a causal relationship diagram of NIMBY risk diffusion is established, and the mechanism of nimby risk diffusion is explained in the form of cause tree. Moreover, based on the causal relationship diagram, the flow diagram of NIMBY risk diffusion system was established, and the system dynamics model framework was determined.

1. Introduction
The Nineteenth National Congress of the Communist Party of China proposed to accelerate the promotion of ‘The Belt and Road’ initiative, in which energy investment is an important breakthrough to promote the ‘The Belt and Road’ initiative, and it is the general trend for enterprises to go out and make energy investment [1]. However, most of the countries along the ‘The Belt and Road’ are backward countries, which have rich energy resources but no technology for development and utilization. Therefore, domestic enterprises may encounter many risks when investing in the host country, among which nimby risk is the most fatal. The concept of nimby risk was first proposed by western scholar Michael O’hare in 1977, and it is a kind of opposition to the destruction of one's own living area [2]. Now, it mainly refers to the negative effect and probability of nimby effect due to nimby facilities, which is determined by host residents' fear of nimby facilities and the openness of nimby site selection process [3]. It is mainly divided into four categories, namely pollution category, risk aggregation category, stigmatization category and psychological displeasure category [4]. The research object of this paper is energy-based facilities, such as mines, hydropower stations, oil extraction [5]. Therefore, the type of nimby risk studied in this paper is pollution-type nimby facility.

Under the ‘The Belt and Road’ initiative, China will have a large number of energy companies investing abroad in the future. In this process, many ‘nimby’ incidents may occur. Therefore, how to avoid the loss caused by ‘nimby’ risks and how to control the spread of ‘nimby’ risks from the source is an urgent problem to be solved at present.

2. Influencing factors of NIMBY risk diffusion
Based on the existing research results of nimby risk, the factors that affect the diffusion process of nimby risk are summarized from five aspects of host residents, host government, construction enterprises, social media and social environment.
2.1. **Host residents resist the emotional cause tree**

Nimby facilities can bring convenience to all residents, but they will have a certain negative impact on residents near the facilities. When residents near the facilities feel unfair, they will resist [6].

![Figure 1. Cause tree of resistance of host residents.](image)

It can be seen from figure 1 that the resistance of the host residents is determined by the attention of the host residents, the satisfaction of the host residents and the credibility of the host government. Among them, the increase in the amount of social news and the expansion of nimby conflicts will attract the attention of host residents. However, the explosion of rumors will disturb the judgment of residents, thus increasing their inner panic, and host residents will pay more attention to the construction of nimby facilities. Host residents' satisfaction is affected by benefit compensation and host residents' participation. Host government's credibility is affected by host residents' trust in the government and host government's governance behavior.

2.2. **Cause and effect tree of host government governance behavior**

In the whole process of nimby risk diffusion, host government is often the direct cause of the nimby movement. The diffusion and degree of nimby risk are closely related to the handling method adopted by host government [7].

![Figure 2. Cause and effect tree of host government governance](image)

As can be seen from figure 2, the governance behavior of host government is only determined by the attention of host government, while the attention of host government is directly determined by the degree of nimby conflict. Because the host government chose to hide the relevant information in the early stage of the decision to nimby project, the attitude of the host residents to the nimby facilities changed from panic to anxiety, which eventually led to aversion, which led to the nimby conflict. It has aroused the attention of the host government, and the host government has to take actions to govern the nimby conflict, so as to gain the understanding of the host residents, thus forming a cycle of governance by the host government on the nimby problems.

2.3. **The cause and effect tree of building an enterprise**

Research scholars have found that before building energy facilities, increasing the corporate social responsibility of building companies can effectively alleviate the occurrence of nimby conflicts and curb the spread of nimby risks [8].
Figure 3. The cause and effect tree of building an enterprise.

The credibility of the construction company is affected by the publicity of the construction company's own information and the governance behavior of the construction company. The credibility of the construction company directly affects the spread of nimby risk, and host residents' understanding of the nimby project directly determines the construction enterprise's trust, so the credibility of the construction enterprise is equal to the sum of the information disclosure degree of the construction enterprise and the governance behavior of the construction enterprise.

2.4. Social news volume causal tree
When the nimby facility was first built, it attracted the attention of social media. When host residents are unable to distinguish the truth from the false information, they may become emotional and extreme, thus increasing the deterioration of nimby conflict [9].

As can be seen from figure 4, the amount of social news is directly determined by media attention, which is only affected by the degree of nimby conflict. In the process of nimby risk diffusion, social media plays a role in amplifying nimby risk. The half-knowledge of host residents about nimby facilities, coupled with negative social news coverage, may exacerbate the outbreak of nimby conflicts. With the outbreak of nimby conflict and the attention from all sectors of society, the amount of media coverage of nimby will continue to increase, and the attention will also increase, thus forming a vicious circle.

2.5. Social environmental factors
With the rapid development of social economy, the public's awareness of environmental protection and rights protection has begun to increase, and host residents no longer accept the government's monopoly in nimby event decision-making [10].

3. Basic assumptions of nimby risk diffusion system model
Based on the characteristics of nimby risk diffusion, the system dynamics model is assumed and simplified to avoid the interference of uncontrollable factors on the simulation results of the model.

(1) Only consider the influence of the interaction between directly related stakeholders in ‘The Belt and Road’ energy investment on the spread of nimby risks, other indirect stakeholders will not be considered.

(2) It is assumed that the host country is a country with stable political situation, good relations with China and is not disturbed by international political risks.
4. Establishment of system dynamics model

4.1. Causal analysis of NIMBY risk diffusion

In this paper, the above influencing factors are included in the three subsystems of the host resident subsystem, the host government subsystem and the construction enterprise subsystem (see figure 5), and the internal correlation of the subsystems is as follows.

Figure 5. Causality diagram of nimby risk diffusion.

First, the host residents’ subsystem mainly describes that the nimby emotions of residents will extend to the group conflict under certain incentives, which will lead to the spread of nimby risks. The key factor is that due to the negative externality of infrastructure construction in energy investment, residents have a risk perception of it. At the same time, when media rumors cannot be accurately identified, the public will have aversion and resistance to nimby facilities. In addition, the host government and the construction company chose to ignore the opposition of the host residents for their own benefit. As a result, residents’ resistance starts to spread and nimby risks are constantly spread. When it reaches its peak, host residents will stop the construction of relevant nimby facilities by means of ‘demonstrations’ and violent conflicts.

Secondly, the host government subsystem mainly describes the degree of the spread of nimby risks in energy investment induced by the difference of the host government's attitude towards the residents' nimby sentiment. The main diffusion process was in the early stage of the construction of nimby facilities. Due to the host government's urgent pursuit of local GDP and insufficient consideration of public opinion, the public's trust in the host government was reduced, which led to the increase of public resistance to nimby facilities and the continuous diffusion of risks. When the severe conflict caused the construction of the border facilities to stop, the government's attention was reversed. At this time, in order to maintain social stability and the local GDP is not affected, the host government began to ease the emotions of the host residents. Through reasonable and timely governance behaviors, the government's credibility can be increased and residents' satisfaction with the government can be improved, so as to reduce the spread of nimby risks.

Thirdly, the sub-system of the construction enterprise describes the influence of different decision-making means of the construction enterprise on the degree of nimby risk diffusion: In the early stage of the construction of nimby facilities, residents of the host country have already generated resistance or even nimby conflicts due to the negative externalities of the facilities themselves. At this time, construction enterprises have already spent some costs, so they choose to ignore the protests of residents to reduce losses. But as the resistance continues to accumulate, the risk continues to spread until it reaches its peak. At this time, violent conflict will occur, and the host residents will impact the construction of the enterprise, causing the enterprise to stop production. In order to reduce losses, construction enterprises adopt the same measures as host governments to reduce the risk of nimby movement by increasing compensation and information disclosure.
4.2. Flow diagram construction of NIMBY risk diffusion
The causality diagram can only describe the feedback logic of the system, and cannot reflect the interaction between the internal factors of the system. Therefore, based on the causality diagram, this paper introduces state variables, rate variables, auxiliary variables, constants, and exogenous variables to establish a system flow diagram, as shown in figure 6.

![Flow diagram of NIMBY risk diffusion system](image)

Figure 6. Flow diagram of NIMBY risk diffusion system.

5. Conclusion
Through literature review, this paper constructs the system dynamics model and draws the following two conclusions. First, the main subjects that influence the spread of nimby risk mainly include host residents, host government, construction enterprises and social media. Second, by building a simulation model and analyzing the diffusion mechanism, it is found that increasing the satisfaction of host residents, increasing the degree of government information disclosure and strengthening the science popularization of enterprises can help mitigate the spread of nimby risks.

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References
[1] Liu Chao, Tang Juan 2020 A study on the mechanism, governance difficulties and countermeasures of the NIMBY conflicts around the Belt and Road public infrastructure Construction Projects. Journal of Xiangtan University(Philosophy and Social Sciences) 44(02):27-32.
[2] O’Hare, Michael 1977 Not on my block you don’t: facility siting and the strategic importance of compensation. Public Policy.25.
[3] Yang Xue-feng, Zhang Tian-cheng 2016 Environmental nimby risk: theoretical connotation dynamic mechanism and governance path. Foreign theoretical dynamics .08:81-92.
[4] Tao Peng, Tong Xing 2010 Governance of mass disturbance which caused by NIMBY. Nanjing Social Sciences.(08), 63-68.
[5] Liu Hai-long 2018 The generation and solution of NIMBY conflicts from the perspective of environmental justice. Journal of Jishou University(Social Science). 39(02): 57-63.
[6] Qin Zhe 2015 The communication function of refuge psychology and mass media in conflict. Young Journalists.(29):19-20.
[7] Chen Bao-sheng 2018 On behavioral logic of local government for NIMBY conflict governance.
Chinese Police Administration (08):119-125.

[8] Li Fei 2019 The respect of human rights of business decisions in accordance to proportionality principle: A perspective of corporate social responsibility. Jinan Journal (Philosophy and Social Sciences). 41(04):34-51.

[9] Forrester J W 1956 Multicoordinate digital information storage device: US, US2736880.

[10] Wu Zong-yan, Song ying-hua, Lv Wei and Fang Dan-hui 2017 Research on factors influencing NIMBY group events in China and their relational structure. China Safety Science Journal. 127(08):169-174.