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Research Article

Social Stability Risk Diffusion of Large Complex Engineering Projects Based on an Improved SIR Model: A Simulation Research on Complex Networks

Zhengqi He,[1,2] **Dechun Huang**,[1,2] **and Junmin Fang**[1]

[1]*Business School, Hohai University, Nanjing 211100, China*
[2]*Jiangsu Provincial Collaborative Innovation Center of World Water Valley and Water Ecological Civilization, Nanjing 211100, China*

Correspondence should be addressed to Junmin Fang; fangjunmin@hhu.edu.cn

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The development of China's new urbanization has driven the rapid increase in large complex engineering projects, which have the characteristics of large-scale investment, long-term construction, and wide social influence, easily causing benefit conflicts among relevant stakeholders, and breaking out social stability risks. In the previous research, the risks of large complex engineering projects mainly concentrated on the assessment of economic risk, schedule risk, etc. However, there were few studies on social risks, and they did not consider how the risks spread on the complex networks based on the social connections such as interpersonal relationship. From the subject of social stability risk diffusion of large complex engineering projects, this paper constructs a related risk diffusion model based on the SIR model to analyze risk diffusion mechanism. Through NetLogo simulation platform, the model is placed under a small-world network environment that is closest to the topology structure of real social interpersonal relationship network for simulation research, aiming to find out key factors of social stability risk intervention for large complex engineering projects, which greatly contributes to the social stability risk management of large complex engineering projects.

1. Introduction

With the acceleration of economic growth and modernization, large complex engineering projects have entered a period of rapid growth, making great contributions to social and economic development. Taking a major water conservancy project as an example, the Chinese government plans to construct 150 projects from 2020 to 2022, with a total investment of 1,290 billion yuan, which can drive direct or indirect investment of 6,600 billion yuan. While different from general projects, the large complex engineering projects have a high degree of complexity and uncertainty. With the characteristics of large-scale investment, long period of construction, as well as numerous stakeholders that involves the problem of multi-party interest balance, it can easily lead to social conflicts and form social stability risk events extending over a large area and with a wide range of impacts. Taking the currently controversial PX project in China as an example, some newly constructed PX projects have triggered many social stability risk events due to the adverse impact on the environment. For instance, the social stability risk event triggered by "Ningbo PX incident" caused direct economic loss of 6.4 billion yuan. There are also some other social stability risk events triggered by large complex engineering projects that have a great impact on the normal order of society and economy. For example, the "Qidong Incident" triggered by the sewage disposal of a paper mill led to a demonstration by about 2,000 people, severely affecting the image of the local government, social order, and economic development. The "Suijiang 325 Incident" triggered by the construction of the Xiangjiaba major water conservancy

project caused traffic interruption for more than 100 hours, greatly affecting local social stability.

The social stability risks have always attracted the attention of the Chinese government. In the report on the work of the government in 2015, it emphasized that "social stability risks which major policy decisions may pose are fully assessed so as to effectively prevent and resolve social conflicts." In 2017, the 19th National Congress of the Communist Party of China pointed out that "resolutely fight the battle to prevent and resolve major risks" and "strengthen the construction of mechanisms for preventing and resolving social conflicts." All have emphasized the importance of preventing and resolving social stability risks. In China's current context of emphasis on preventing and resolving major risks, since social stability risks of large complex engineering projects belongs to the category of major risks, it has also become the focus of attention from all walks of life and the hot topic in academic research.

The social system is a special complex large system. The conflict of interests among subjects is the root of the social stability risks of large complex engineering projects, and the complex network formed by the interaction among subjects is an important carrier for the spread of social stability risks. Although some regions and departments in China have established local social stability risk assessment systems, and achieved certain outcomes in social stability risk management, social stability risks in large complex engineering projects still occur and have not been fundamentally avoided, causing the failure of the "stability evaluation" safety valve. The reason is that, on the one hand, it is difficult to effectively deal with subject conflicts under the existing social stability risk system of large complex engineering projects. On the other hand, it ignores the influence of complex social network relationships on the diffusion process of social stability risks. Many systems in the real world can be described with complex networks. With the rise of social networks such as Weibo, WeChat, and Twitter, the research on complex networks has expanded from the complex network of natural sciences to that of human society, and has become the focus of attention in the academic and practical circles. On the complex network, the conflicts among the subjects of large complex engineering projects demonstrate some new characteristics. For example, the different network structures formed among the subjects have changed the evolution results of the subject conflicts and significantly affected the process of social stability and risk diffusion. These new features weaken the effective understanding and accurate grasp of traditional engineering project impact and social risk management theory on the social stability risk diffusion mechanism of large complex engineering projects. Therefore, by ignoring the influence of complex networks on the spread of social stability risks of large complex engineering projects, and conducting research only from the social impact of conflicts of interest in large complex engineering projects, neither the diffusion mechanism of social stability risks of large complex engineering projects can be grasped, nor a comprehensive, effective, and realistic social stability risk management mechanism can be put forward. As a result, the "safety valve" of the institutionalized arrangements for social stability risk management of large complex projects will fail. Therefore, under the complex network environment, studying the social stability risk diffusion process of large complex engineering projects and proposing a social stability risk management mechanism that conforms to its scientific laws is an alternative way to solve the social stability risk problem of large complex engineering projects in China, which is also an urgent task in practice.

2. Literature Review

2.1. Research on the Impact of Large Complex Engineering Projects on Social Stability. As the characteristics of large-scale investment have a wide range of impacts, the construction of large complex engineering projects will generally affect the local ecological environment and human social environment [1–4]. Especially, in the process of reconstruction of nature and human society, the evolution of various social elements in time and space will occur. This is an uncontrollable variable, which will have a huge impact on social stability without proper handling, causing social conflicts and social stability risks [5, 6]. Taking the construction of a mega industrial park project as an example, Liu et al. [7] analyzed its impact on social stability, and proposed a practical framework of social risk management. He et al. [8] studied the impact of large-scale engineering projects on social stability from the perspective of stakeholder conflicts.

2.2. Research on Social Stability Risks of Large Complex Engineering Projects. Social stability can be literally explained as a steady, settled, and harmonious state of politics, economy, culture, ecology, etc. It includes not only political stability and economic stability but also normal social order and peace of mind. In a broad sense, social risks can be understood as the social instability and disharmony caused by the political, economic, cultural, ecological, and other risk factors, triggering social conflicts, and endangering social stability and social order with certain probability, which is accumulated to a certain extent on the subject's interactive relationship network and becomes reality; social risks will evolve into social crises, which will cause a catastrophic impact on social stability and social order. Social stability risks can be defined as the shift of steady status for some uncertain factors, resulting in the risks of social disorder and social environment disharmony in the social system [9]. In recent years, with the Chinese government attaching great importance to social stability risk management, research on social stability risks of large complex engineering projects has gradually become a hot spot. Scholars' research mainly focuses on two aspects. On the one hand, from the perspective of social stability, risk assessment to construct an assessment index system and model for empirical research is of great importance [10, 11]. Wu et al. [12] established an assessment index system about social stability risks of major water conservancy projects in fragile eco-environment regions (FEER), and by using the set pair analysis (SPA) and the principal component analysis (PCA) methods, they

established an assessment model for social stability risks, which was applied to the major water conservancy projects in Shaanxi Province, China. Ma and Cong [13] used cloud model and ordered weighted averaging and matter-element model to establish an assessment model for social stability risks of Not In My Back Yard major projects. On the other hand, many scholars have focused on the social stability risks of specific types of large complex engineering projects, studying their formation and prevention mechanisms. It includes major water conservancy projects [9, 14], power energy projects [15, 16], urban demolition projects [17–19], transportation infrastructure projects [20, 21], environmental engineering Projects [22, 23] and so on.

2.3. Research on Risk Diffusion Based on Infectious Disease Model. Once the social stability risks of a large complex engineering project form, it is prone to spread in the society due to its high-risk, unexpected, and diffused characteristics, leading to a wider range of social instability, and the proliferation of social stability risks gradually attract the attention of scholars [24, 25]. The most common method for the risk diffusion research is the infectious disease model, including those like SIS model and SIR model, which are mainly applied in the medical field to study the spread of various infectious diseases [26]. Based on improving the SIR model, Jiao and Huang [27] constructed the SIHR model containing four types of subjects to study the infectiousness of COVID-19 and put forward a policy to control the spread of COVID-19. With the development of research, infectious disease models have gradually expanded from the medical field to the risk diffusion research in the economic, social, and other fields [28, 29]. Among them, there are many researches on the spread of rumors, which is quite similar to that of social stability risks. Li et al. [30] constructed a SIHR model based on probability generating function to study the spread of rumors, and conducted numerical simulation to examine the differences between rumor transmission recovery mechanism and disease transmission recovery mechanism. Qiu et al. [31] constructed a novel SIR rumor spreading model with the influence mechanism to study the spread of rumors in society. Sun et al. [32] constructed an uncertain SIR rumor spreading model to study the influence of perturbation in the transmission mechanism of rumor spreading.

2.4. Research on Risk Diffusion on Complex Networks. The well-known physicist Hawking said that, "the 21st century will be the century of complexity science." Complexity science has triggered tremendous changes in the natural science. The basis of complex network theory is the random graph theory established by famous mathematicians, Erdos and Renyi [33]. Qian et al. [34] gave a stricter definition of complex networks: networks with some or all of the properties of self-organization, self-similarity, attractor, small world, and scale-free are called complex networks. With the deepening of people's research on complex networks, it has become a highly active interdisciplinary research field, encompassing multiple disciplines such as computer science, statistics, physics, and social sciences. At present, scholars' research on complex networks is mainly concentrated on two aspects: First of all, based on the analysis of the realist world by powerful data analysis tools to study the topological characteristics of realist complex networks [35]. Secondly, use complex network theory to study the normal operation of many realist systems [36, 37]. In reality, the spread of various risks can be regarded as the infectious dynamic behavior on complex networks that follow specific laws, while the infectious dynamic behavior has always received extensive attention from scholars [38, 39]. Research on risk diffusion on complex networks has been widely used in supply chain, finance, project management, and other fields [40–43]. In the late 20th century, the "Collective dynamics of 'small-world' networks" [44] published in Nature magazine and the "Emergence of scaling in random networks" [45] published in Science magazine proposed the small-world network model and the scale-free network model, providing a way for researchers to describe the actual system with networks. It further verified that the real-world network is a network with small-world effects and scale-free characteristics, and provides a realistic and feasible way to solve many important issues in the real world. With the in-depth study on various types of complex networks such as small-world network and scale-free network, infectious models based on small-world network and scale-free network have also been studied in depth [46]. Many scholars have proposed effective risk prevention strategies by exploring the spread of various risks on different and specific complex network structures [47–49].

Therefore, this paper will analyze the relevant characteristics of the social stability risk diffusion of large complex engineering projects, discuss the applicability of the infectious disease model, improve the traditional SIR model, and have a simulation analysis on complex networks to study the diffusion process of social stability risks of large complex engineering projects.

3. Social Stability Risk Diffusion Model of Large Complex Engineering Projects Based on an Improved SIR Model

3.1. Definition of Large Complex Engineering Projects. The project is a very broad concept, ranging from the construction of a basketball court to the construction of a national high-speed railway. A project can span decades, like the construction of the Three Gorges Project, or it can be completed in a few days, like the renovation of a football field lawn. It can stretch thousands of kilometers in space, such as the Beijing-Shanghai high-speed rail, or it can be completed in a small office, such as the development of an enterprise management platform. The investment of a project can reach hundreds of billions, such as the South-to-North Water Diversion Project, or less to tens of thousands, such as the construction of a country road. With the rapid development of China's economy, the scale of engineering projects is increasing, and the projects are getting more and more complicated. Projects with investment of billions or even

tens of billions are emerging in an endless stream. Regarding which standard the investment quota reaches can be regarded as large complex engineering projects, people from all circles of life have not reached a consensus. This paper believes that large complex engineering projects cannot be simply defined from the investment quota but should be considered in terms of investment scale, construction period, technical difficulty, and social influence. The large complex engineering projects studied in this paper refer to those characterized by huge construction scale, huge investment scale, many factors involved, and those that have a major and far-reaching impact on the region and the entire country. The engineering projects here have a wide range of connotations, including water conservancy projects, high-speed railways, large-scale petroleum and chemical projects, etc., such as the Three Gorges Project, the South-to-North Water Diversion Project, the Beijing-Shanghai High-speed Railway, the Guangdong-Hong Kong-Macao Bridge, the West-East Gas Pipeline, and strategic Petroleum reserve project, etc.

3.2. The Subjects of Social Stability Risk Diffusion of Large Complex Engineering Projects. After the social stability risks of large complex engineering projects form, due to their diffusion characteristics, they will spread among key subjects such as the government, project legal persons, and local people as well as the public, the media, and other relevant subjects, shaping a complex network of social stability risk diffusion of large complex engineering projects. On this complex network, different types of subjects such as the government, project legal persons, local people, and the public have different understanding of and attitudes towards large complex engineering projects, leading to different attitudes towards risk diffusion, and the different risk perceptions further make their risk spreading capabilities different. Some subjects are not supportive of large complex engineering projects, or for the reason that the benefit compensation received is lower than what was expected, when the social stability risks caused by large complex engineering projects spread out, they will actively participate in the diffusion process and become a new transmission source.

There are also some other subjects who support the large complex engineering projects, or as the benefit compensation meets their psychological expectation, they will not get involved when the social stability risks spread out, but choose to ignore it or even try to persuade others. These subjects are divided based on the role they play in the spread of social stability risks of large complex engineering projects. For example, some of the local people will directly participate in the spread of social stability risks, while some will not and become the new type of subjects in the risk diffusion. Similarly, for other subjects such as the government and the public, a certain proportion of subjects in each type will participate or not participate in the spread of social stability risks. By combining with the attitudes of the subjects involved in the spread of social stability risks and the division of the subjects of the classic infectious disease model, this paper divides the subjects of social stability risk diffusion of large complex engineering projects into four categories: the ignorant, malcontents, staggerers, and the rational.

(1) *The Ignorant*: in the process of spreading the social stability risks of large complex engineering projects, the ignorant refer to the kind of subjects who are not familiar with the large complex engineering projects and the related information about social stability risks, and they will not spread the social stability risks without being exposed to social stability risk information.

(2) *Malcontents*: the malcontents refer to those subjects who are resistant to the large complex engineering projects and dissatisfied with the relevant benefit compensation, so that they appeal for benefits by violent protests and other means and actively spread the social stability risks.

(3) *Staggerers*: the staggerers can be understood as those subjects who have known the social stability risk information related to the large complex engineering projects. However, for certain reasons such as their own lack of active participation and that benefit compensation has reached expectations, they maintain a wait-and-see attitude at this stage and will not actively participate in the spread of social stability risks temporarily.

(4) *The Rational*: the rational are the subjects who get access to a large amount of information about social stability risks of the large complex engineering projects. However, due to certain reasons such as support for large complex engineering projects and social stability maintenance, they do not participate in the spread of social stability risks (or are immune to social stability risks). The difference between the rational and staggerers is that the latter do not participate in the spread of social stability risks for the time being, but when they get access to a certain amount of social stability risk information, they may become a transmission source. While the rational are already immune to risks, they will not participate in the spread of any social stability risks.

3.3. Interactive Model of Social Stability Risk Diffusion of Large Complex Engineering Projects. In the process of spreading the social stability risks of large complex engineering projects, the four types of subjects, namely, ignorant, malcontents, staggerers, and the rational, interact and influence each other, forming a diffusion network about social stability risks. In this process, on the basis of certain social connections, one subject can pass the social stability risk information to other subjects after receiving it. Therefore, the diffusion network can be regarded as a directional and powerless network with people as nodes and relationships among people as edges, as shown in Figure 1. When perceiving the social stability risks, subject A will spread it to those subjects in contact with it such as B, C, and D. B and C may not be interested in the risks or may doubt their

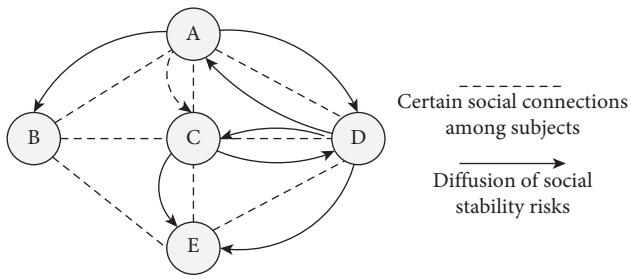

Figure 1: Network diagram of social stability risk diffusion of large complex engineering projects.

existence after receiving the risk information, so they will not spread them again. While affected by the risk information and perceiving the social stability risks, subject *D* will panic and further spread the risks to those subjects in contact with it such as *A*, *C*, and *E*. Subject *C* is not used to participating in the spread of social stability risks, but due to the increased exposure to risk information, it gradually turns into a communicator, further spreading social stability risks to related subjects with connections.

The interactive model of social stability risk diffusion of large complex engineering projects is shown in Figure 2, with four subjects of the ignorant, malcontents, staggerers, and the rational. When the ignorant perceive the social stability risks, some become malcontents, some become staggerers, and the others become the rational. Those who become malcontents will spread the risks again, causing the rise in the number of malcontents. Those who become staggerers will not spread risks temporarily but may turn to malcontents with increased connections with social stability risk information. In the process of social stability risk diffusion, some malcontents will turn to staggerers under appropriate social handling or for some personal reasons they will not spread risks for the moment, while the others will not participate in the spread of risks and become the rational.

3.4. Infectious Disease Characteristics of Social Stability Risk Diffusion of Large Complex Engineering Projects. The spread of social stability risks of large complex engineering projects is essentially the process wherein various subjects perceive the social stability risks caused by the construction of large complex engineering projects and spread them to other subjects with connections through various transmission channels. Infectious diseases generally have the characteristics such as pathogens, infectious agents, infectiousness, and immunity, to which the spread of social stability risks of large complex engineering projects is similar.

(1) Pathogen of Social Stability Risk Diffusion of large complex Engineering Projects: In the process of social stability risk diffusion of large complex engineering projects, the pathogen is the source of risks, namely, the various conflict events triggered during the construction of large complex engineering projects. The source of risks is the prerequisite for the spread of risks, or risk diffusion will not exist. When interest conflicts among subjects triggered by large complex engineering projects occur, group incidents break out, forming a source of social stability risks, which will be further diffused through infectious media to other relevant subjects with connections.

(2) Infectious media of Social Stability Risk Diffusion of large complex Engineering Projects: The infectious medium is the carrier through which the risk source transmits. The infectious medium of social stability risks of large complex engineering projects is the relationship network among the subjects. It includes not only the Internet, newspapers, and other new media and traditional media but also the various social relationships formed in the regions. Once the source of social stability risks form, risk information spreads to a larger area through these infectious media, which have a huge impact on the entire society.

(3) The Infectiousness of Social Stability Risk Diffusion of Large complex Engineering Projects: Like infectious diseases, the spread of social stability risks of large complex engineering projects is also infectious. When perceiving the social stability risks, a subject will spread it to the external environment through the infectious media. Especially, in today's era, when the Internet is so developed, risk information will spread rapidly. Under the great impact of large complex engineering projects, other subjects will also accept the risk information and form a certain degree of panic. These subjects will become staggerers and malcontents. With the increased degree of impact, the staggerers may further turn into malcontents. This in turn affects the surrounding subjects, thus forming the infectiousness of the social stability risk diffusion of large complex engineering projects.

(4) Immunity of Social Stability Risk Diffusion of large complex Engineering Projects: In the process of infectious disease transmission, some people will build immunity due to their antibodies and will no longer be infected by infectious diseases. Similarly, in the spread of social stability risks of large complex engineering projects, some subjects will not be affected by social stability risk information due to their relatively complete knowledge structure, a good understanding of large complex engineering projects, and strong psychological endurance. They will not participate in the spread and become rational people of the social stability risks of large complex engineering projects, that is, they have a certain degree of immunity to the social stability risks.

3.5. Applicability of the Infectious Disease Model. The transmission model of infectious diseases originated from the analysis of smallpox infection in the 18th century. With the deepening of research, scholars have successively constructed some infectious disease models that quantitatively study the spread of infectious diseases, gradually expanding

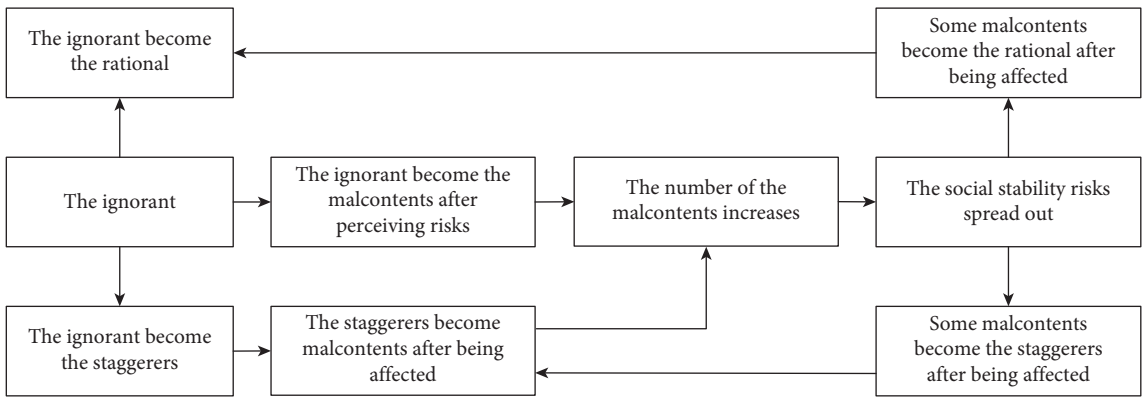

Figure 2: The interactive model of social stability risk diffusion of large complex engineering projects.

from the field of medical research to general transmission mechanisms. Infection models such as SI model, SIS model, and SIR model were formed. Based on the SIR model, the follow-up research content of this paper will improve it, so the SIR model will be mainly introduced in the following part. There are three types of people in the SIR model. In addition to healthy people and infected patients, there is also an immune group. Immune group means that the infected patient has immune function after being cured or disappears in the group, and will no longer have any influence on the infection process. In the SIR model, S represents the population in a healthy state, I represents those who have been infected, and R represents the immune population. The SIR model has the following assumptions (Figure 3):

(1) $S(t)$ represents the proportion of people in a healthy state at time t, $I(t)$ represents the proportion of people in an infected state at time t, and $R(t)$ represents the proportion of people in an immune state after being cured at time t.

(2) People in a healthy state will be infected by infected patients with a certain probability to become patients, and we will record the infection rate as λ.

(3) Patients who have been infected will be cured with a certain probability and become healthy people. We record the cure rate of patients as μ. People in the cured immune group will not be infected again, nor will they participate in any infection process (Figure 4).

Figure 4 shows the infection process of the SIR model. According to the above assumptions, there are $\lambda S(t)I(t)$ people with a healthy state who are infected and become patients, and $\mu I(t)$ patients are cured and become immune populations at every moment. Therefore, the SIR model can be obtained as:

$$\begin{cases} \dfrac{\mathrm{d}S(t)}{\mathrm{d}t} = -\lambda S(t)I(t), \\ \dfrac{\mathrm{d}I(t)}{\mathrm{d}t} = \lambda S(t)I(t) - \mu I(t), \\ \dfrac{\mathrm{d}R(t)}{\mathrm{d}t} = \mu I(t). \end{cases} \tag{1}$$

From this differential equation, it can be seen that the number of infected people will gradually increase. When the time reached a certain point, the number of infected people will start to decrease due to the decline in the number of healthy people until the number of infected patients is reduced to zero.

The spread of social stability risks of large complex engineering projects has the characteristics of infectious diseases, and the spread on social network is similar in terms of spreading environment, spreading mechanism, spreading direction, and spreading stage, etc.

(1) *Diffusion environment*: Infectious diseases spread on social network based on the connections among people. Human individuals are equivalent to the nodes of social network, and communication among people is the way of infection, which is equivalent to the edges of a social network. While the social stability risks of large complex engineering projects also spread among stakeholders, namely, the nodes, connections, and communication among related subjects are the edges. Therefore, the spreading environment of infectious diseases is similar to that of social stability risks of large complex engineering projects, and both spread on a complex network.

(2) *Diffusion mechanism*: When an infectious disease spreads, the virus carrier infects others through connections, and then the infected people further infect other people with connections. The transmission is based on the direct connections among people, and the virus is transmitted outward by depending on people's connections; this is the mechanism of virus transmission. The spread of social stability risks of large complex engineering projects is similar. After perceiving the social stability risks, the relevant subjects will pass risk information to subjects who have connections with them, and further spread it to other subjects and through them to the entire society. The position and capability of the individual on the network determines the infectiousness of the social stability risks. Therefore, the spreading mechanism of infectious diseases is similar to that of social stability risks of large complex engineering projects.

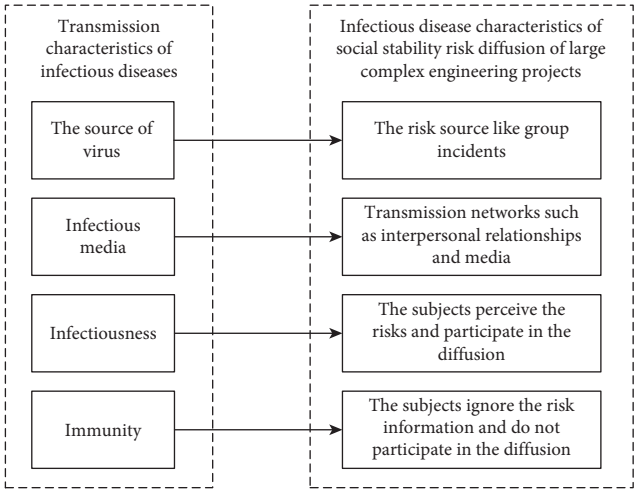

Figure 3: The infectiousness of social stability risk diffusion of large complex engineering projects.

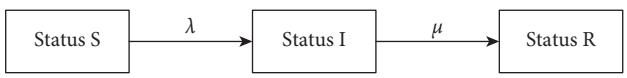

Figure 4: Schematic diagram of the infection process of the SIR model.

(3) *Diffusion Direction*: The spread of infectious diseases is radial and directionless. In the process of spreading social stability risks of large complex engineering projects, although the relationship among the subjects has certain sequential characteristics due to different status, the spread of risk information is also radial and can be affected by each other. There is no one-way influence, that is, the spread of social stability risks is also directionless. Therefore, the diffusion direction of infectious diseases is similar to that of social stability risks of large complex engineering projects.

(4) *Diffusion Stage*: There are the incubation period, the outbreak period, and the recovery period in the spread of infectious diseases. There are also certain periods in the social stability risks of large complex engineering projects. When the risk information spreads out, not all the subjects will become malcontents and actively participate in the spread of social stability risks, as some will take a wait-and-see attitude. At this time, the social stability risks are not very serious, which is equivalent to the incubation period. With the group incidents becoming critical, social stability risks will erupt on a large scale, and eventually die out because of the disposal of all parties. Therefore, the diffusion stage of infectious diseases is similar to that of social stability risks in the large complex engineering projects.

To sum up, the spread of social stability risks of large complex engineering projects on the social network is similar to that of infectious diseases, so it is very appropriate to introduce infectious disease models into the research on the social stability risks of large complex engineering projects.

3.6. IMSR Model Construction. Based on the traditional SIR model, this paper constructs the IMSR model for social stability risk diffusion of large complex engineering projects and improves it from the following four aspects. First of all, compared with the three types of subjects in the traditional SIR model, this paper increases the model subjects into four types. According to the previous subject analysis of social stability risk diffusion of large complex engineering projects, the subjects in the hypothetical model include four categories: the Ignorant (abbreviated as I), Malcontents (abbreviated as M), Staggerers (abbreviated as S), and The Rational (abbreviated as R). Secondly, assuming that the subjects have memory and forgetting functions as time passed, the staggerers and malcontents will spontaneously change their state with a certain probability if not contacting other types of subjects. This is called memory mechanism and forgetting mechanism [50]. Thirdly, after the subject is exposed to social stability risks, it is assumed that there is an acceptance probability, which is not fixed since it will be affected by external influences such as the amount of risk information and the social effect of the risks. Lastly, assuming that the social stability risks of large complex engineering projects spread under the complex network topology, by learning from the average field theory in statistical physics and considering the influence of the network node degree in the model, the average degree of the complex network is introduced into the model.

Based on the previous analysis of the four types of subjects, this paper gives the diffusion rules of social stability risks:

(1) When contacting the malcontents, the ignorant will be affected by the social stability risks diffused. During the spread of social stability risks, there is a probability $p(x)$ for the ignorant to become a malcontent, and we called it risk diffusion probability.

(2) When contacting the malcontents, the ignorant temporarily neither spread the social stability risks nor explicitly reject them. The probability of becoming a staggerer is α, since the staggerers just temporarily do not spread social stability risks, we call α the risk dormancy rate.

(3) When contacting the malcontents, the ignorant will refuse to spread the risks on the ground of not being affected by social stability risks. The probability of becoming the rational is β, which is called the risk rejection rate.

(4) It is believed that the staggerers have memory function. With the increase in exposure to risk information or for other influencing factors, they will be awakened spontaneously with a certain probability θ and become the malcontents. We call θ the risk recovery rate. At the same time, after contacting

the malcontents, there is a probability $p(x)$ for the staggerers to turn into the malcontents.

(5) It is believed that the malcontents have forgetting function. As time goes by, the malcontents tend to calm down and they will spontaneously turn into staggerers with a certain probability σ; as they will not participate in the spread of social stability risks for the time being, we call σ the risk hibernation rate.

(6) When the malcontents contact other malcontents, staggerers, or the rational, there is a probability μ that the malcontents will turn into the rational under the persuasion of other subjects, and will no longer spread the social stability risks, and we call μ the risk extinction rate.

The risk diffusion framework of IMSR model is shown as Figure 5.

It is believed that the risk diffusion probability is not a fixed value, but it is related to how many times the ignorant contact the malcontents. Drawing on the assumption of the rumor acceptance probability in the literature [51], this paper considers the risk diffusion rate as:

$$p(x) = \left|(M-\rho)e^{(-|\mathrm{SI}|\times(x-1))} - M\right|. \tag{2}$$

In formula (2), x represents the cumulative number of times that the ignorant have contacted the malcontents. M is a function of SI, and $|\mathrm{SI}|$ represents the degree of risk amplification or restraint in society. When $\mathrm{SI} > 0$, it means that risks have been amplified in society, and $M = 1$ at this time. When $\mathrm{SI} < 0$, it means risks have been restrained in society, and $M = 0$. $\rho = p(1)$ represents the risk diffusion probability when the ignorant first contact the malcontents. It can be obtained that when there is a social amplification effect of risks, the risk diffusion probability can be expressed as:

$$p(x) = 1 - (1-\rho)e^{(-|\mathrm{SI}|\times(x-1))}. \tag{3}$$

When there is a social restraint effect of risks, the risk diffusion probability can be expressed as:

$$p(x) = \rho e^{(-|\mathrm{SI}|\times(x-1))}. \tag{4}$$

It respectively shows the changing curves of risk diffusion probability when there is a social amplification effect of risks and a social restraint effect of risks, as shown in Figure 6.

As shown in Figure 6(a), when there is a social amplification effect of risks, the risk diffusion probability increases with the number of times the people contact the malcontents; the greater the degree of social amplification, the faster the growth of risk diffusion probability. At this time, because of the amplification effect of risks, every time the ignorant contact the malcontents, the perceived risks become greater and greater, leading to the greater risk diffusion probability. As shown in Figure 6(b), when there is a social restraint effect of risks, the risk diffusion probability decreases with the number of times the people contact the malcontents, and the greater the degree of risk restraint, the slower the decrease of the risk diffusion probability. At this time, because of the amplification restraint of risks, every time the ignorant contact the malcontents, the ignorant will dislike the risk information transmitted by the malcontents, and become less willing to participate in the risk diffusion as the number of contacts increases; thus, the risk diffusion probability decreases.

On a complex network, $I(t)$, $M(t)$, $S(t)$, and $R(t)$, respectively, represent the density of the ignorant, malcontents, staggerers, and the rational at time t. According to the given risk diffusion rules of large complex engineering projects, dynamic equation of IMSR model is got as below:

$$\begin{cases} \dfrac{\mathrm{d}I(t)}{\mathrm{d}t} = -[p(x)+\alpha+\beta]\langle k\rangle I(t)M(t), \\[2ex] \dfrac{\mathrm{d}M(t)}{\mathrm{d}t} = p(x)\langle k\rangle I(t)M(t) - \mu\langle k\rangle M(t)[M(t)+S(t)+R(t)] - \sigma M(t) + \theta S(t) + p(x)\langle k\rangle S(t)M(t), \\[2ex] \dfrac{\mathrm{d}S(t)}{\mathrm{d}t} = \alpha\langle k\rangle I(t)M(t) + \sigma M(t) - \theta S(t) - p(x)\langle k\rangle S(t)M(t), \\[2ex] \dfrac{\mathrm{d}R(t)}{\mathrm{d}t} = \beta\langle k\rangle I(t)M(t) + \mu\langle k\rangle M(t)[M(t)+S(t)+R(t)]. \end{cases} \tag{5}$$

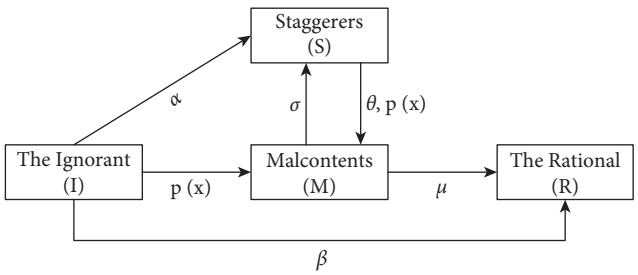

Figure 5: The risk diffusion framework of IMSR model.

Among them, $I(t)+M(t)+S(t)+R(t)=1$, and $\langle k\rangle$ represents the average degree of the complex network.

From the above formula, it gets:

$$\begin{aligned}\frac{\mathrm{d}R(t)}{\mathrm{d}I(t)} &= \frac{\beta\langle k\rangle I(t)M(t)+\mu\langle k\rangle M(t)[M(t)+S(t)+R(t)]}{-[p(x)+\alpha+\beta]\langle k\rangle I(t)M(t)}\\ &= \frac{\beta\langle k\rangle I(t)M(t)+\mu\langle k\rangle M(t)[1-I(t)]}{-[p(x)+\alpha+\beta]\langle k\rangle I(t)M(t)}\\ &= \frac{(\mu-\beta)I(t)-\mu}{[p(x)+\alpha+\beta]I(t)}.\end{aligned} \tag{6}$$

It further gets:

$$\mathrm{d}R(t)=\frac{\mu-\beta}{p(x)+\alpha+\beta}\mathrm{d}I(t)-\frac{\mu\mathrm{d}I(t)}{[p(x)+\alpha+\beta]I(t)}. \tag{7}$$

Assuming that there are a total of N subjects on the network, when the social stability risks break out at the beginning, there is only one malcontent, and the rest are the ignorant. Then, there are:

$$\begin{aligned}I(0)&=\frac{N-1}{N},\\ M(0)&=\frac{1}{N},\\ S(0)&=0,\\ R(0)&=0.\end{aligned} \tag{8}$$

In particular, when the number of subjects is large enough, $I(0)=\lim_{N\longrightarrow\infty}N-1/N=1$. In the process of spreading social stability risks of large complex engineering projects, as time goes by, the number of malcontents increases, and then gradually reduces to zero. At this time, the network reaches a steady state, and there are only the ignorant and the rational. Let $R(\infty)=R$, then $I(\infty)=1-R(\infty)=1-R$, and integrating formula (7), it gets:

$$R=-\frac{\mu-\beta}{p(x)+\alpha+\beta}R-\frac{\mu}{p(x)+\alpha+\beta}\ln(1-\beta). \tag{9}$$

Then, it gets:

$$R=1-e^{-(p(x)+\alpha+\mu/\mu)R}. \tag{10}$$

Let $\tau=p(x)+\alpha+\mu/\mu$, then formula (10) can be written as:

$$R=1-e^{-\tau R}. \tag{11}$$

For $\tau=p(x)+\alpha+\mu/\mu$, $p(x)>0,\alpha>0$, then $\tau>1$. Let $f(R)=R-1+e^{-\tau R}$ and taking its derivative, we can get $f'(R)=1-\tau e^{-\tau R}$, $f''(R)=\tau^2e^{-\tau R}$. Since $f(0)=0$, $f(1)=e^{-\tau}>0$, and $f'(0)=1-\tau<0$, $f''(R)$ is always greater than 0, there are two solutions of 0 and R_s in formula (11), and $0<R_s<1$. This shows that for the parameters $p(x)$, α, and μ, no matter what the value is, when the network reaches a steady state, there are two possible situations for the proportion of rational people, that is, there is no diffusion threshold.

The above analysis shows that the proportion of rational people R in the final steady state is a function of the risk diffusion rate $p(x)$, the risk dormancy rate α, and the risk extinction rate μ. Next, we use simulation research methods to analyze the relationship between the proportion of rational people R and the risk diffusion rate $p(x)$, the risk dormancy rate α, and the risk extinction rate μ in the final steady state.

4. Simulation Analysis of Social Stability Risk Diffusion of Large Complex Engineering Projects on Complex Networks

4.1. Simulation Rules on Complex Networks. On the basis of constructing the IMSR model for the social stability risk diffusion of large complex engineering projects, for the purpose of more clearly analyzing how the subjects vary in the spread of social stability risks and explaining the process of social stability risk diffusion, further simulation research is needed to have a more vivid analysis of its diffusion process. As it is easily affected by the complexity of large complex engineering projects and inner dynamic changes of diffusion networks, the diffusion process will be accompanied by the mutual impacts and constant accumulation of risks, despite certain regular patterns, which further complicates the process of social stability risk diffusion of large complex engineering projects. The network of social stability risk diffusion of large complex engineering projects is essentially a complex network based on the multi-subject interaction on real social networks, and it is affected by external systems like the socioeconomic environment. It has been verified by a large number of scholars that the real social networks have small-world characteristics, Watt and Strogatz [44] studied social network, thinking its topology structure lied somewhere between completely regular and completely random, and characterized by small average length and large clustering coefficients, which belongs to a typical small-world network. By using "Tomocom" data, Tomochi et al. [52] analyzed the structure of social network and the result showed the social network belonged to the small-world network. Lu et al. [53] studied a community

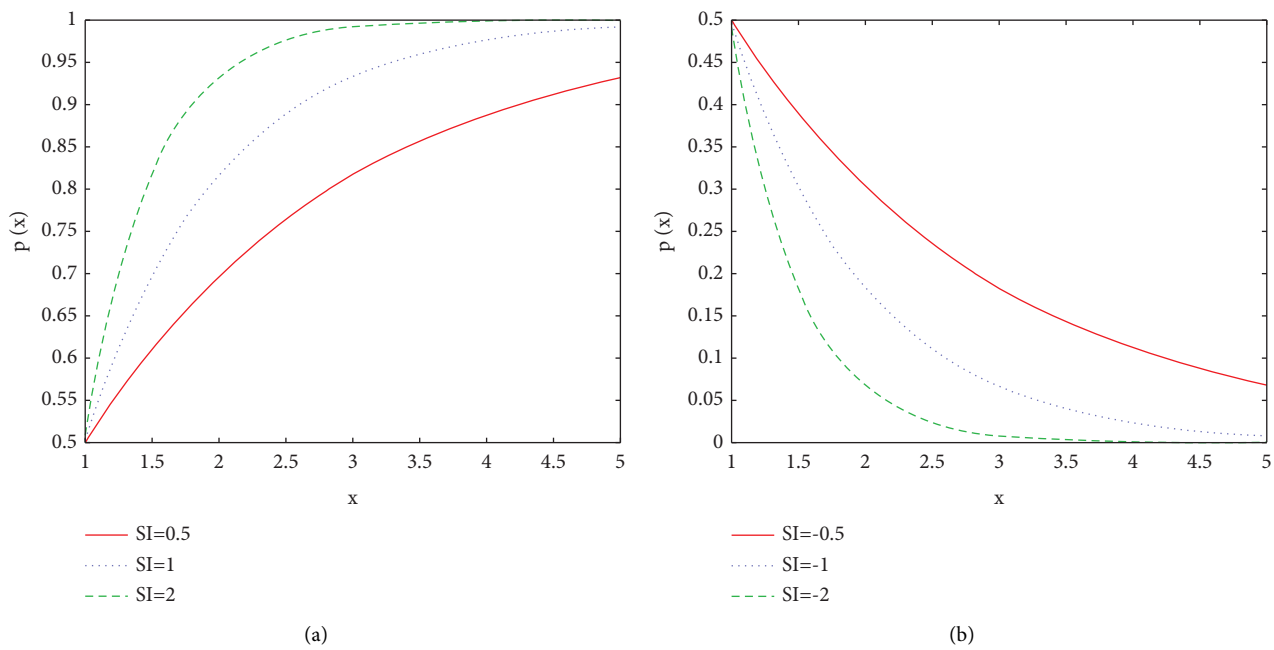

FIGURE 6: Changing graph of risk diffusion probability $p(x)$ in different situations: (a) there is a social amplification effect of risks; (b) there is a social restraint effect of risks.

model for social networks based on social mobility and analyzed the degree distributions, clustering coefficients, average distances, and diameters of networks. Experimental results demonstrated that the proposed model possessed the small-world property and could reproduce social networks effectively and efficiently. What is more, scholars also verified that social networks such as Facebook and Weibo were also featured with the small-world network, Su and Yen [54] analyzed 226 Facebook users, verifying that Facebook had obvious small-world characteristics. Dong et al. [55] studied the information dissemination on Sina Weibo during natural disasters, believing that the topology structure of Sina Weibo interactive network had the attribute of small world. In view of the fact that small-world networks can provide help to explain the problems related to complex socioeconomic systems and that the actual communication networks are similar to small-world networks, the type of complex network structure constructed in this paper is the small-world network. In the simulation study of social stability risk diffusion of large complex engineering projects on the small-world networks, this paper uses the NetLogo simulation platform, on which the simulation rules of IMSR model are as follows:

(1) Generate a WS small-world network with a certain number of nodes and an average degree of $\langle k \rangle$. The number of nodes indicates the number of subjects on the network of social stability risk diffusion of the entire large complex engineering projects, and the average degree indicates that each subject on the diffusion network is directly related to individuals with the number of $\langle k \rangle$ on average. The types of nodes on the diffusion network are divided into four categories, namely, the ignorant I, malcontents M, staggerers S, and the rational R, and the colors of the nodes correspond to yellow, red, green, and gray, respectively.

(2) In the initial state, it is assumed that there is only one malcontent, who is extremely dissatisfied with the current state, and actively spread the social stability risks in various ways, and we set the node to be red. All other nodes are the ignorant, indicating that they have not yet got the relevant social stability risk information, and we set them to be yellow.

(3) The malcontents transmit information about social stability risks to neighboring nodes of the ignorant; some subjects will believe in the risk information and participate in the spread of social stability risks, and they will become malcontents with the probability $p(x)$ (the color of the nodes turns red). Some subjects cannot judge the risk information well and are temporarily in a wait-and-see state, and they will become the malcontents with the probability α (the color of the nodes turns green). Other subjects who do not believe in the risk information at all and refuse to spread the social stability risks will turn into the rational with probability β (the color of the nodes turns gray).

(4) As time goes by, some staggerers who are exposed to more risk information or begin to believe in risk information for other factors will join in the spread of the social stability risks, and then spontaneously transform into the malcontents with probability θ (the color of the nodes turns red).

(5) When contacting the malcontents, some of the staggerers will be further affected and turn into the malcontents with probability $p(x)$ (the color of the nodes turns red).

(6) Over time, due to factors such as excessive exposure to risk information and under persuasion, some malcontents will temporarily take a wait-and-see attitude and will not participate in the spread of social stability risks, that is, spontaneously transform into the staggerers with probability σ (the color of the nodes turns green).

(7) When surrounded by staggerers, the rational, or other malcontents, some malcontents will be intervened by outside factors and will gradually turn into the ideal, namely, they will become the rational with probability μ (the color of the nodes turn gray).

(8) When there are not any malcontents on the entire network of social stability risk diffusion (no nodes with red color exist), the process of social stability risk diffusion is over.

4.2. Basic Variable Setting of NetLogo Simulation Platform. According to the simulation rules above, it primarily generates the WS small-world network on NetLogo platform and the initial network status will be set, as shown in Figure 7.

In Figure 7, the relevant initial parameters of the model are on the left. "Num-nodes" represent the total number of nodes on the network, namely, the total number of subjects on the diffusion network of the social stability risks of large complex engineering projects. "Rewiring-probability" represents the random reconnection probability p of generating the WS small-world network. "Initial-malcontent" represents the number of malcontents on the entire diffusion network in the initial state, and SI represents the social amplification degree of risks on the diffusion network (in the simulation, we assume that the risks are amplified in the society, setting SI > 0), then the risk diffusion rate $p(x)$ can be obtained from formula (3). "Dormancy-probability" represents risk dormancy rate α, "rejection-probability" represents risk rejection rate β, "recovery-probability" represents risk recovery rate θ, "hibernation-probability" represents risk hibernation rate σ, "extrusion-probability" represents risk extinction rate μ, "clustering-coefficient" represents aggregation coefficient of the generated WS small-world network, and "average-path-length" represents the average distance of the generated WS small-world network.

This paper conducts an investigation on a major water conservancy project in Guangdong Province, and conducts interviews and investigations on the government, project developers, experts, residents, and other related subjects involved in the project to obtain the initial values of the relevant parameters. Due to the sensitivity of social stability risks, this paper has carried out "desensitization" treatment, and the names of large complex engineering projects have been given, but only briefly introduced. The research object is a comprehensive major water conservancy project that focuses on flood control and water supply, and takes into account power generation and shipping. Together with upstream and downstream dikes, it forms a flood control system called "combined with dykes and reservoirs." The

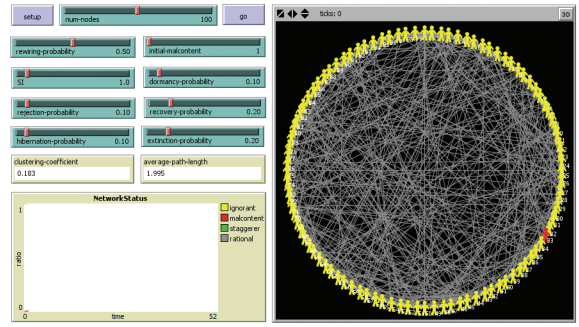

Figure 7: The initial status of IMSR model simulation on WS small-world network.

major water conservancy project plays an important role in ensuring water safety and promoting economic development; thus, it has received extensive attention from the local government and people.

In the initial state, it assumes that the reconnection probability p on the small-world network is 0.5, the number of subjects on the entire network is 100, with the initial number of malcontents being 1, and the rest are all the ignorant. It also assumes that the social amplification degree of risks SI is 1, the risk dormancy rate is 0.1, the risk rejection rate is 0.1, the risk recovery rate is 0.2, the risk hibernation rate is 0.1, and the risk extinction rate is 0.2. The model is run under this state, generating the simulation results as shown in the lower left and right of Figure 7. At the bottom left of Figure 8, it can be seen from the changing trend of subjects in different states that, at the beginning, the number of malcontents on the diffusion network increases rapidly, while the number of ignorant decreases sharply. There are the ignorant, malcontents, staggerers, and the rational on the entire diffusion network. With the spread of social stability risks on the network, the number of malcontents gradually decreases after reaching the peak, and the number of rational people gradually increases, until the malcontents spreading social stability risk factors on the entire network disappear, with only ignorant and rational people left to reach a stable equilibrium state. At this time, the number of rational people on the entire network is 88.

From the theoretical derivation of the previous model, it can be seen that the network equilibrium state is related to the risk diffusion rate, the risk dormancy rate, and the risk extinction rate, among which the risk diffusion rate is determined by the social amplification degree of risks SI. Therefore, the parameters SI, dormancy-probability, and extinction-probability are adjusted to simulate and analyze the influence of changes in risk diffusion rate, risk dormancy rate, and risk extinction rate in the final steady state.

4.3. Simulation Results and Analysis

4.3.1. The Relation between Final Steady State and Risk Diffusion Rate. It can be seen from formula (3) that the risk diffusion rate $p(x)$ is determined by the social amplification degree of risks SI on the diffusion network, and the number of times that the ignorant contact the malcontents x. On the

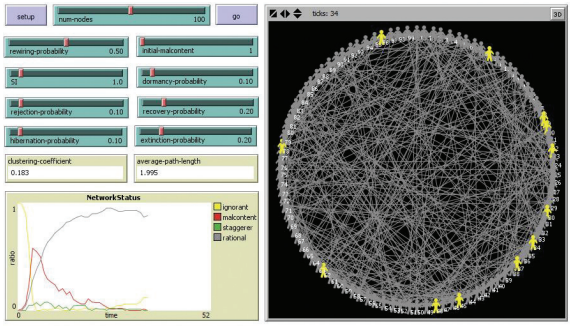

Figure 8: The simulation results of initial parameter values of SWN-IMSR model.

simulation model, x can be calculated by the number of times that the malcontents contact the ignorant, so the influence of SI variation in the final steady state is mainly considered. From formula (3), it can be further seen that when SI increases, $p(x)$ also increases. When the values of SI are 2, 3, and 4, the simulation results are shown in Figure 9.

As shown in Figure 9, after a period of spreading of the social stability risks on the diffusion network, it finally reaches a steady state, ending up with only the ignorant and the rational, that is to say, the diffusion process of social stability risks is over. In the final steady state, the final number of rational people are 84 (when SI = 2), 81 (when SI = 3), and 76 (when SI = 4). When the social amplification degree of risks SI increases, the risk diffusion rate $p(x)$ increases; finally, the proportion of rational people on the diffusion network gradually decreases, thus the spread of social stability risks of large complex engineering projects becomes more violent. From the simulation results, it can be seen that in order to effectively control the spread of social stability risks of large complex engineering projects, the value of the social amplification degree of risk SI should be reduced. In the process of social stability risk diffusion of large complex engineering projects, the reduction of information asymmetry can significantly affect the social amplification degree of risk SI. When the information asymmetry decreases, the government's credibility can be improved, the subjects have relatively more trust in the government, and the social amplification degree of risk SI will decrease. Therefore, as the main owner of information resources, the government has the responsibility and obligation to perform the information disclosure function when the social stability risks of large complex engineering projects break out, build a sound information disclosure mechanism, and protect the public's right to know, so as to reduce the risk of the social amplify degree to control the spread of social stability risks.

4.3.2. The Relation between the Final Steady State and Risk Dormancy Rate. It can be seen from the previous analysis that, in the steady state, the proportion of rational people R is inversely proportional to the risk hibernation rate α on the IMSR model. As the risk dormancy rate α increases, the proportion R decreases. When the value of the risk dormancy rate in the initial state is 0.1, the number of rational people in the final steady state is 88. When the values of risk dormancy rate α are 0.2, 0.3, and 0.4 (namely, the dormancy-probability values in the simulation interface are 0.2, 0.3, and 0.4), respectively, the simulation results are as shown in Figure 10.

As shown in Figure 10, after a period of spreading of the social stability risks on the diffusion network, it finally reaches a steady state, ending up with only the ignorant and the rational, that is to say, the diffusion process of social stability risks is over. In the final steady state, the final numbers of rational people are 85 (when $\alpha = 0.2$), 82 (when $\alpha = 0.3$), and 75 (when $\alpha = 0.4$). In the final steady state, when the risk dormancy rate α increases, the proportion of rational people in the entire diffusion network gradually decreases, leading to more violent risk diffusion as well as serious social stability risks of large complex engineering projects. From the simulation results, it can be seen that in order to effectively control the spread of social stability risks of large complex engineering projects, the value of the risk dormancy rate α should be reduced. Similar to the social amplification degree SI of risk, in the process of social stability risk diffusion of large complex engineering projects, the reduction of information asymmetry can effectively reduce the risk dormancy rate α, thereby effectively controlling the social stability risk diffusion of large complex engineering projects.

4.3.3. The Relation between the Final Steady State and Risk Extinction Rate. It can be seen from the previous analysis that, in the steady state, the proportion of rational people R is proportional to the risk extinction rate μ on the IMSR model. When the risk extinction rate μ increases, the proportion R increases. When the value of the risk extinction rate μ in the initial state is 0.2, the number of rational people in the final steady state is 88. When the values of risk extinction rate μ are 0.3, 0.4, and 0.5 (namely, the extinction-probability values in the simulation interface are 0.3, 0.4, and 0.5) respectively, the simulation results are as shown in Figure 11.

As shown in Figure 11, after a period of spreading of the social stability risks on the diffusion network, it finally reaches a steady state, ending up with only the ignorant and the rational, that is to say, the diffusion process of social stability risks is over. In the final steady state, the final numbers of rational people are 89 (when $\mu = 0.3$), 93 (when $\mu = 0.4$), and 97 (when $\mu = 0.5$), respectively. In the final steady state, when the risk extinction rate μ increases, the proportion of rational people on the entire diffusion network gradually increases, making it more difficult for risk diffusion on the network, and the social stability risks of large complex engineering projects can be alleviated. Through the simulation results, it can be seen that in order to effectively control the spread of social stability risks in large complex engineering projects, the value of the risk extinction rate μ can be increased. In the process of social stability risk diffusion of large complex engineering projects, the ability to deal with risk events can significantly affect the risk extinction rate μ. When the ability is strong, it can quickly act on relevant subjects (namely dissatisfied) that have been

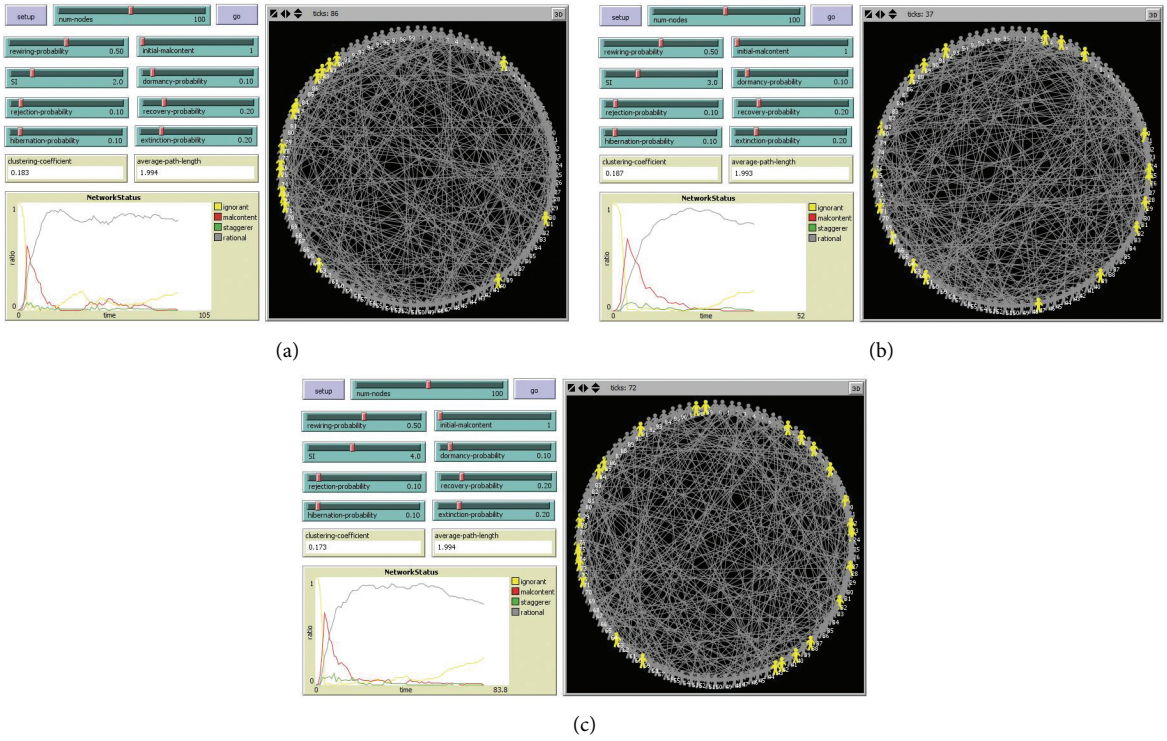

FIGURE 9: The simulation results of the IMSR model when the social amplification degree of risks SI takes different values: (a) the simulation result when SI = 2; (b) the simulation result when SI = 3; (c) the simulation result when SI = 4.

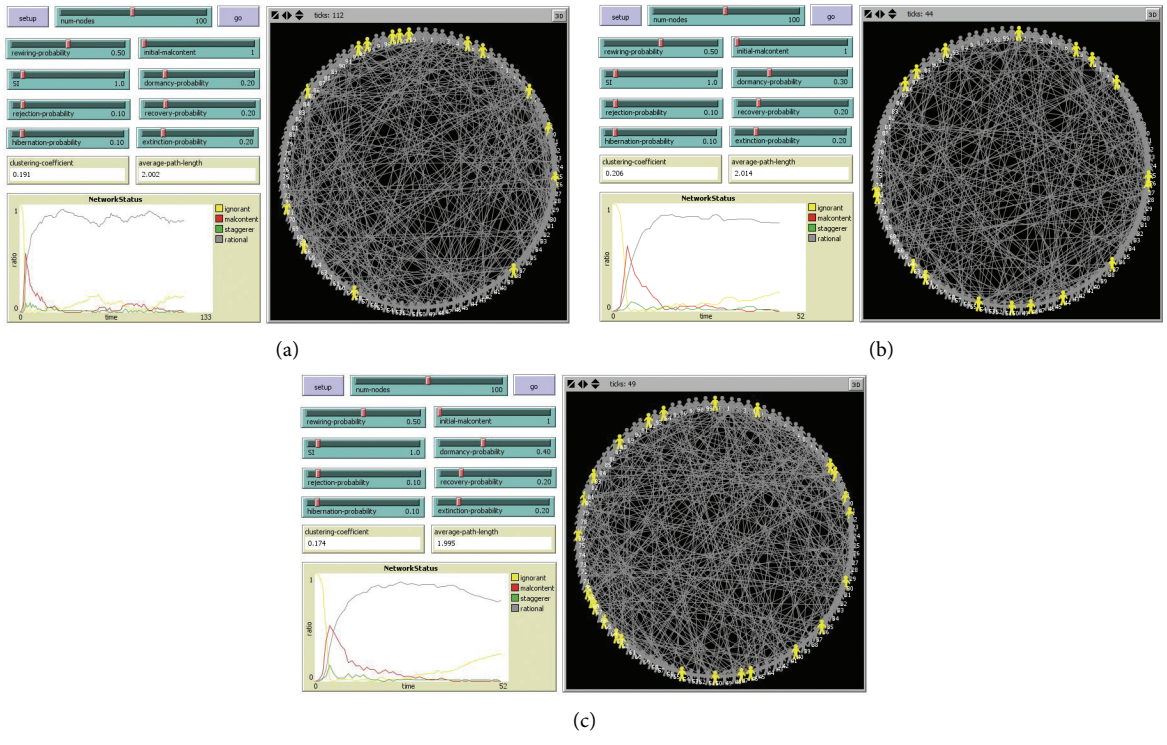

FIGURE 10: The simulation results of the IMSR model when the risk dormancy rate α takes different values: (a) the simulation result when $\alpha = 0.2$; (b) the simulation result when $\alpha = 0.3$; (c) the simulation result when $\alpha = 0.4$.

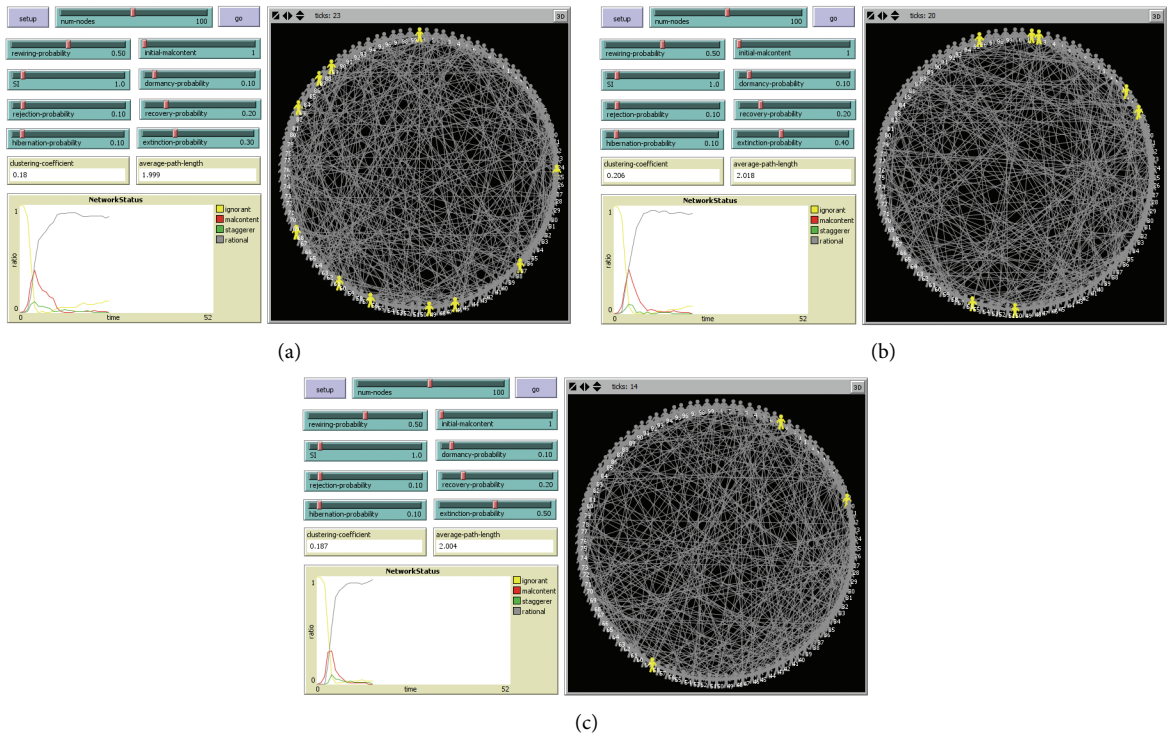

Figure 11: The simulation results of the IMSR model when the risk extinction rate μ takes different values: (a) the simulation result when $\mu = 0.3$; (b) the simulation result when $\mu = 0.4$; (c) the simulation result when $\mu = 0.5$.

affected by risk information, accelerate their transition to staggerers and the rational, and increase their risk extinction rate. Therefore, the government should build a sound social stability risk response mechanism, such as strengthening regional social security and economic compensation at the macro level, and strengthening risk rumors control and psychological counseling at the micro level, so as to control social stability diffusion by increasing the risk extinction rate.

5. Conclusion

Based on the analysis of subjects, interactive model, and infectious disease characteristics of the social stability risk diffusion of large complex engineering projects, this paper discusses the adaptability of the infectious disease model. The traditional SIR model is improved from the aspects of diffusion subjects and diffusion rules, and by regarding the small-world network as the complex network topology, the diffusion process of social stability risks of large complex engineering projects is studied through the NetLogo simulation platform. The results are shown as below:

First of all, we found that the changes in risk diffusion rate $p(x)$, risk dormancy rate α, and risk extinction rate μ can affect the final steady state of social stability risk diffusion of large complex engineering projects, which are basically consistent with the theoretical analysis results. Under the impact of malcontents, the risk diffusion rate $p(x)$ referring to the ignorant participates in the spread of social stability risks and is directly affected by SI, namely, the social amplification degree of risks. The larger the SI is, the greater the risk diffusion rate $p(x)$ is, and finally the proportion of rational people is lower when the state becomes steady. Similarly, the greater the risk dormancy rate α is, the lower the proportion of rational people in the final steady state is. Furthermore, for the purpose of effectively intervening in the spread of social stability risks of the large complex engineering projects, effective measures should be taken to reduce the social amplification degree SI and risk dormancy rate α of risks, which exist on the network of social stability risk diffusion of large complex engineering projects. Then, it affects the diffusion process to effectively defuse the social stability risks.

What is more, the malcontents no longer participate in the spread of social stability risks since they are affected by other subjects or their interest demands are met; thus, the increase in the risk extinction rate μ will increase the proportion of rational people in the final steady state. Therefore, at the same time of reducing social amplification degree SI and the risk dormancy rate α, the risk extinction rate μ on the network of social stability risk diffusion of large complex engineering projects should also be increased as much as possible, aiming to better control the spread of social stability risks of the large complex engineering projects.

There are still three deficiencies in the study. Firstly, from the aspect of diffusion subjects and diffusion rules, the IMSR model constructed in this paper is improved based on the traditional SIR model, but the division of subjects and the analysis of diffusion rules still remain at the theoretical level; whether new subjects and more complex diffusion paths can

be added is worthy of further exploration. Secondly, although the small-world network is indeed the network structure most in line with the real social network, this paper only considers the small-world network as a network structure for simulation research, and does not choose other network structures such as scale-free networks for comparative analysis. Thirdly, real data are not used in the simulation study of social stability risk diffusion of large complex engineering projects on the small-world network; the relevant parameters such as the social amplification degree of risks SI, the risk diffusion rate $p(x)$, the risk dormancy rate α, and the risk extinction rate μ are assigned with hypothetical values, which still deviate from the actual situation, although these assignments are determined based on a large number of literatures and interviews with relevant experts. The further research of this paper should focus on the following three aspects. Firstly, further combine the construction practice of large complex engineering projects in China, analyze more types of subjects participating in the spread of social stability risks, consider the diffusion paths among more subjects, and improve the IMSR model. Secondly, improve the model by constructing other network structure types, such as scale-free networks, and conduct further comparative analysis to study the process of social stability risk diffusion under different network structure types. Thirdly, increase the relevant case collection and social survey, and try to use real data from some typical cases, including social networks such as Facebook and Sina Weibo, enabling the selection of relevant parameters in simulation research to be more scientific and reasonable. At the same time, it is possible to propose more appropriate intervention strategies for the spread of social stability risks of the large complex engineering projects based on more accurate parameter selections.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare no conflicts of interest.

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