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Adaptive Control Theory and Index System for Social Stability Risk Assessment of Major Projects: Based on 22 Typical Cases

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Abstract

The article will systematically evaluate the research status on social stability risk assessment. Then summarize and comb the social stability risk assessment framework based on different perspectives, and finally analyze the applicable scope and limitations of existing assessment frameworks. A new framework – Adaptive Control Theory for assessing social risk governance is proposed, as active control and advance prevention are added on the basis of the theoretical framework of social combustion. A scientific, rational and comprehensive index system of social stability risk evaluation matched is established, and the index weight is determined by Fuzzy Identification Theory based on 22 typical cases of social stability risk in the past six years. Finally, the paper discusses and analyzes the characteristics of construction projects with different risk levels.

Keywords: Social stability risk assessment framework, Adaptive Control Theory, indicator system, prevention and control.

1. Introduction

With the progress of science and technology and the need of social and economic development, the social structure of our country is constantly changing, and the interest demands of different social strata are gradually divergent, and also the interests of all parties have begun to rub up for their own interests in some events, including the land expropriation disputes, labor disputes, and adjacent avoidance effects in which the social contradictions and conflicts are constantly convex (see Jing et al. [9]). Unstable factors and disputes hiding behind the rapid economic development are easily changed into social crisis, especially the potentially unstable risk factors in major matters which may threaten the harmonious development of the society and the national security (see Mostafa et al. [12]). Thus, the stable environment is crucial to the construction of a harmonious and developing society in China. China has emphasized that it is pivotal to promote reforms in the contradictive overall situation to maintain social stability. And

the importance of social stability risk assessment is self-evident as a means of pre warning and control for social stability.

The risk assessment of social stability makes systematic investigation, scientific prediction, analysis and evaluation of factors that may affect social stability, and formulates risk coping strategies and plans. It can effectively avoid, prevent and control the possible social stability risks in the implementation of major matters to better ensure the success of major matters. Experience shows that risk assessment and research on major social stability disturbances are of wide and profound practical significance. At present, many scholars have put forward their own evaluation framework for the risk management of social stability. These assessment frameworks have a certain contribution to the governance of social risk.

1.1. The theoretical study

Ulrich Beck puts forward the risk society what is an uncertain society in fact, emphasizing that risks are often unpredictable and invisible (see Beck [2]). He argues that the present society is different from the previous society, and people are facing a series of uncertainties now. In this society, human beings cause their own problems with unconsciousness or even the help of science, in which people do not actually know what exact dangers they are subject to. Therefore, the risk society is characterized by ignorance rather than knowledge of probability (see Patrick et al. [14]). This provides us with a reference to the understanding of social risks.

However, many scholars argue that social risks are not static but dynamic. The risks after social crisis are transferable. In the study of risk variation, Kasperson et al. (1988, 2005) put forward the Social Amplification of Risk (see Xiao et al. [18]). The theory holds that factors such as psychological, social, institutional and cultural interaction will interact with risk events, which will strengthen or weaken people's risk perception and make new risk behaviors, usually resulting in new social consequences to exceed direct damages to human health or the environment from the event itself. In view of the information system and the public response system are the core of the social risk enlargement (or reduction), the government thus must make a good grasp of the formal or informal risk source to manipulate information.

In the field of sociology, deviance is defined as a set of disobeying against given norms accepted by the overwhelming majority of a community or society. It applies not only to individual behavior but also to group activities, which provide a way of thinking for the study of mass events. The theory of control is a representative theory in the study of deviance. It assumes that people's behavior is rational, and one sees the opportunity as a stimulated action (see Anthony [1]). Travis Hirschi, a famous control theorist, proposes that human beings are carefully calculated the potential benefits and possible risks to make a decision whether to commit a crime. When the four ties of attachment, responsibility, devotion, and belief are strong enough, it is impossible to violate the rules and thus help maintain social control and compliance.

Given that social control process refers to the dynamic operation process of social control means, the process of social control consists of four specific links, involving

decision-making, implementation, monitoring and feedback (see Zheng [22]). There is a disturbance outside this control system, which includes ideological and cultural influences outside the system and alien invasions. If a social control system does not have good stability, a small disturbance may lead to failure of social control mechanism and further social disorder. The information of the output of the control process is not only the feedback to the decision-making body but also to the social goal. Hence, the actual trajectory of the social operation is compared with the predetermined track of the society. If there is a deviation from the timely correction, it is possible to amend the social goal and make it conform to the law of social operation.

1.2. A perspective of environment behavior

Cao et al. [3] put forward the evaluation framework and methods of risk management in Chinas social stability based on the social ecosystem in the perspective of "environment-behavior". They posit that the so-called social stability risk is the possibility of social instability, but the social instability is in essence the comprehensive performance of individual behavior in the social ecosystem, while the individual behavior is the product of the subjective cognition and value judgment of the actors on the environmental factors. Cao et al. claim that environmental factors are the basic inducements of the risks of social stability. The environment dimension provides a theoretical framework and an operable scheme to explore the risks of social stability with theoretical significance. However, there are some flaws in the theoretical framework of environmental behavior for the environmental dimension is the only gauge of risk assessment in this framework. It means the theory attaches too much importance to the role of environmental factors and lacks precautionary factors and the impact of social actors' mentality on social risk stability. Besides, it lacks empirical cases and data. According to further verification and confirmation, it is also necessary to continue to explore and improve the size, probability and weight of each risk point.

1.3. A perspective of risk perception

At present, many developed countries attach importance to analyzing and monitoring the social environment, and conducting social impact assessments on public risk perception (see Renn and Sellke [15]). Some scholars have shown that by monitoring and assessing the risk perception and negative emotions of netizens, it can effectively explain and predict the social stability risks faced by major projects (see Xiao et al. [19]). On the basis of the public risk perception perspective, Hu et al. [7] have constructed a new framework to assess the risks of social stability, which is used to analyze how public risk perceptions lead to social stability risks and further social protests. Hu et al. demonstrate the risks of social stability caused by man-made technology risks, such as nuclear power plants and waste incineration plants. Risk sources (including risk facilities, risk events, unknown risks, etc.) are selectively perceived through the role of media intermediaries such as social organizations, news media and interpersonal communication (see Francesco and Ariadne[6], Ibitayo et al. [8]). Individual risk perception is reflected at

the psychological level (such as anxiety, fear, etc.) and cultural level (such as trust, world outlook, social and economic background, etc.). When individual risk perception is spread and recognized in a larger group, the risk perception of the public is gradually formed (or perceived as a social risk perception). At this time, risk perception is reflected as social panic in the psychological level of and social distrust and stigmatization in the cultural layer. When social panic, anxiety, social mistrust, and stigmatization are all reached to a certain extent, the public's mass protest appears when the public's perceived risk damage is much more than the risk income.

Based on this, Hu et al. advocate that risk is subjective. On the basis of two major risk perception schools of "psychological measurement" and "cultural theory", risk perception perspective – a new perspective, is put forward for the risk assessment of social stability. The theoretical framework shows that the public perception of risks and risk income is a factor that affects the risks of social stability, and provides a new perspective and a new approach for us to assess social risk. However, the framework only simply determines the social risks from the perceived dimension of the public, overly focuses on the psychological process. For further research, it can introduce new variables on this basis. And its variables can be materialized because the mental process is a subjective variable with some difficulties in its judgement and evaluation.

1.4. Problem oriented perspective

Xu et al. [20] present a new framework for risk assessment of social stability in investment projects on the basis of the perspective of problem solving oriented. They believe that at present, local governments and engineering consultancy institutions at various levels generally adopt the "overall risk grade oriented project" evaluation framework. Yet there are many problems. To this end, they raise the new framework of project evaluation in problem solving oriented, and study the main links of investment projects, such as risk survey, risk identification, risk analysis, risk assessment and risk response measures, in order to guide the project to evaluate the actual work. In view of the shortcomings and errors of the existing risk assessment framework for social stability in China's major projects, a new framework for the risk assessment of social stability is proposed, which is based on "finding problems - analysis problems - solving problems". Through thorough investigation, the main risks affecting social stability are determined on the basis of the analysis of various risk factors. Then, the probability and degree of impact of each risk are predicted according to the experience of experts, and the degree of risk and the degree of controllability are judged and the unacceptable risks must be classified into practical and feasible measures. All risks are in a low risk and controllable state before they can arrive at a feasible conclusion of the project.

The theoretical framework holds that any major risk factor may lead to social risks, which provides a new way of thinking for us to assess social risks. However, the framework has high cost and low operability in the implementation process. There are no specific ways of finding problems, analyzing problems and solving problems, nor do they involve risk prediction.

1.5. Theoretical framework for social combustion

Niu [13], a sociological expert, began to find a new way to study the human society by examining the natural world with the theory of social combustion, and developed a system of social stability warning. Li [10] proposes the theoretical framework of social combustion, managing the risk of social stability of major projects. By analogy with social phenomena of disorder and instability, he puts forward the theory of Social Burning Theory and holds that: (1) In social life, the disharmony between "man and nature" and the disharmony of "man and person" are almost always visible and unavoidable. These phenomena can be regarded as "burning material", and may cause social instability, which is the basic cause of social disorder; (2) Deemed as a material for "combustion assisting agents combustion agent", it is a specific event or phenomenon that causes social unrest, such as malicious attacks by the hostile forces of the society, misleading of media public opinion, excessive exaggeration or distortion of facts, the widespread dissemination of the gossip, pursuing one-sided interests inconsistent with the overall situation, irrational inferences and guesses, spreading rumors and the amplification of social psychological functions; (3) "Ignition temperature" is a sudden event with certain scale and influence, and it is the fuse which leads to social instability.

The theory of social combustion illustrates that, if the risk factors are not eliminated or resolved in time, the three factors, such as combustion substances, combustion assisting agents and ignition temperature, will work together, and quickly close to the threshold (four) of social system stability and safety, and cause different levels of social risks. However, the scope of application of the theoretical framework has some limitations, that is, it is only suitable for the construction projects with large risks, and it lacks the content of active control and pre control.

1.6. Evaluation of existing theory and evaluation index system

In summary, through the research and analysis of the research on the risk assessment framework of social stability at home and abroad, relatively mature theoretical evaluation frameworks have been raised from multiple angles, which are of great significance for reference. Most scholars in China build a framework for the risk assessment of social stability from a specific point of view. There are few studies on the establishment of a systematic and comprehensive assessment framework, most of which do not involve prevention and control. In contrast, the theory of social control in foreign countries has a relatively early development, and has developed a more mature theoretical system. It provides a good reference for the construction of the risk assessment framework for social stability. However, the existing theoretical framework mainly studies the group behavior from the large social groups, and has a good explanation of the reasons for the formation of the behavior, the performance and the results. But it only focuses on the study of the large social groups and neglects the influence of the small and medium social groups. Also the technical components of the risk study are too narrow and vague to be the key criteria for measurement. At last the research on the social subject has not fully taken into account the diversity of the subject.

In addition, the current risk assessment framework for social stability is mostly lacking a risk assessment index system for social stability, what has weak operability in the process of determining and evaluating the risk. According to the evaluation framework, the risk assessment of social stability needs to establish the corresponding risk assessment index system, to monitor and evaluate the risk level and change trend of social stability in time, and to analyze the current social stability risk according to the results of the assessment, and to formulate the risk management policy and implement the risk management of the society.

2. Adaptive Control Theory

2.1. Basic framework of adaptive control theory

The social risk assessment framework proposed in different perspectives has been sorted out, and its scope of application and its limitations have been analyzed. On the basis of the risk variables of the theoretical framework in different perspectives, a new assessment of social risk management framework–Adaptive Control Theory is put forward, as shown in Figure 1. It aims to increase the active control and pre-control links based on the theoretical framework of social combustion by replenishing the shortages of the former framework.

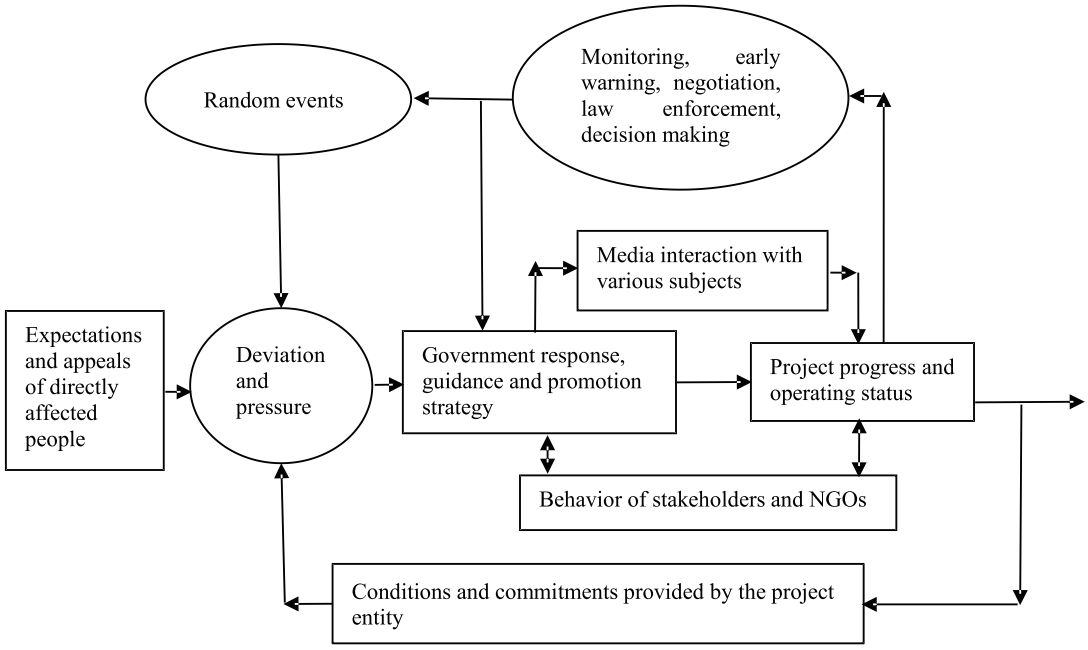

Figure 1: Frame diagram of adaptive control theory.

2.2. The development of adaptive control theory for "social combustion theory"

Social physicists have proposed the "Social Combustion Theory" by comparing the instability of human society with the burning of nature. As we know, once the burning phenomenon in nature threatens the safety of human life and property, we will not let it develop, then fire-fighting measures must be taken to minimize the damage caused by the burning phenomenon, and the best state of fire extinguishing (lowest cost, least loss) is "fire was killed in the bud" or "prevent problems before they happen." According to the principle of fire extinguishing, the purpose of fire prevention and extinguishment is achieved by reducing the "Burning Substances", lowering the "Ignition Temperature", changing the "Combustion Agent" and other channels. The same principle applies to the prevention and control of social stability risks. "Fire Prevention" is more important than "Fire Fighting". Unlike the Social Combustion Theory, the Adaptive Control Theory emphasizes the importance of "prevention" and "control". The government in this link plays the role of the "Firemen" to reduce social risks through strategies such as response, guidance and promotion.

Adaptive Control Theory demonstrates that:

(1) In the process of project implementation, conditions and commitments provided by the project entity and expectations and appeals of directly affected are difficult to accord with each other, the deviations and pressures faced by the two are always visible and inevitable. It regards this kind of disharmony and insecurity as "Combustible Material", which is the fundamental cause of social instability.

(2) Some random events triggered by specific groups will have a significant impact on the normal social order, which can lead to widespread concerns around the community or even the entire society, and suddenly increasing senses of crisis among the public especially stakeholders. In this case, random events are considered as "Fire Source".

(3) Facing the deviations and pressures between the project entity and the affected people, with the impetus and pressure of the media and stakeholders, NGOs, etc., especially the occurrence of random events, the government will be alert and take a series of strategies, such as response, guidance and promotion, to avoid social instability. The government thus plays the role of fire brigade throughout the process.

(4) The interactions between the media and various subjects fully utilize the role of media intermediary, which will promote and accelerate the dissemination of such disharmonious factors and be selectively perceived by individuals. The behavior of stakeholders and NGOs will also strengthen the development of the harmonious factor. These play the role of "Combustion Aid" in this case. However, in the process of government control of social stability risks, its response and guiding strategies use the media to improve the efficiency of interactions with various entities and increase the speed of fire fighting. In this sense, it is more appropriate to refer to the interactions between the media and the various entities as well as the actions of stakeholders and NGOs as "Catalysts".

2.3. Several key nodes of social stability risk control

The negative effects caused by major projects will result in conflicts between local governments, project implementation entities and local residents. In addition, the dissemination of information such as rumors and gossip, will lead to a deeper distrust of major projects, which will directly affect and act on the construction process of major projects. In this process, Adaptive Control Theory emphasizes that:

(1) Minimize interest deviation and psychological pressure

The major project entity pursues the implementation of its own project to the maximum extent possible by paying the least cost, while the affected party pursues that the project is not allowed to have a negative impact or the project entity pays corresponding compensation for its negative effects. In order to ensure the smooth progress of the project, the project entity will provide certain conditions and commitments to the affected people. As mentioned above, the project entity pursues the maximization of self-interest, and the commitment of the project subject can hardly meet the expectations and demands of those directly affected. At this time there are deviations of interest and psychological pressure to both parties, which will become the most fundamental underlying factor (source of risk) of the overall risk as "Combustible Material", and it will be out of control once it gets an opportunity. "Risk Contradictions, Source Governance". So it emphasizes to minimize the deviation of interests and psychological pressure and the amount of combustibles.

(2) Promote positive interaction between the various subjects

With rapid development of technology, the spread of messages is no longer limited by time and space. Messages are rapidly spread through the interactions between the media and the various subjects, and the media audience selectively perceives and accepts such information, and this choice tends to accept negative news and spread it again. The interactions between the various subjects tend to exacerbate the psychological stress of the affected people, especially when random events occur. Of course, the media also plays an active role in the government's resolution of random events, providing a common platform for government and public communication to promote the resolution of random events and resolve the risk. It emphasizes to strengthen the positive interactions between all subjects and control the vicious spread of rumors.

(3) Control of dynamic and stochastic processes

Adaptive Control Theory emphasizes that the social stability risk management is a dynamic and random process. When interest deviation and psychological pressure exist, random events may occur at any time, which is bound to be a long-term process for social stability risk assessment. Before the interest deviation is resolved, the risk assessment and risk resolution should be carried out in stages continuously, which is a circular process.

(4) Active prevention

Adaptive Control Theory addresses the importance of prevention. Actual results have a lot to do with risk prevention and control. The deviation of interests and psychological pressure between the major engineering subjects and the affected people is

nonlinearly amplified through the interactions between the subjects, thus erupting large-scale protests, demonstrations, etc., when the accumulated total amount is equal to or greater than the maximum critical value of social stability and security. At the time of the activation of one or several "fire lines", a series of public crises will erupt, which will cause great harm to social stability and people's lives. However, if prevention and control are adopted, it is possible to reduce or stabilize the deviation of interests and psychological pressure between the main project subjects and the affected people, thus preventing the occurrence of random events.

3. Index System of Social Stability Risk Assessment for a Class of Construction Projects

Corresponding to the various aspects of Adaptive Control Theory, the influencing factors involved in the social stability risk assessment framework are integrated and summarized. Hence, the social stability risk indicator system of major engineering projects was constructed with multiple perspectives and comprehensive perspectives (see Deng et al.[4], Wang [16], Xiang et al. [17], Zhao et al. [21]) to reference scholars' existing index system of social stability evaluation and the characteristics of such construction projects, and to take a comprehensive consideration of the relevant government functions and related mechanisms of the participating entities, the normative issues of the relevant personnel, the position of the public, the risks in the project implementation and operation, and the possible environmental impacts, etc. in the construction of major projects.

3.1. Social stability risk assessment index system based on adaptive control theory

Adaptive Control Theory emphasizes the importance of prevention and control, preventive and regulatory measures need to be taken on the basis of phased risk assessment. Therefore, a comprehensive risk evaluation index system of social stability is compiled, which contains six dimensions of the legitimacy of the government regulation and control policy, the rationality of the compensation for the local residents, the feasibility of project builders' demolition action plan, the enthusiasm of the stakeholders involved, smoothness of interaction between subjects, the smoothness of each subject's interaction and controllability of random events, shown in Table 1.

Table 1: Index System of Social Stability Risk Assessment.

Level indicators	The secondary indicators
The legitimacy of government regulation policy	(1) whether the planning bureau proves that the new project is illegal construction
	(2) whether to make a written announcement
	(3) whether the affected party is informed of the relevant rights and obligations of the affected party
	(4) whether the period of compulsory demolition undertaken by the government shall not be less than the statutory period
	(5) whether the compulsory execution of the government has been examined and ruled by the court
The rationality of compensation for local residents	(6) whether it conforms to the principle of equitable compensation
	(7) whether information disclosure and rights and interests notification are in place for the affected persons (local residents)
	(8) whether the implementation measures such as compensation and resettlement for the people involved are complete
	(9) whether there are necessary safeguards for the vulnerable and the vulnerable
	(10) whether the process of the affected person's participation in project decision-making, the convenience of participation and the feedback (interpretation, guidance and persuasion) on the affected person's opinions are effectively guaranteed
Feasibility of project builders' demolition action plan	(11) whether the action plan of the project builder is legal and compliant (environmental protection regulations)
	(12) whether the project builders have the approval procedures of environmental protection and planning
	(13) whether the existing financial resources of project builders can support relevant costs and expenditures
	(14) can the existing buildings be dismantled smoothly according to the time announced by the government
	(15) whether the impact of project construction on the future natural and cultural environment can be accepted by the public
	(16) whether the programme of action of the project builders is adequate
	(17) whether the supporting measures of the action plan of the project builders are perfect
	(18) whether the compensation funds for residents can be paid in full and on time
The enthusiasm of the stakeholders involved	(19) media and Internet (including public figures, experts, scholars, etc.
	(20) whether the stakeholders support it
	(21) whether the experts support it
	(22) whether ngos support it
	(23) whether relevant reporting, commitment and supervision systems have been established

The smoothness of each subject's interaction	(24) whether a special consultation office for local residents and project builders should be established
	(25) whether a seminar with project builders and local residents can be convened with the participation of senior administrative leaders
	(26) the true degree of media and online information and the guidance of public opinion
	(27) whether information disclosure to stakeholders is in place
	(28) whether to establish a standardized and orderly expression channel and consultation resolution mechanism for the major appeals of project builders and local residents
	(29) whether to establish a public opinion gathering analysis and "demolition" situation prediction and early warning mechanism
	(30) whether a legal and arbitration assistance mechanism has been established for major differences and outstanding contradictions
The controllability of random events	(31) adequate information on local residents who may have overreacted
	(32) have adequate information on vulnerable local residents and difficult local residents
	(33) relating to the unreasonable objection put forward by the masses and demands, whether for fully reasonable interpretation according to law and policy, powerful argumentation and detailed instructions, and most of the understanding and support of the masses
	(34) whether there are necessary explanation channels and relief channels when local residents have serious doubts about the demolition or have serious difficulties caused by the demolition
	(35) whether there are risk groups (including bad lawyers, intermediaries, etc.) that trigger mass collective petitions or mass incidents of the masses
	(35) whether an unstable factor accounting and reporting system should be established
	(37) whether the risk prevention and resolution plan is detailed, practical and perfect
	(38) whether the reporting and reporting mechanism of important information is perfect
	(39) whether the correct adjustment mechanism of dynamic monitoring mechanism, on-site emergency response mechanism and response measures for dealing with mass incidents is perfect
	(40) whether the organization and accountability mechanism for risk resolution and liability investigation are perfect

3.2. Data sources

Through extensive collection of news and other materials from the Internet and offline, this study has obtained typical cases of 22 social stability risks involving major projects in the past six years, and numbered them in the order of collection (1-22), as shown in Table 2.

Table 2: 22 Typical Cases in China (in order of collection).

The serial number	The time span (Year)	place	The project name	Project results	Result code
1	2013	Ning An, Yunnan	10 million tons refinery project in ningan, yunnan	The project will be put into trial	1
2	2015	Heyuan, Guangdong	Heyuan power plant phase ii project	Formally started	1
3	2012	Qidong, Jiangsu	PX incident in qidong, jiangsu province	Never cancel	0
4	2012	tianjin	Tianjin PC nimbyism	Re-evaluate the project	0
5	2010	Suzhou, jiangsu	Demolition of tongan town in suzhou new district, jiangsu province	Suspension of transfer to safety	0
6	2017	Daqing, Heilongjiang	Zhongwang daqing project	Suspension of construction	0
7	2014	HuiNing; Jiangsu	Jiangsu ju ning garbage power project	Project goes smoothly	1
8	2016	Xiantao; Hubei	Xiantao waste incineration power plant construction project	Project termination	0
9	2016	YongCheng, Henan	Henan huarong aluminum co., LTD. Annual production of 2 million square corrosion electrode foil and 20,000 tons of water purification agent projects	Project goes smoothly	1
10	2013	Zhangzhou, Fujian	Fujian zhangzhou PX project	Project goes smoothly	1
11	2016	Lianyungang, JiangSu	Lianyungang nuclear fuel incident	Suspension of construction	0
12	2016	Xianyou, Fujian	Xianyou garbage power plant project	Project goes smoothly	1
13	2012	Shifang, Sichuan	Shifang molybdenum copper incident in sichuan	Project termination	0
14	2014	ShangHai	Shanghai nanhui industrial park battery plant project	Project termination	0
15	2014	Guangzhou, Guangdong	Shaheding old factory renovation project	smoothly	1
16	2013	Changsha, Hunan	People from all over the world are strongly opposed to relocation in environmentally sensitive areas	Not found	-
17	2016	Wanning, Hainan	Hainan wanning garbage incineration power plant project	smoothly	1

The serial number	The time span (Year)	place	The project name	Project results	Result code
	2016	Longkou, Shandong	Residents in longkou, shandong province, have opposed the suspension of the yulong petrochemical base project	Project termination	0
19	2012	Ningbo, Jiangsu	PX incident in ningbo, jiangsu province	Project termination	0
20	2016	JiangYin, JiangSu	Wooden community built garbage transfer station	The unknown	-
21	2015	YunFu, GuangDong	Waste disposal projects	Project termination	0
22	2016	ZhengZhou, HeNan	Gree's environmental protection project in henan	Project termination	0

Note: In order to make the results more intuitive project, will be followed by a "1" represents the project go smoothly, "0" on behalf of project suspension (yet not restart) or project is terminated, "-" on behalf of the project results unknown (in the process of search and finishing materials to relevant results).

These cases all involve risk generation and control in project demolition, reconstruction and new construction. These projects have the following characteristics: Firstly, they will have negative external effects while bringing certain economic benefits. Secondly, these negative impacts include environmental issues such as air and water pollution, ecological impacts, landscape impacts, noise pollution, and the resulting health problems, as well as non-environmental impacts including economic and social impacts. In addition, costs and benefits are asymmetrical, leading to unfairness and thus varying degrees of social stability risks. Moreover, these cases cover nearly half of the provinces in China, and the provinces in different provinces have their own features, high representation.

3.3. Data sorting

Data sorting is the premise of data analysis. There are four main steps, as shown in the Figure 2.

The first step is to create a case document library. Each case is organized into a complete word document according to the chronological order of event development, and highlights the time of the event and the involved stakeholders in the document, and finally forms 22 word documents.

The second step is to build a case table library. One-to-one correspondence with 22 documents in the case document library, forming 22 excel forms. In each table, the horizontal factors are stakeholders, including the Chinese government, central media, local media, relevant media, environmental protection agencies, environmental organizations, enterprises, local governments, local government departments, relocated residents, and local public. The vertical factor is the development stage (timeline)and the cross-factors are the actions taken by the specific stakeholders at that time.

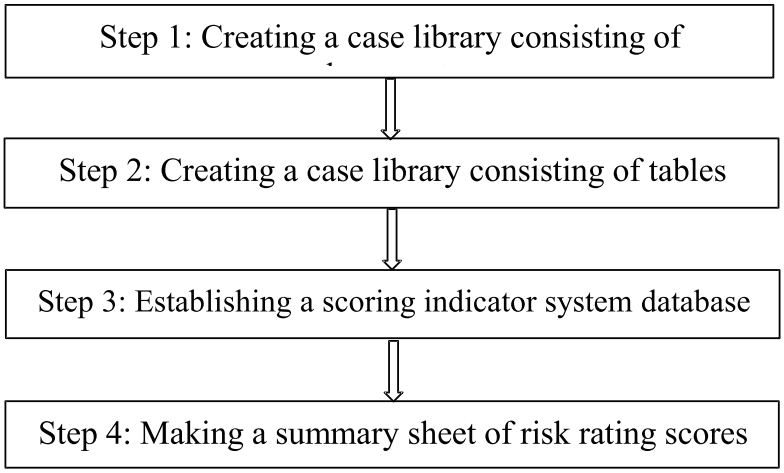

Figure 2: A Flowchart for Steps.

The third step is to establish a database of scoring indicator systems. According to the social stability risk evaluation index system that has been established above, the reason items and scores are increased, and each case is scored by the expert scoring method to form 22 scoring index systems. The scoring standard is to classify the risk level of the indicator into 5 levels, and score 1-5 points according to the risk level from low to high. The lower the risk, the lower the score, and the higher the risk, the higher the score.

The fourth step is to establish a general score sheet. Summarize the 22 scoring indicator systems into a new sheet. In the new table, the vertical data is the case number, the horizontal direction is 40 indicators, and all the score data are standardized into the table, and the final score data of 40 indicators of 22 cases are obtained, as shown in Table 3.

4. Determination of the Weight of Evaluation Indicators

In the assessment of social stability risks, the determination of the weights of the indicators of 40 indicators is very important. We use a combination of subjective and objective methods to determine the weight of each indicator (see Ma and Du [11]). Firstly, the initial weight is determined according to the objective method. Then, based on the weight establishment, an initial solution of the indicator vector–the total risk value of the case is calculated. If the solution is basically matched with the result of the case (the result of the high-risk project is terminated, and the result of the low-risk project is smooth), it is not necessary to adjust the target weight vector, otherwise the initial solution needs to be adjusted by subjective method of determining the target weight.

4.1. Basic principles and methods of fuzzy pattern recognition

The fuzzy pattern recognition method compares and matches the object feature information to be identified with the given sample feature information, and gives the

Table 3: Score of 40 Indicators in 22 Cases (After Standardization).

Indicator 1 - Indicator 20																				
Serial number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.2	0.2	0.2	0.2	0.2	0.6	0.6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1	0.4	0.6	0.2	0.8	0.8
2	0.2	0.2	0.4	0.2	0.2	0.4	0.4	0.2	0.2	0.4	0.2	0.2	0.2	0.2	1	0.4	0.4	0.2	1	0.8
3	0.8	0.6	0.6	0.2	0.6	0.8	0.8	0.8	0.6	0.8	0.8	0.4	0.2	0.2	1	0.4	0.8	0.4	1	1
4	0.2	0.2	0.8	0.2	0.2	0.6	0.8	0.4	0.4	0.4	0.2	0.2	0.2	0.2	1	0.4	0.6	0.2	0.8	0.8
5	0.2	0.2	0.2	0.2	0.2	1	0.8	0.4	0.4	0.8	0.2	0.2	0.2	0.2	0.2	0.2	0.6	1	0.8	0.8
6	0.2	0.2	0.2	0.2	0.2	0.4	0.6	0.4	0.6	0.4	0.2	0.2	0.8	0.2	1	0.8	0.6	0.2	1	0.8
7	0.2	0.4	0.4	0.4	0.2	0.8	0.4	0.4	0.6	0.6	0.4	0.4	0.2	0.4	1	0.4	0.2	0.8	0.6	1
8	0.2	0.6	0.6	0.2	0.2	0.8	0.8	0.6	0.6	0.2	0.4	0.4	0.4	0.2	1	0.4	0.6	0.6	0.6	1
9	0.2	0.2	0.2	0.2	0.2	0.6	0.2	0.6	0.4	0.2	0.2	0.2	0.2	0.2	0.6	0.2	0.6	0.6	0.4	0.2
10	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.2	0.8	0.2	0.2	0.2	0.6	0.4
11	0.4	0.4	0.6	0.2	0.8	0.8	0.8	0.8	0.8	0.6	0.2	0.2	0.2	0.8	1	0.6	0.6	0.6	0.6	1
12	0.2	0.6	0.6	0.2	0.2	1	0.6	0.6	0.6	0.6	0.2	0.4	0.8	0.4	1	0.8	0.6	0.6	0.6	1
13	0.2	0.2	0.2	0.2	0.6	0.8	0.2	0.6	0.6	0.2	0.2	0.2	0.2	0.2	1	0.6	0.6	0.6	0.6	1
14	0.2	0.2	0.2	0.2	0.2	0.8	0.2	0.6	0.6	0.2	0.2	0.2	0.2	0.2	1	0.2	0.6	0.6	0.6	1
15	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.8	0.2	0.2	0.2	0.4	0.2
16	0.4	0.2	0.8	0.4	1	0.2	1	1	1	1	1	0.2	0.2	0.2	1	0.2	0.2	0.2	0.2	1
17	0.2	0.2	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.4	0.2	0.2	0.8	0.2	0.2	0.2	0.2	1
18	0.2	0.4	0.2	0.4	0.2	0.2	0.4	1	0.2	0.4	0.2	0.2	0.2	0.4	1	0.4	1	0.2	0.2	1
19	0.4	0.4	0.2	0.2	1	0.8	0.8	1	1	0.4	0.2	0.4	0.4	0.2	0.8	0.2	0.2	1	0.8	1
20	0.4	0.4	0.2	0.2	0.2	0.2	0.4	0.2	0.2	0.2	0.4	0.4	0.2	0.2	0.8	0.2	0.2	0.2	0.2	1
21	0.2	1	0.2	0.2	0.2	0.2	0.4	1	0.8	0.2	0.2	0.2	0.2	0.2	1	1	1	0.2	0.2	1
22	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.4	0.4	0.2	0.2	0.8	0.2	0.2	0.2	0.2	1
Indicator 21 - Indicator 40																				
Serial number	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	0.4	0.8	0.2	0.2	0.2	0.4	0.6	0.2	0.4	0.4	0.6	0.4	0.4	0.4	1	0.4	0.4	0.4	0.4	0.4
2	0.8	0.4	0.4	0.2	0.2	0.6	0.6	0.6	0.4	0.4	0.6	0.4	0.4	0.2	0.6	0.4	0.4	0.4	0.4	0.4
3	0.8	0.8	0.2	0.8	0.2	0.2	0.8	0.6	0.6	0.4	0.6	0.2	0.8	0.6	0.8	0.4	0.6	0.4	0.4	0.2
4	0.2	0.6	0.6	0.8	0.4	0.2	0.8	0.4	0.4	0.4	0.6	0.4	0.6	0.2	0.6	0.4	0.4	0.4	0.2	0.2
5	0.2	0.2	0.6	0.6	0.6	0.4	1	0.6	0.6	0.6	0.6	0.6	1	0.8	0.6	0.4	0.4	0.4	0.6	0.2
6	0.4	0.4	0.4	0.8	0.8	0.8	0.6	0.6	0.6	0.4	0.6	0.6	0.4	0.6	1	0.6	0.4	0.2	0.2	0.2
7	0.4	0.2	0.8	0.6	0.6	0.4	0.6	0.6	0.6	0.6	0.6	0.6	0.8	0.6	0.8	0.6	0.6	0.4	0.6	0.6
8	0.8	0.2	0.6	0.6	0.4	0.6	0.6	0.8	0.6	0.6	0.4	0.6	0.2	0.4	1	0.6	0.6	0.6	0.4	0.6
9	0.2	0.2	0.4	0.4	0.4	0.2	0.2	0.4	0.2	0.4	0.4	0.4	0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4
10	0.4	0.2	0.6	0.6	0.6	0.4	0.2	0.6	0.6	0.6	0.6	0.6	0.2	0.2	0.4	0.2	0.2	0.4	0.2	0.2
11	0.2	0.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1	0.6	0.6	0.4	0.6	0.6
12	0.2	0.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
13	0.2	0.2	0.6	0.6	0.4	0.8	0.2	0.6	0.6	0.6	0.6	0.6	0.4	0.6	0.6	0.6	0.4	0.2	0.2	0.6
14	0.2	0.2	0.6	0.6	0.4	0.4	0.2	0.2	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.2	0.2	0.6	0.4
15	0.2	0.2	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
16	1	0.2	1	1	0.8	0.2	1	1	0.4	0.4	0.8	1	1	1	1	0.2	1	1	0.2	1
17	0.2	0.2	0.2	0.8	0.4	0.4	0.4	0.2	0.2	0.2	0.4	0.4	0.4	0.2	1	0.2	0.2	0.2	0.2	0.2
18	1	0.2	0.2	0.8	1	0.4	0.4	0.4	0.2	0.2	0.4	0.2	0.6	0.4	1	0.2	0.4	0.4	0.4	0.2
19	0.2	0.2	0.2	0.8	0.8	1	0.4	0.8	0.2	0.2	0.6	0.2	1	0.2	1	0.2	0.2	0.4	0.4	0.2
20	0.2	0.2	0.2	0.2	0.2	0.4	0.4	0.4	0.2	0.2	0.2	0.2	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2
21	0.2	0.2	0.2	1	1	0.2	0.2	1	0.2	0.2	0.4	0.8	0.2	0.4	0.2	0.2	0.2	0.2	0.2	0.2
22	0.8	0.2	0.2	0.2	0.8	0.2	0.4	0.8	0.2	0.2	0.2	0.2	0.8	1	0.2	0.2	0.2	0.4	0.2	0.2

judgment of the mode to which the object belongs. It is essentially the process of using the computer to identify the data structure. The fuzzy pattern recognition is to make the computer simulate the human brain's image thinking and fuzzy logic thinking to identify, which is an effective way to solve the identification problem of the system itself containing fuzzy information (see Du and Wu [5]).

The basic process is as follows: (1) The transformation of features, that is, the original feature value domain is divided into several parts, and the characteristic meaning of each part is also changed in essence. (2) Establish the membership function of the fuzzy set according to the specific situation. (3) Establish a fuzzy similarity relationship. (4) Processing of fuzzy results.

For the existing case databases, it has the following characteristics: the model used for comparison - the social stability risk level is ambiguous; the identified object -the case result itself is determined. Consistent with the characteristics of the recognition object of the fuzzy pattern recognition method, according to the objective index weight determination method, the fuzzy pattern recognition method can be used to determine the weight.

4.2. Measurement results of weight of each evaluation index

Suppose there are n case index systems to be evaluated, and each case indicator system has m evaluation indicators, which together constitute a measured indicator matrix (x_{ij}), $i = 1, 2, \ldots, m$, $j = 1, 2, \ldots, n$. The m evaluation indicators are identified according to the c-level social stability risk standard, then the indicator standard matrix (y_{ih}), $h = 1, 2, \ldots, c$, can be obtained, which refers to the h standard value of indicator i. The social stability risk of the project is a fuzzy concept, so it can be described by relative membership. According to the matrix (x_{ij}) and (y_{ih}), we can get the index relative membership matrix (r_{ij}) and the index standard value relative membership matrix (s_{ih}) for social stability low-level risk (ie, level 1). As shown in Equation (4.1) and Equation (4.2).

$$r_{ij} = \begin{cases} 0, & x_{ij} \le y_{ic} \text{ or } x_{ij} \ge y_{ic} \\ \dfrac{x_{ij} - y_{ic}}{y_{i1} - y_{ic}}, & y_{i1} > x_{ij} > y_{ic} \text{ or } y_{i1} < x_{ij} < y_{ic} \\ 1, & x_{ij} \ge y_{i1} \text{ or } x_{ij} \le y_{i1} \end{cases} \tag{4.1}$$

$$s_{ih} = \begin{cases} 0, & y_{ih} = y_{ic} \\ \dfrac{y_{ih} - y_{ic}}{y_{i1} - y_{ic}}, & y_{i1} < x_{ih} < y_{ic} \text{ or } y_{i1} > x_{ih} > y_{ic} \\ 1, & x_{ih} = y_{i1}. \end{cases} \tag{4.2}$$

Define u_{hj} as the relative membership degree of the sample j belonging to the h-level social stability risk criterion, and the relative membership matrix (u_{hj}) of the sample will be obtained. Then to calculate the optimal relative membership degree of the sample j for the h-level criterion is d. After repeated derivation, the iterative model for initial

Table 4: Relative Membership Matrix.

Case name	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5	Case name	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
1	0.106	0.201	0.313	0.247	0.133	12	0.053	0.109	0.271	0.393	0.174
2	0.107	0.211	0.328	0.235	0.119	13	0.074	0.150	0.307	0.314	0.155
3	0.053	0.103	0.233	0.390	0.222	14	0.085	0.166	0.311	0.289	0.149
4	0.076	0.161	0.339	0.292	0.132	15	0.318	0.377	0.177	0.083	0.045
5	0.111	0.233	0.348	0.209	0.100	16	0.058	0.101	0.198	0.347	0.296
6	0.062	0.125	0.283	0.358	0.173	17	0.131	0.232	0.303	0.215	0.120
7	0.058	0.118	0.275	0.372	0.178	18	0.089	0.159	0.272	0.295	0.185
8	0.060	0.117	0.258	0.367	0.197	19	0.062	0.118	0.249	0.360	0.210
9	0.200	0.510	0.191	0.067	0.032	20	0.179	0.296	0.277	0.160	0.088
10	0.159	0.366	0.296	0.121	0.058	21	0.109	0.184	0.275	0.263	0.168
11	0.045	0.090	0.222	0.428	0.215	22	0.147	0.254	0.295	0.195	0.109

solution of target weight is obtained. That is, Equation 3 and Equation 4, where w_i represents the index weight of the evaluation index i.

$$u_{hj} = \frac{1}{\sum\limits_{k=1}^{c} \frac{\sum\limits_{i=1}^{m}[w_i(r_{ij} - s_{ih})]^2}{\sum\limits_{i=1}^{m}[w_i(r_{ij} - s_{ik})]^2}} \tag{4.3}$$

$$w_i = \frac{1}{\sum\limits_{l=1}^{m} \frac{\sum\limits_{j=1}^{n}\sum\limits_{h=1}^{c}[u_{hj}(r_{lj} - s_{ih})]^2}{\sum\limits_{j=1}^{n}\sum\limits_{h=1}^{c}[u_{hj}(r_{lj} - s_{lh})]^2}}. \tag{4.4}$$

According to the established case index database, there are 22 case index systems to be evaluated, and each case index system has 40 evaluation indicators, constituting the actual measured indicator matrix. According to the actual measured index matrix and the indicator standard matrix, in this case $c = 5$, the initial weight vector of the index is calculated by applying the iterative formulas (4.3) and (4.4). The given iteration precision is $\varepsilon = 0.001$. After iteration, the index initial weight vector satisfying the iterative precision requirement is obtained w_0. To adjust the data according to the specific situation of the evaluation, and the relative membership degree matrix of the social stability risk level and the weight table of each index came out, as shown in the table below.

4.3. Verification results of 22 typical cases.

After getting the relative membership matrix, we can get the risk level of each case. The higher the level is, the higher the risk is, and vice versa. The level feature value 1 corresponds to high risk, the level feature value 0.8 corresponds to higher risk, the level

Table 5: Weight of Each Indicator.

Indicator 1-10										
Indicator	1	2	3	4	5	6	7	8	9	10
weight	0.007	0.011	0.012	0.001	0.014	0.038	0.032	0.037	0.029	0.018
Indicator 11-20										
Indicator	11	12	13	14	15	16	17	18	19	20
weight	0.009	0.003	0.005	0.003	0.017	0.086	0.030	0.022	0.042	0.082
Indicator 21-30										
Indicator	21	22	23	24	25	26	27	28	29	30
weight	0.023	0.007	0.022	0.046	0.036	0.021	0.031	0.040	0.017	0.015
Indicator 31-40										
Indicator	31	32	33	34	35	36	37	38	39	40
weight	0.030	0.026	0.037	0.026	0.059	0.012	0.018	0.013	0.010	0.013

Table 6: Comparison Table of Project Risk Grade and Evaluation Result.

Name	Level 1	Level 2	Level 3	Level 4	Level 5	Level	Risk Value	Risk Ranking	Assessment Results
Case 1	0.106	0.201	0.313	0.247	0.133	3	0.4684	8	1
Case 2	0.107	0.211	0.328	0.235	0.119	3	0.465	7	1
Case 3	0.053	0.103	0.233	0.390	0.222	4	0.6496	19	0
Case 4	0.076	0.161	0.339	0.292	0.132	3	0.5206	10	0
Case 5	0.111	0.233	0.348	0.209	0.100	3	0.5826	14	0
Case 6	0.062	0.125	0.283	0.358	0.173	4	0.6148	16	0
Case 7	0.058	0.118	0.275	0.372	0.178	4	0.6018	15	1
Case 8	0.060	0.117	0.258	0.367	0.197	4	0.6158	17	0
Case 9	0.200	0.510	0.191	0.067	0.032	2	0.3462	3	1
Case 10	0.159	0.366	0.296	0.121	0.058	2	0.3618	4	1
Case 11	0.045	0.090	0.222	0.428	0.215	4	0.6704	21	0
Case 12	0.053	0.109	0.271	0.393	0.174	4	0.6502	20	1
Case 13	0.074	0.150	0.307	0.314	0.155	4	0.5686	13	0
Case 14	0.085	0.166	0.311	0.289	0.149	3	0.5016	9	0
Case 15	0.318	0.377	0.177	0.083	0.045	2	0.224	1	1
Case 16	0.058	0.101	0.198	0.347	0.296	4	0.7308	22	-
Case 17	0.131	0.232	0.303	0.215	0.120	3	0.3924	6	1
Case 18	0.089	0.159	0.272	0.295	0.185	3	0.5388	11	0
Case 19	0.062	0.118	0.249	0.360	0.210	4	0.624	18	0
Case 20	0.179	0.296	0.277	0.160	0.088	2	0.3148	2	-
Case 21	0.109	0.184	0.275	0.263	0.168	3	0.5604	12	0
Case 22	0.147	0.254	0.295	0.195	0.109	3	0.3894	5	0

feature value 0.6 corresponds to intermediate risk, the level feature value 0.4 corresponds to low level risk, and the level feature value of 0.2 corresponds to almost no risk.

As seen from Table 6, From the calculation results, the risk level of 22 cases can be obtained. We compare the actual situation of 22 cases with the risk level obtained by

Table 7: The Corresponding Relationship Between Project Risk Value and Project Result.

Case Number	Case 15	Case 20	Case 9	Case 10	Case 22	Case 17	Case 2	Case 1	Case 14	Case 4	Case 18
Risk Value	0.224	0.3148	0.3462	0.3618	0.3894	0.3924	0.465	0.4684	0.5016	0.5206	0.5388
Project Result	1	-	1	1	0	1	1	1	0	0	0

Case Number	Case 21	Case 13	Case 5	Case 7	Case 6	Case 8	Case 19	Case 3	Case 12	Case 11	Case 16
Risk Value	0.5604	0.5686	0.5826	0.6018	0.6148	0.6158	0.624	0.6496	0.6502	0.6704	0.7308
Project Result	0	0	0	1	0	0	0	0	1	0	-

the relative membership matrix, and find that the method is basically consistent with the actual situation, indicating that the results of this study are reliable.

The relative total risk value of each case is calculated by the weight of the risk index determined by the fuzzy pattern recognition method. Corresponding to the relative risk value with the project result one by one, the corresponding relation table between project risk value and project result is obtained, as shown in Table 7. It can be clearly seen from table 10 that projects with high risk levels are basically terminated or suspended, while projects with low risk levels are continued after adjustment. The risk level is in good agreement with the project results, so it can be considered that the social stability risk indicator system and its weight are applicable and can be used for risk assessment of other projects.

4.4. Discussion

(1) Analyze according to the size of risk index

It can be seen from Table 5 that the risk weights of Indicator 4, 12, 14, 13, 1, 22, 11 are small, indicating that these are not the decisive factors leading to the occurrence of risks. It is not difficult to find that these five indicators (Indicator 4, 12, 14, 1, 11) are all in terms of procedures and formalities. Generally speaking, the starting point of such projects is economic construction or convenience facilities, so the procedures are legal and compliant, and they will not have too much impact on the social stability risks, which explains the reasons for the low risk ratio of these indicators. Indicator 13 determines to a greater extent whether the construction project can proceed smoothly and does not pose too much risk, and it will not cause too much risk. Indicator 22 also has a smaller impact on risk, indicating that NGOs play a minimal role in all stakeholders, and the real threat to risks is other interests. Indicator 28, 19, 24, 35, 20 and 16 have a large proportion of risk weights, indicating that these indicators play a crucial role in the occurrence of risks. Analysis of these indicators shows that whether the stakeholder support has a great influence on the judgment of the risk level of the entire project, and if the relevant negotiation and settlement mechanism is not established, the risk level of the project will be further improved.

Consistent with Adaptive Control Theory proposed above, the stakeholders correspond to the directly affected people in the model, and the negotiation solution mechanism corresponds to the government's response, guidance and promotion strategies. It

can be seen that playing the role of a good firefighter for the entire risk both downgrade and resolution have great influence and effect.

(2) Analysis on construction projects with different risk levels

By dividing 22 cases according to the risk level and analyzing the characteristics and characteristics of construction projects with different risk levels, there will be a further understanding of the project characteristics of different risk levels.

For projects whose risk belongs to Level 2 (Case 9, 10, 15, 20), the builders have very detailed action plans, and the stakeholders do not have too many objections, equivalent to "burning material" rarely, which prevents further expansion of risk at source. Case 20 is that the resistance of the stakeholders is very strong, but the action plan of the project is accurate, and it also established a standardized and orderly expression channel and a settlement mechanism for the main demands of local residents. The firefighting work is very good, so it can also resolve the risk well and put the risk at a lower level.

Case 3, 6, 7, 8, 11, 12, 13, 16 and 19 belong to risk level 4. Judging from the risks of the various indicators in these cases, the stakeholders of these projects have great objections to the project, and there is no good negotiation and resolution mechanism– the government's fire protection work is not done very well. When both prevention and fire fighting are missing at the same time, the project is in a high-risk situation. At this time, there will be a series of social crises that affect social stability.

5. Conclusions

This paper analyzes the characteristics of projects at different risk levels, compares the risk weights of each indicator and ranks them. The results show that the risk weights of indicators related to the attitudes of stakeholders, the degree of media attention, and the negotiation mechanism of the project are relatively large.

The results of the study show that no effective measures have been taken in the "prevention" and "firefighting" links of high-risk projects. While low-risk projects take effective measures in the "prevention" link or "firefighting" link or both to minimize risks. This conclusion is highly consistent with the framework logic of Adaptive Control Theory, which shows that Adaptive Control Theory can explain the inherent logic of social stability risk assessment very well.

Moreover, the research results show that the social stability risk assessment index system of a type of construction project proposed in this paper has applicability, can be used to evaluate the risk of projects with similar characteristics, and to carry out risk degradation according to the logical framework of Adaptive Control Theory.

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