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Emergency Identification of Supply Chain Security Risk Aggregation for New Infrastructure Projects

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Abstract: *With the rapid development of new infrastructures, the supply chain of new infrastructure projects is characterized by networked operations, high density, technical complexity, strong coupling and environmental impact, and its safety status is influenced by an increasing number of factors. However, the current construction and operation of new infrastructure is in the early stage of exploration, and the safety of risk and emergency management has become an urgent issue to be addressed. This section of the paper mainly introduces the research related to the safety risk of new infrastructure engineering supply chain, mainly from three aspects, firstly, defining the safety risk characteristics of new infrastructure engineering supply chain, secondly, explaining the construction method of risk aggregation, and finally, dealing with the risk of new infrastructure engineering supply chain through risk lasso, this research has enriched the risk management of new infrastructure engineering supply chain in a certain sense and has important Theoretical significance and practical significance*

Keywords: *New infrastructure projects, Supply chain, Risk aggregation*

1. Introduction

In the traditional view, infrastructure mainly refers to engineering facilities that provide public services for social production and the life of residents, and is a public service system used to ensure the normal conduct of social and economic activities in a country or region, and is the material infrastructure conditions on which society depends for survival and development [1]. Over the past few decades, infrastructure, as an important support for China's economic and social development, has played a huge role in promoting production efficiency and improving people's quality of life [2]. However, as society's production and living patterns continue to evolve and upgrade, the original infrastructure is beginning to struggle to meet the needs of efficient social operations, and the call for a new generation of infrastructure is becoming louder and louder. The Economic Work Conference of the Central Committee of the Communist Party of China set out the key tasks for 2019 and proposed strengthening the construction of new infrastructure such as artificial intelligence, the industrial internet and the Internet of Things, which was the first time that new infrastructure appeared in a conference at the central level [3].

The new infrastructure is an effort to build infrastructure at the technology end, mainly in seven major areas, including 5G infrastructure, ultra-high voltage, intercity high-speed rail and intercity rail transportation, new energy vehicle charging piles, big data centers, artificial intelligence and industrial internet[4]. It includes three major aspects: first, information infrastructure, including communication network infrastructure represented by 5G, Internet of Things, industrial Internet and satellite Internet, new technology infrastructure represented by artificial intelligence, cloud computing and blockchain, and arithmetic infrastructure represented by data centers and intelligent computing centres, etc[5]. Second, convergence infrastructure, mainly refers to the in-depth application of Internet, big data, artificial intelligence and other technologies to support the transformation and upgrading of traditional infrastructure, and thus the formation of convergence infrastructure, for example, intelligent transportation infrastructure, intelligent energy infrastructure, etc[6-8]. Third, innovation infrastructure. It mainly refers to infrastructure with public welfare attributes that support scientific research, technology development and product development, such as major science and technology infrastructure, science and education infrastructure, industrial technology innovation infrastructure, etc[9].

However, in order to seize this once-in-a-lifetime development opportunity, it is necessary to develop in a rational, prudent, orderly and steady manner. The large amount of capital and enterprises entering the "new infrastructure" sector will easily lead to risks such as blind expansion, vicious competition, confusing standards and overcapacity[10]. We will continue to manage risk in a targeted manner and effectively support emergency needs.This paper attempts to identify the phenomenon of risk aggregation in the supply chain of new infrastructure projects and provide an important reference for emergency management. This paper will provide a brief introduction to the theory of supply chain security risks, risk point sets and risk lassoes from the perspective of supply chain security risks in new infrastructure engineering systems[11-12].

2. Supply Chain Security Risks for New Infrastructure Projects

The definition of charging post infrastructure can be summarized as having the following characteristics.The basic concepts as well as the risk characteristics are first described in the context of the study of the security risk characteristics of the supply chain for new infrastructure projects.

Risk: The effect of uncertainty on an objective. Risk is usually expressed in terms of sources of risk and the consequences and likelihood of potential events. Based on the definition of risk, a definition of supply chain security risk for new infrastructure engineering systems can be given.

New infrastructure project supply chain security risk: the impact of uncertainties arising in the system during the construction and operation of a new infrastructure project on component nodes in the system or on the system as a whole. Since there is a supply chain security risk in the system, the risk must be generated or triggered by something, i.e. a risk point.

Risk point: A node in a new infrastructure project system that has risk factors and is a component of the system that may generate or propagate risk during construction operations and production. If a risk point exists, there must be a set to summarize the set of risk points that have similar properties, i.e. the set of risk points.Risk point set: a set of risk points that are similar in nature

Secondly, the daily construction and operation of the new infrastructure engineering system contains a large number of unsafe factors. When a failure occurs and leads to an accident, the scope of impact is large, which may cause the engineering staff to be stranded in a light way, or the whole project operation order in a heavy way, or even the investment failure, causing the construction and operation to appear, rework and other conditions, resulting in system paralysis. In the process of operating new infrastructure engineering systems, the risks are mainly characterised by the following.

Diversity of risk points: The construction and operation system of new infrastructure projects involves multiple links, and its safety is a combination of the design of the physical structure of daily construction and operation, the external environment in which it is located and the operation of personnel. Strong coupling between risk points: the occurrence of an incident is not only triggered by a single risk point, but the risk is propagated between risk points throughout the system, leading to an incident when a high-risk risk point is reached. The seriousness of the consequences of risk evolution: in the event of an accident, it is easy to cause congestion and disorder in the works, and in serious cases it may lead to riots and even major casualties, etc. High complexity of risk management: Risk management emphasises the interconnectedness of the entire risk management system, and risk management for each system must be an organic whole; failure of risk management in any sub-system may lead to failure of the entire management system

3. Risk Aggregation Emergency Identification

Commonly used risk identification methods include hierarchical analysis, failure mode and effect analysis and hazard and operability study, etc. However, when there are too many indicators, their data statistics are large and the weights are difficult to determine; the FMEA method mainly targets individual equipment; the HAZOP method is a method that relies on expert knowledge and is too subjective; the above methods are not suitable for fault identification of the system as a whole. In this case, the IFS method is more suitable, which mainly takes into account the cumulative number of failures of the nodes throughout the year

The IFS method takes into account the cumulative number of failures of a node throughout the year (Invalid Frequency), the Structural Location Importance and the Functional Importance. Nodes are identified as risk points based on one of three main criteria:

(1)Based on historical incident data, a node may be marked as a risk point when its annual number

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of failures is greater than the average annual number of failures of system nodes. (2) Based on the structural location importance, a node is marked as a risk point when its structural location importance is greater than the average structural importance of the system nodes. (3) Based on the functional importance of a node, a component node is considered a risk point when it is important to the functional realisation of the whole system.

And in this paper risk points are also identified when the number of consequences such as late starts, accidents or stoppages directly caused by a node is greater than the average value of the system nodes.

4. Risk aggregation Emergency Identification Methods

Risk points are mainly divided into 3 major categories according to node attributes: physical structure category, external environment category risk points and human factors category. Among them, the physical structure category includes all equipment and facilities risk points involved in the construction and operation of new infrastructure projects, involving components, equipment or units such as vehicles, signal systems, power supply systems, electromechanical systems, civil construction facilities and engineering systems; the external environment category includes external risk points that will have an impact on the construction and operation of new infrastructure projects, involving both the natural environment and the social environment; human-caused nodes The Human Factors node includes risk points involving people in the construction and operation, mainly involving personnel and staff.

The risk point identification method is based on the theory of accidental release of energy. In the normal production process, energy is subject to various constraints and flows, transforms and does work according to people's will, but if there is some factor that makes the energy lose control, break through the set constraints or limits and accidentally escape or release, it will definitely cause an accident. For a risk point, an accident can occur when the risk point is in an abnormal state and causes an accidental release, therefore the risk point can be considered to have both safe and unsafe states. When the applied energy exceeds its tolerance threshold or the risk point is subjected to energy transfer from other risk points that exceed its tolerance threshold, the safety barrier of the risk point is considered to have failed, the energy will be out of control and the risk point is converted to an unsafe state; when the energy release is over, its unsafe state can be converted to a safe state by a series of measures to remedy the situation

For the state of the risk point, as the unsafe state value cannot be calculated directly from its own assessment, and in order to quantify the unsafe state of each risk point, the ratio of the number of annual failures of the specified point to the total number of annual failures is used to quantify the probability value of the unsafe state of each risk point in the system, and the formula for calculating the probability of the unsafe state of the risk point is shown in Equation (1).

$$R(m) = \frac{K_m}{\sum_m^n K_M} \tag{1}$$

$R(m)$ - the unsafe state value of the m -th risk point. K_m- the number of failures at the m -th risk point throughout the year. The probability of a safe state at the risk point can be calculated using 1 - $R(m)$

The risk lasso is a concept proposed to portray the process of risk transmission at the point of risk. The idea is that activities can be divided into different levels, each with vulnerabilities, and that unsafe factors are seen as sources of light. The risk lasso: a sequence of causative factors linked by coupling relationships between risk points, as the occurrence of an accident is not necessarily the direct result of a single risk factor, but also the coupling between risk factors, which can lead to an accident through a series of propagation, and therefore the resulting complete risk lasso is not linear, but rather a complex mesh. The completed risk lasso model can be used to predict changes in the state of the risk point, on the basis of which risk propagation paths can be obtained. The construction of the risk lasso is based on Bayesian networks. Bayesian networks, also known as belief networks, are widely used in network modelling and are good for describing dependencies and are a probabilistic graphical model. Its network structure is visible, explanatory, easy to use, can better deal with ambiguity and other advantages, and can describe the uncertainty causality between system behaviour with the help of probability theory. Once the Bayesian network has been constructed, the propagation relationships between nodes can be used for path prediction or reverse derivation of propagation paths

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5. Conclusion

This research mainly introduces the research related to the security risk of new infrastructure engineering supply chain, mainly from three aspects, firstly, defining the security risk characteristics of new infrastructure engineering supply chain, secondly, explaining the construction method of risk aggregation, and finally, dealing with the risk of new infrastructure engineering supply chain through risk lasso, this research has enriched the risk management of new infrastructure engineering supply chain in a certain sense, and has important theoretical and practical significance

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References

[1] Jokar E , Aminnejad B , Lork A . Assessing and Prioritizing Risks in Public-Private Partnership (PPP) Projects Using the Integration of Fuzzy Multi-Criteria Decision-Making Methods[J]. 2021.
[2] Nikjow M A , Liang L , Qi X , et al. Engineering Procurement Construction in the Context of Belt and Road Infrastructure Projects in West Asia: A SWOT Analysis[J]. Journal of Risk and Financial Management, 2021, 14(92).
[3] Huo Q , Li Y . Research on "PPP+ABS" Management Model of Infrastructure Project Based on AHP and Entropy Method[J]. IOP Conference Series: Earth and Environmental Science, 2021, 791(1):012200 (5pp).
[4] Yu J L , Jia Q , Hu H Q . Charging infrastructure construction from the perspective of new infrastructure[J]. Energy Reports, 2021, 7:224-229.
[5] Gu T , Zhang P , Zhang X . Spatio-temporal Evolution Characteristics and Driving Mechanism of the New Infrastructure Construction Development Potential in China[J]. Chinese Geographical Science, 2021, 31(4):646-658.
[6] Jia K . New Infrastructure Construction in China: Both Urgent and Long-Term Support. 2020.
[7] Hu G , Zhu G , Xu Z . Analyze the key points of accounting for water infrastructure projects based on new government accounting system [J]. China Water Resources, 2019.
[8] Eckersten S , Balfors B . Challenges and Opportunities in Early Stage Planning of Transport Infrastructure Projects: Environmental Aspects in the Strategic Choice of Measures Approach[J]. Sustainability, 2021, 13(3):1295.
[9] Dehe B . An empirical investigation in the decision-making processes of new infrastructure development[J]. 2014.
[10] Alkahtani W H . Challenges in Mobile Computing Management.
[11] Hertogh M , Westerveld E . Playing with Complexity. Management and organisation of large infrastructure projects[J]. erasmus university rotterdam, 2010.
[12] Ceballos J , Agudelo J C , Barandica L . Management of Geohazards Caused by the Impact of New Infrastructure Projects on Common Right of Way (ROW)[C]// ASME 2017 International Pipeline Geotechnical Conference. 2017.