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Establishment of the Chemical Project Risk Management Model Based on BP Neural Network

Xinhua Wu

Department of Resources and Civil Engineering, Shandong University of Science and Technology, Shandong 271019, China
xinhuawu@126.com

Objective: To study the chemical project risk management model by using BP neural network. Methods: Taking YYN chemical project as the study example, establish the risk management model through the study theories related to BP neural network, and conduct the application analysis. Results: Through the study, it's found that the design of management model in this study has a certain application value in the aspect of chemical project risk management. Conclusions: BP neural network is an important method for studying the chemical project risk management model, which is worthy of the study and analysis of related companies.

1. Introduction

The chemical industry is one of the important national economic industries in China, and it has an irreplaceable position in many fields and has a certain relevance with people's daily lives. Therefore, some scholars believe that the development level of chemical industry can serve as one of the important indicators for measuring the national strength. In order to promote the development of chemical industry, many countries have elevated it as a key development project to the level of national strategy. In the stable development of social economy, the chemical industry plays a significant role in the harmonious development of our country's society and many chemical companies have joined the reform management of chemical industry. Under the impact of global economy, the competitive environment of domestic chemical market has become fiercer, and the existing environment for chemical companies has become increasingly complex and changeable. In particular, many traditional chemical industries may suffer from the impact of high-tech development and utilization. Therefore, during the development of chemical projects, companies must strengthen the control of chemical project risk management factors and minimize the risk management coefficient. BP neural network is one of the project management models and can play a greater role in the risk management of chemical industry projects. Relevant chemical companies can handle various types of project risk management issues through BP neural network models and enhance the capabilities in project management and control.
This Paper first analyzes the theoretical risk identification model and object of study of the chemical project risk management, and then determines the project risk factor and risk level through risk assessment and risk identification.

2. Literature review

The birth of risk management is closely related to the background of the world's great environment. Risk management began first in Germany after the First World War. At that time, after the baptism of war, Germany suffered from all kinds of sore diseases, and the economic environment was very tragic, which resulted in very serious inflationary inflation. On the occasion of the innovation, the manager began to pay attention to controlling, disposing and eliminating the risk in all aspects, so as to reduce the huge loss that the risk may bring, and to maximize the efficiency of production and increase the output. Early risk management is mainly about personnel professional and normative aspects of control. Although the practice is simple, in the actual production, input is small but the effect quickly, which began to gradually get social acceptance and recognition.

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The risk management of major construction projects started in 1950s in the United States. With the application and popularization of science and technology in the project, the industrial and commercial enterprises in China flourished, the risk of the traditional project appeared to be particularly prominent, and some scholars put forward the need to make the project risk management. Then the first famous document on project risk management appeared, namely, The Theoretical Possibility and Consequences of Major Accidents in Large Nuclear Power Plants. It was issued by the US Nuclear Regulatory Commission (USNRC), systematically exposing the risks inherent in nuclear power projects. At the same time, the chemical energy project after World War II began to enter the high speed development stage all over the world. For instance, the chemical fertilizer base construction project of Lowa State of the United States and the petrochemical projects of the Ge Corp (GE) energy company all play an important role in all kinds of projects in the same period. In the early 1960s, many American colleges and universities began to research and explore the risk management in project management. For example, the University of California at Berkeley, the University of Michigan and University of Delaware in the United States, and other school related scholars began to invest in the research in this field. The researches related to risk management and analysis of project began to appear in various scientific and technical papers. In the late 1970s, the concept of chemical project risk was formally put forward, marking the beginning of the management and analysis of chemical projects. Subsequently, the academic research on risk management has become increasingly mature, and the research content has gradually developed from rough experience management to academic, systematic and specialized, and risk management has become an independent subject of project management.

In the twenty-first Century, under the background of great innovation of science and technology, social production has been developed rapidly, and the society has shown the magnificent sight of the rapid growth of the productive forces and the rapid growth of the production of science and technology. At the same time, due to the intensification of the competition, the surge of various types of risk and the complexity of economic relations, the project of the enterprise is also faced with unprecedented uncertainty, which may lead to huge losses and even bankruptcy of the project. Modern risk management has gradually penetrated into the management of all kinds of large and medium-sized projects, helping the project meet the needs of the market. Bowers and Khorakian believed that a stable and efficient project management theory would help to better improve the quality of the project, to raise the project management to the height of life and death, and to achieve the goal of improving the quality of the project (Bowers and Khorakian, 2014). At the same time, Bai and others thought that project quality must also attach great importance to the role of risk management (Bai et al., 2016). Only by strictly grasping project risk will it help the development and upgrading of enterprises. The project risk is classified according to the risk consequences, the source of risk, the form of risk, the impact of risk and so on, and the process and influence of project risk management are pointed out. Its discussion on the quality of project management is of reference to this article.

In the study, Ho and others pointed out the concept of "zero defect", and made clear the basic principles of risk management in the project, that is, to control the risk by conforming to the standard, to use the zero defect to request the project process and to use the preventive measures to control the project risk and any quality problem (Ho et al., 2015). This idea is widely recognized by world-renowned enterprises and has been vigorously promoted in different project management.

In addition, Chen and others applied risk management theory to enterprise management and served as the key node. The risk management was carried out in the whole process of the project cycle, so that the quality of work could be improved and the overall quality of the project would be improved in the end (Chen et al., 2018). Dong and others mentioned in their paper that the risk management in the course of the project must be the work of the enterprise from the top to the bottom. All the employees must take on the corresponding risk function, and carry out the meticulous management of the target of risk management, which would bring about the qualitative change of the project quality (Dong et al., 2017). Kokangül and others believed that modern risk management theory must be combined with probability theory, statistics, as well as the latest computer technology, network technology and communication technology in mathematics to make external technology become the "engine" of project risk reduction (Kokang et al., 2017).

In risk management, Song and others put forward the idea of "risk management and control of default risk probability decision model", that is, risk control was carried out by establishing risk management and control probability decision model of default risk. Based on the utility probability decision method, they used the expected utility value as a decision criterion to judge the risk size (Song et al., 2017). However, due to the fact that the probability of actual risk factors in chemical enterprises is not easy to obtain, this method is not applicable to the establishment of the model.

Marcelino-S Daba and others studied how to use effective information collection to carry out risk assessment and management decisions for chemical projects. Their paper evaluated and analysed a series of methods that could be used in the risk management of chemical projects, and pointed out the advantages and disadvantages of different methods (Daba et al., 2015). It had some enlightening significance to the study.

To sum up, the above research work mainly focuses on the project risk management and mainly describes the origin of project risk management, the scope of application of project risk management and how the project risk management theory improves the quality of the project, but it is rare to study the risk management of the project by the BP neural network. Therefore, based on the above research situation, this paper mainly studies the establishment of risk management model for chemical projects based on BP neural network. The risk management model of chemical project based on BP neural network is established. The structure of BP neural network structure and the selection of transfer function are analysed, and the data acquisition method for training and learning BP neural network is discussed. Combined with the BP neural network model established, taking a chemical project as an example, the project risk management model is established and evaluated.

3. Method

3.1 Risk Management Theory for Chemical Projects

Because the risk represents an abstract and vague concept, it's still difficult for scholars in various fields to define a perfect cycle and a clear explanation. However, if you go back to the most basic conceptual thinking, the description of the word "risk" focuses on the future, measurable and manageable indefinite things aiming at individuals and companies. In other words, the "risk" refers to the unexpected benefits or losses in the aspects of personnel or finance due to the uncertainty of its future results. The risk described in this way is measurable and can be planned and managed. According to the definition and description of the risk, further research on the concept related to project risk may be conducted. After a comprehensive comparison through a large number of documents, the project risk can be defined as: any activity or event that has a negative impact on the objectives, quality, performance, or time cost of execution in a project plan, which is also called project risk. The concept of risk definition is as shown in Figure 1. Wherein, the increase or occurrence of risk factors or risk factors themselves will result in dangerous accidents in the project, making the change unexpected in the project plan cause the project loss or disasters, which is the so-called project risk.

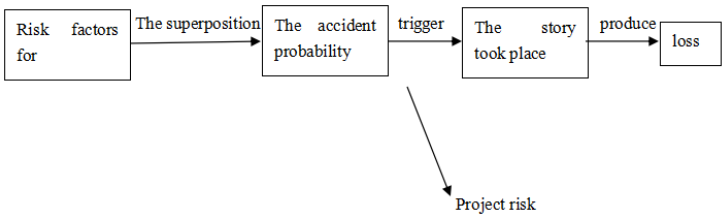

Figure 1: Definition of project risk

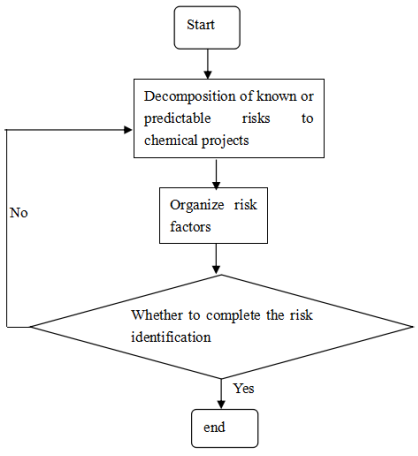

Figure 2: Process diagram of risk identification of chemical project

Risk identification, as the name suggests, is to systematically and continuously identify the various risks faced and analyze the potential causes that risk accident happens by adopting various methods. Generally speaking, risk identification can be implemented through such steps as information collection and

management, risk description and assessment, extraction of risk effect key factors, and weight analysis on risk factor. In order to ensure the accuracy of risk analysis, a comprehensive and systematic investigation and analysis on risk factors is required, so as to reveal the type, nature, and consequences of the risks. As risk exists throughout the project, the identification and measurement of risks are also a continuous and uninterrupted development process. At the same time, it also embodies the principles of regularity and institutionalization of risk identification. The main process of risk identification for chemical projects is as shown in Figure 2.

3.2 The methods for establishing risk identification models for chemical projects

Because of the characteristics of BP neural network, there is only one input layer and one output layer. So, we only discuss the number of hidden layers. One of the most common methods for designing the number of hidden layers is the trial-and-error method. This method is to find the best strategy by assuming that the neural network has different levels of hidden layers, and through observing such network performances as training time, generalization ability, and error size. Different from people's inference of common sense, simple increment of the number of hidden neurons will not necessarily lead to the better accuracy. On the contrary, if there are too many neurons in the hidden layer, neural networks can be trained through the effects of noises. In this way, the design principle of the number of hidden neurons is that as long as the network can accurately reflect the input and output, the performance of neurons with less number of hidden layers is the best. After the basic completion of the design of model structure design, it requires to set the learning rate of BP neural network, which reflects the rate that BP neural network matches to the objective function. If the learning rate is set too low, the total learning time may be lengthened, which is not conducive to the calculation and fitting of the algorithm; if the learning rate is set too high, the fitting function will be insufficient in accuracy, and its robustness and over-fitting are also not ideal. This Paper reviews a number of literatures and considers it appropriate to set the learning rate between 0.01 and 0.8 during the risk design of chemical projects.

3.3 Object of study

YYN Chemical Project is a deep-processing and comprehensive utilization project of chemical industry products affiliated to a large state-owned enterprise in Hubei Province. The YYN Chemical Project is located in the hinterland of the Jianghan Plain in the central and southern area of Hubei Province, which is a chemical logistics base that is constructed for meeting the demands of the rapid development of petrochemical industry and integrates the storage and transportation functions for liquid chemicals. The project was launched in 2014, covering an area of 128 acres, with a total investment of 130 million yuan, and is expected to be completed and put into production by the end of 2017. A large state-owned enterprise relied on by the project is affiliated to China National Chemical Industry Group and it is a modern chemical enterprise integrating design and construction, undertaking the research & development and construction tasks of large-scale and super large-scale chemical projects. It is not only a specialized company integrating the development, production, sales, and after-sales service of chemical products, but also the large-scale equipment research & development base, achievements transformation base and production and manufacturing base in chemical industry and petrochemical industry, etc. The establishment of BP neural network model is completed by combining the risk identification, and the structure diagram is as shown in Figure 3 below.

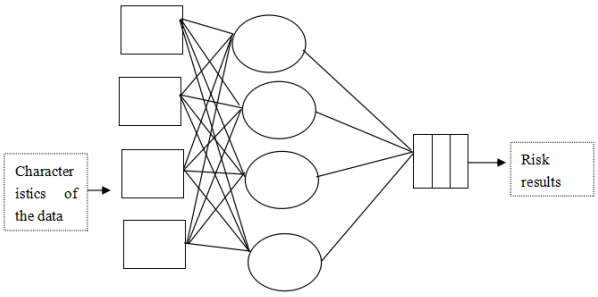

Figure 3: BP neural network structure diagram

3.4 Acquisition and processing method for chemical project risk data

Data acquisition is actually a process of information acquisition, i.e. collecting the data from the detected units, such as sensors, simulation and digital unit, and it is acquired based on BP neural network data acquisition, and measured through the modular measurement. Among them, data acquisition is an important node for

learning and adjusting the internal connection relationship of the model and correcting the accuracy of the model after the BP neural network establishes the model. Therefore, the accuracy of the collected data is crucial to the accuracy of the model. When studying the risk management of chemical projects, the data used to train and test the mathematical models have certain requirements on the accuracy and mathematical steel, and for this purpose, the data acquisition process is carried out in accordance with the standards of chemical industry. Generally speaking, the data acquisition requirements for chemical project risk management mainly include the following aspects: Firstly, the data must be quantified, and the physical characteristics must be represented in a numerically quantified manner. If some subjective evaluation is involved, it can be converted into a digital form through the method of quantitative scoring. To be specific, the analysis methods for the quantification of data in the field of chemical engineering include standard deviation method, relative standard deviation method, and standard recovery rate, and other practical data quantitative analysis methods; Secondly, the data must be true and objective. In the risk assessment management, the authenticity of the data directly affects the assessment result. Therefore, the collection of the data needs to be true and objective. It is necessary to conduct an on-site inspection on the chemical project, and quantify the development status and future development direction through the data. It's required as far as possible to search the information from several aspects, summarize the collected data, conduct scientific assessments and arguments, and make checks at all levels, and further adjust the questionable data to an appropriate situation and use the real and objective data to map the models; Thirdly, the dimension of the data collected should be appropriate, which requires the multi-sources of data and a certain redundancy, so as to guarantee a certain robustness of the mathematical model the data trained and tested. Fourthly, the collected data must be sampled through multiple times, and single evidence of data may not be able to describe the characteristics of things.

4. Results and discussion

4.1 Risk assessment for YYN chemical project

Through the assessment on various risk indicators in YYN project according to expert interviews and the Delphi method, the characteristics data of the YYN chemical project shown in Table 1 were obtained. The dimensionality-reduced feature data as shown in Table 2 were obtained upon data processing. The four-dimensional data of Table 2 is imported into a trained neural network, and the output value of "y=6" is obtained. According to the risk determination rule established in this Paper, mild risk is inputted when the total risk value of the project is entered in the range of 0-0.3; the medium risk is input when in the range of 0.4-0.6, and the high risk is inputted when greater than or equal to 0.7. Therefore, under the BP neural network risk identification established in this Paper, YYN Chemical Project's total risk data of the project belongs to moderate risk, which needs to be improved.

Table 1: YYN chemical project risk original characteristic data sheet

a1	a2	a3	a4	a5	b1	b2	b3	b4
0.2	0.5	0.2	0.3	0.4	0.8	0.6	0.4	0.6
c1	c2	c3	c4	c5	c6	d1	d2	d3
0.2	0.1	0.8	0.2	0.3	0.2	0.7	0.4	0.3
d4	d5	e1	e2	e3	e4	f1	f2	f3
0.5	0.4	0.3	0.9	0.3	0.5	0.2	0.3	0.4

Table 2: Data table of YYN risk factors after data processing

Serial number	Factor1	Factor2	Factor3	Factor4	The total risk
1	-0.7	-0.4	0.5	0.2	0.6

4.2 BP enlightenment from neural network risk assessment

Through the application of BP neural network, conduct the risk identification, assessment and management for YYN chemical project. Through a series of data analysis and processing, the risk level of each risk factor in the risk list is obtained. Among them, there are five major risks leveled at "high risk", as shown in Table 3.

Table 3: The list of risks of YYN chemical project grade strength

The serial number	The risk that	Risk level
1	The design level is insufficient， affecting the actual effect of the project	High risk
2	Safety accidents during production	High risk
3	Leakage and deterioration of chemical raw materials and finished products	High risk
4	The funds for the project are not available on time	High risk
5	The flow of people causes the project to be affected	High risk

5. Conclusions

In the management of chemical projects, it is necessary to use the scientific management methods to reduce the incidence of project risks and to prevent other risk factors from causing interference to chemical projects. With the rapid development of the chemical industry, people are paying more and more attention to chemical project risk management. This Paper, mainly based on the BP neural network model, carries on the research and analysis on the chemical project risk management. The BP neural network model was used to evaluate the risk factor and risk level of chemical project risk. Through study, it is found that the risk assessment on the chemical project in this Study is relatively good, and can control the influencing factors related to chemical industry project risk management, which is conducive to the strengthening of project management and control for chemical enterprise.

The Study on the project's risk management model for chemical projects is relatively insufficient in depth, for it does not provide an in-depth exploration of the risk response system and it mainly studies the project risk assessment and identification. Due to the length limitation, this Paper omitted many risk processes when studying the BP neural network model, and conduct simple summarization for the relevant content of the risk project.

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