Research on Enterprise Risk Prediction Path Based on Knowledge Graph

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Abstract. Identifying risk information from enterprise big data is the top priority of enterprise risk management. Based on the literature research of enterprise risk early warning, the task of risk identification and risk evaluation in early warning research is summarized as enterprise risk prediction, and its realization path is divided into three parts: risk information mining, risk knowledge base construction and risk evaluation. The knowledge graph can realize the digitalization of enterprise risk prediction research, more accurately evaluate and predict enterprise risks, and improve the efficiency of enterprise risk early warning.

Keywords: Enterprise risk prediction; Risk warning; Knowledge graph; Risk identification; risk evaluation

1 Introduction

With the improvement of the digital level, enterprises have accumulated a large amount of data in the Internet, which contains rich corporate knowledge. However, due to the difficulty in grasping the overall information, various crisis events such as public opinion, finance and strategy occur frequently, which has caused a huge impact on enterprise operation. These problems require managers to accurately grasp the effective information, mining enterprise knowledge, and timely identify the potential risks contained in the information, so as to reduce or even avoid the occurrence of crisis events from the root.

Knowledge graph can integrate enterprise data, event data, related subjects and other information to form visual enterprise knowledge, which has attracted the attention and application of researchers. In recent years, many researchers have reviewed the research problems, methods and status of knowledge graph from different aspects such as graph construction[1~2] .In the vertical field of enterprise risk management, there have also been many related studies[3]. However, although these scholars have reviewed the research and application status of knowledge graph in enterprise risk management, there is a lack of more systematic and in-depth review and summary of the research and application of knowledge graph in the specific task of enterprise risk early warning.

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Therefore, based on the era background of big data and oriented to enterprise risk management, this paper summarizes risk identification and risk evaluation in enterprise risk early warning as enterprise risk prediction tasks, and puts forward the realization path of risk prediction based on knowledge graph based on literature survey.

2 Theoretical basis

Some scholars divide enterprise risk into management risk, financial risk, market risk, credit risk, investment risk, etc. However, in the big data era of information explosion, the risks faced by enterprises have long exceeded the early concept of risk, and should also include judicial risk, public opinion risk, intellectual property risk and other broader aspects.

Enterprise risk early warning mainly studies how enterprises build error prevention and correction mechanisms for risks or crises, and its main task is to reduce the harm of crises to enterprises through advance prediction and control of risk events. Therefore, risk identification is to determine the risk information through various methods, which is the first step of risk early warning. Risk assessment is the core of risk warning, which evaluates the risk information and determines the risk degree. Risk warning is to send an alarm signal to the value of the existing risk, which is the premise of subsequent risk control.

The massive multi-source heterogeneous data in the Internet provides a rich data source for enterprise risk early warning. With the application of deep learning in knowledge extraction and other research problems, knowledge graph has become a widely concerned digital intelligence method in recent years. In enterprise risk early warning, knowledge graph can integrate complex enterprise data, convert data into knowledge, and realize risk identification and judgment by mining the implicit association.

In the aspect of graph construction for enterprise risk early warning, Zhang et al. proposed a KGANN knowledge injection model based on the structure and content of knowledge graph[4]. Chen et al. constructed a large-scale enterprise risk knowledge graph and implemented an intelligent question answering system based on the knowledge graph[5]. In terms of the graph application for risk early warning, Ding et al. constructed the enterprise knowledge graph from five dimensions, and identified enterprise risks based on it[6].

From the above literature, it can be found that the digital intelligence method based on big data and taking artificial intelligence algorithm as the path will become the research trend in enterprise risk early warning research. The application of knowledge graph to integrate enterprise data reflects the idea of data governance in enterprise management in the era of big data. On the other hand, knowledge graph provides the ability to analyze problems from the perspective of relationships, which can better explore the implicit risk information in enterprise data.

3 Research definition and research path

Based on the analysis of the objects, methods and other relevant elements of risk management in the current social environment, this paper believes that the research on enterprise risk warning should focus on the first two sub-tasks: risk identification and risk evaluation. Therefore, this paper summarizes these 2 tasks as "enterprise risk prediction". According to the previous theoretical research, this paper defines "enterprise risk prediction" as: identifying risk information through various types of enterprise data, building a risk evaluation system on this basis, and separating the risk elements beyond the safety threshold. The ultimate goal is to predict the risk level and impact of possible corporate risks.

3.1 Risk identification

Risk identification refers to the mining of enterprise risk information through enterprise data on the basis of analyzing enterprise risk elements. Faced with multi-source heterogeneous enterprise data, building a risk knowledge base is one of the commonly used risk identification methods. Hyunsoo et al. proposed a risk identification method based on concepts rather than keywords based on ontology, which transformed text information into ontology concepts and carried out risk identification from the theoretical level[7].

This paper divides the risk identification task based on enterprise big data into two parts: risk information mining and risk knowledge base construction, as shown in Figure 1. Firstly, based on the analysis of enterprise risk factors, text mining technology was used to scan various types of enterprise text data and mine text features to obtain risk information. Then, deep learning is used to construct a risk knowledge base with knowledge graph as the core to identify enterprise risks in a visual form.

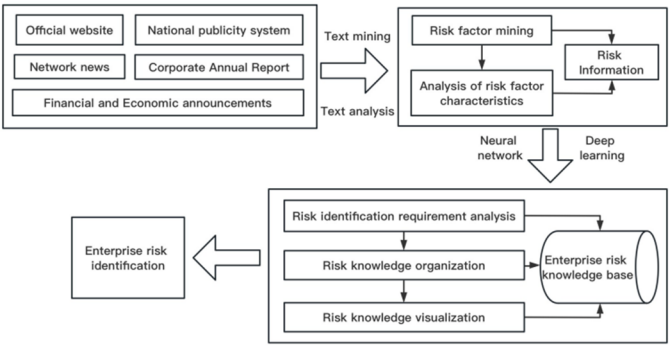

Fig. 1. Risk identification process

3.2 Risk assessment

Risk assessment is not only the key task of risk prediction, but also the core of enterprise risk early warning. According to the existing risk information, the goal is to find

the possible risk anomalies in the enterprise, and predict their risk level and impact degree.

The enterprise risk prediction work oriented to big data should be based on the characteristics of enterprise risk information and the actual needs of enterprise risk management. On the basis of enterprise information organization, enterprise knowledge mining and enterprise risk identification, the knowledge graph method and traditional risk assessment ideas are integrated to design an enterprise risk assessment model suitable for big data environment, and finally the risk information is presented to users in a visual form.

3.3 Risk prediction realization path

According to the above research definitions, this paper divides the enterprise risk prediction based on knowledge graph into two sub-tasks: risk identification and risk evaluation. In addition, risk identification is divided into two parts: risk information mining and risk knowledge base construction, and the process of enterprise risk prediction based on knowledge graph is proposed, as shown in Figure 2.

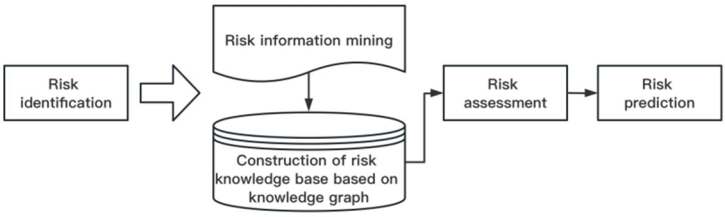

Fig. 2. Implementation path of enterprise risk prediction

(1) Enterprise risk information mining: Based on text mining, mining risk information from enterprise data, and analyzing the text characteristics of risk information, so as to mine the enterprise risk elements.

(2) Construction of risk knowledge base with knowledge graph as the core: According to the characteristics of enterprise data and types of enterprise risk events, enterprise risk knowledge tuples are extracted from enterprise big data. Through the construction of knowledge graph, the integration of enterprise multi-dimensional information is realized.

(3) Enterprise risk evaluation: construct risk evaluation model and evaluate risk grade based on risk knowledge base.

(4) This paper will analyze the main research content and research methods in each subtask through the literature survey method, and summarize the research status to determine the future research direction of each part.

4 Construction of risk knowledge base based on knowledge graph

4.1 Enterprise data characteristics

In the research of enterprise risk early warning, the existing research mainly focuses on structured corporate financial data, but pays less attention to semi-structured and unstructured data such as news, microblog and financial announcement. However, these data contain rich enterprise knowledge, which can provide reliable basis for risk prediction, financial anti-fraud and other enterprise scenarios.

Based on the evaluation criteria of information sources (reliability, novelty and timeliness), we can focus on five categories of enterprise data: official website and encyclopedia data, national publicity system data, enterprise annual report data, financial announcement data and network news data. The data sources of enterprises and their characteristics are shown in Table 1.

Table 1. Classification and characteristics of enterprise data sources

Data source	Data characteristics	Data type	Examples	Available data
Official website and encyclopedia	High degree of professionalism and authority	semi-structured	Wikipedia	Enterprise name, abbreviation, etc
National publicity system	Slow update, high professional degree, high authority	semi-structured	National Enterprise Credit Information Publicity System	Administrative penalty information, etc
Corporate Annual Report	Slow update, high professional degree, high authority	unstructured	Tencent official website	Enterprise management information, etc
Financial and Economic announcements	Timely update,, commercial components, high credibility	unstructured	East Money Information	Financial information, etc
Network news	Timely update, less commercial components, high credibility	unstructured	Sina News	Public opinion event information, etc

4.2 Risk knowledge base construction

On the basis of risk information mining, how to organize and visualize risk information, so as to obtain risk knowledge, is an important content to improve the effect of enterprise risk identification. However, unstructured data has the characteristics of wide sources, complex types and diverse forms, which poses great challenges for the construction of risk knowledge base. At present, there are many researches on the construction of enterprise knowledge graph, including knowledge organization[8], forms of expression[9], and risk identification[10].

The above studies show that the knowledge graph method combining ontology and visualization technology can realize the orderly organization of enterprise risk knowledge, and it is easier to mine the potential association between enterprise knowledge, so it has better enterprise risk identification effect. Therefore, the construction of enterprise risk knowledge base based on knowledge graph theory will play an important role in the task of risk identification, and is one of the important research directions in the future.

4.3 Construction methods

The basic idea of enterprise risk graph construction is as follows: first, according to the source analysis of enterprise data, the enterprise big data in the Internet is collected and cleaned. Then, based on the ontology and the knowledge requirements of enterprise risk management, the dimensions of the graph structure are divided and the relationship in the enterprise graph is analyzed, and the enterprise risk graph pattern layer is constructed. On this basis, the deep neural network is used to construct the automatic extraction model of entities, attributes and relationships, and the graph data layer is filled. Finally, the knowledge reasoning method is used to improve the knowledge graph. Based on the above analysis of graph construction ideas, this paper summarizes the construction logic of enterprise risk graph, as shown in Figure 3.

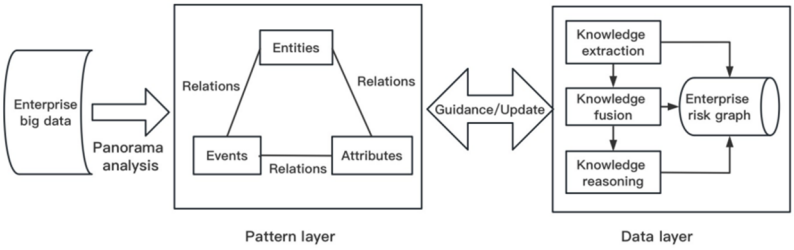

Fig. 3. Construction logic of enterprise risk graph

5 Construction of enterprise risk assessment model

5.1 Risk assessment model

Traditional research on enterprise risk early warning focuses on enterprise financial risk, so it mainly sends early warning signals to risk indicators that deviate from the safety threshold by constructing financial risk evaluation models. With the development of artificial intelligence technology and the expansion of the scope of enterprise risk, some scholars have gradually tried to introduce machine learning[11] into the construction of risk assessment models. In addition, there are many researches on BP neural network[12] and its improved algorithm in the construction of risk evaluation models such as financing risk and logistics risk.

At present, some scholars have begun to study the construction of risk assessment model integrating knowledge graph method, including algorithm research[13] and other aspects. In addition, some scholars use knowledge graph technology to research and design risk evaluation models for enterprises' bidding and procurement[14], accident hidden dangers and other risks. In terms of practical application, risk management knowledge graph has been widely used in financial market supervision and risk control management of commercial banks.

According to the above research, it can be concluded that the risk evaluation model based on knowledge graph technology can evaluate more dimensional enterprise risks, make positive effects in improving the efficiency of risk early warning, and effectively enhance the ability and level of enterprise risk management.

5.2 construction method

Based on the above research, this paper proposes a construction method of risk evaluation model based on knowledge graph from the goal of enterprise risk prediction: Firstly, based on enterprise risk information intelligence demand analysis and risk information mining, different entity classes of knowledge graph are assigned weights according to their importance. Secondly, the frequency statistics of entities and relationships after knowledge extraction and fusion are carried out, and the weights of nodes and edges in the graph are determined by weight calculation, so as to further build a risk knowledge graph with weights and directions. The larger the weight value and the access value, the higher the risk probability of the node, so the prediction of the risk node is realized. Finally, the link relationship in the graph was extracted according to the edge, and the risk propagation probability was calculated according to the weight value of the edge, so the prediction of risk impact range is realized. The specific idea is shown in Figure 4.

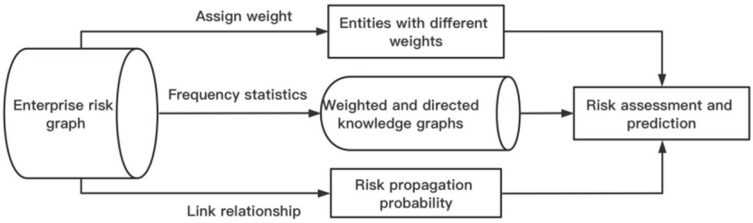

Fig. 4. Risk assessment process

6 Conclusions

The research scope of enterprise risk warning has gradually expanded and the research methods have shifted to intelligence，This paper proposes a research path of enterprise risk prediction based on knowledge graph. However, this paper holds that the current problems and future research directions lie in the following aspects:

(1) The effect of map construction needs to be improved. The types of risk events are diverse, which poses great challenges to graph construction. On the one hand, it is necessary to represent enterprise risk knowledge with high quality from the perspective of knowledge representation. On the other hand, the performance of the model is improved from the perspective of algorithm.

(2) The risk assessment model integrating knowledge graph needs to be further studied. How to further use the data and structural characteristics of the knowledge graph to construct a risk assessment model based on the structural information of the graph is one of the main research contents to be solved in the risk prediction task. To solve this problem, starting from the structure of knowledge graph, different graph structure analysis methods can be introduced to transform the traditional index system calculation into quantitative calculation based on graph information.

(3) Research results are applied academically. There are a large number of influencing factors in the operation of enterprises, but the real situation is usually simplified in academic research, which leads to large differences between the experimental results and the real situation.

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