

Construction of Logistics Financial Risk Ontology Model Based on Risk Correlation

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Abstract—In the traditional research on the pre-control of logistics financial risk, the linear causal relationship between risk and risk events is often emphasized. However, the causal mechanism of logistics financial risk events is the complex situation of the interaction, integration and upgrading of risks. In order to better promote the healthy development of logistics finance and reduce the frequency of occurrence of risk events, it is necessary to study the correlation characteristics and correlation models between risks. In this paper, we propose a framework for logistics financial risk ontology based on the characteristics of logistics financial risk events, and build a logistics financial risk ontology model in this framework. Taking the risk event (RW risk) of the financing enterprise to escape, the feasibility of applying the logistics financial risk ontology model for risk-related reasoning and analysis is verified.

Keywords—logistics finance risk; ontology; semantic parsing; risk association

I. INTRODUCTION

As an emerging financial innovation business, logistics finance is a cooperative innovation between banks and other financial institutions through logistics companies, relying on guarantees such as inventory, accounts receivable and even trade relations in the supply chain, and in the process of supply chain operation, it provides financing, supporting settlement and insurance services to customers, especially small and medium-sized enterprises [1]. Compared with western developed countries, China's logistics finance started late, and there are still various problems. The risk division of each participating entity is inconsistent, and the supporting laws and regulations are not perfect. Therefore, in order to promote the healthy development of logistics finance, it is necessary to discriminate and control the risks that exist, and take certain preventive measures. At present, scholars at home and abroad have already produced a large number of research results in the field of logistics financial risk. These results mainly focus on the identification, assessment and prevention of logistics financial risks. Siskin [2] analyzed the risks that may occur in the retail finance business for retailers, and considered that it is necessary to implement strict supervision. At the same time, it also introduced some necessary monitoring measures, but basically limited the risk sources to the business itself. Ziyuan Yin [3] established a multi-person multi-criteria logistics financial project risk fuzzy evaluation method based on fuzzy mathematics theory. In fact, logistics finance has various forms and links, and it is constantly changing, and the process and operation are complex. Therefore, in this dynamic process, the

logistics financial risks generated are diverse and constantly changing, which also determines the logistics financial risks and the relationship between risks is also very complicated. However, there are few literatures on the research of logistics financial risk from the perspective of risk correlation.

On the basis of previous studies, this paper introduces the concept of logistics financial risk ontology, which facilitates the formal representation of logistics financial risk. At the same time, it uses ontology knowledge reasoning technology to find out the correlation between each risk ontology, so as to excavate the potential risks in logistics financial risk events, and provide comprehensive risk prevention and control decision-making for management in logistics financial field. With the deepening of ontology theory and technology research, ontology has been applied in many fields. In these professional fields, most of them realize the integration of domain knowledge and knowledge information sharing by building domain ontology [4]. Taher[5] proposed a general-purpose, semantically rich ontology model for SLA to improve its definition and evaluation in cloud computing. Fuxin Li[6] used ontology-based knowledge discovery and knowledge reasoning methods for studying the correlation characteristics of risk sources and providing accurate judgment for the pre-control of risk sources based on the characteristics of heavy-duty railway accidents, combined with text mining and data mining. Therefore, based on the ontology, this paper proposes a logistics financial risk ontology framework, and builds a logistics financial risk ontology model based on the framework. Taking the financing enterprise runaway with money risk event as an example, validating the feasibility of applying logistics financial risk ontology model to analyze risk association semantics.

II. THEORETICAL BASIS

A. Logistics Financial Risk and Related Characteristics

Although the development of logistics finance business can bring "win-win" effect to third-party logistics enterprises, supply chain node enterprises and financial institutions, in the actual logistics financial business operations, the three major entities will also face various risks. Nanan Shan [7] proposed a relatively complete risk evaluation index system for the risk of logistics financial business for the first time by using the SEM model. The first-level risk factors in the system include warehouse inventory control measures, company management level, and pledge goods, credit risk factors and technical factors. Yixue Li [8] summarized and identified the risk

sources of logistics financial services from five aspects: macro and industry system risks, supply chain system risks, operational risks, collateral realized risks and credit risks and constructed a risk identification ring diagram for the business based on the idea of financial system engineering.

After literature review and expert survey, this study summarizes the relevant information collected, removes the repeated risk factors, and screens the effective risk factors, and finally obtains the following six kinds of logistics financial risks: management risk, assessment risk, supervise risk, pledge risk, customer credit risk and environmental risk.

The logistics financial risk events that occur in the logistics finance business may be caused by a single risk factor or by multiple risk factors. Selecting a number of typical financial risk events with complex financial risks and high risk levels to complete the collection and analysis of contextual information in the field of logistics and financial risk, through the determination of core concepts and relationships, the construction of ontology architecture, the addition of instances and ontology model evolution process, Constructing ontology meta-model of risk event causation. Logistics financial risk event cause ontology meta-model, as shown in Figure 1.

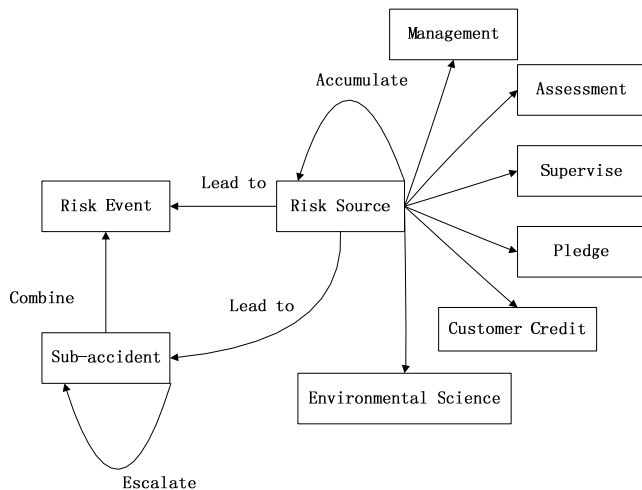


FIGURE 1. ONTOLOGICAL METAMODEL OF RISK EVENT CAUSE

B. *Ontology Theory*

The concept of ontology originated from the branch of philosophy. Ontology is an explanation of objective existence, which focuses on the abstract nature of the objective world. In the field of artificial intelligence, Neches et al. defined ontology as: giving the basic terms and relations that constitute the vocabulary of related fields, and defining the rules that govern the extension of these terms by using these terms and relations [9]. Stanford scholar Gruber et al. defined ontology as a normative explanation that can be accepted by most people and clearly and formally explained the concept system [10]. Later, scholars such as Studer extended the definition and considered ontology as a clear formal specification of shared conceptual model [11].

Based on the formal description of ontology, the computer can understand the semantic relationship between concepts and concepts in the field [12], and the description of the ontology clearly and accurately is the premise of ontology application. There are many ontology description languages. At present, the typical ontology description languages include: RDF(S), SHOE, OIL, OWL, etc. At present, the most popular application in the academic world is the OWL representation language. This article chooses to apply the OWL language. OWL defines the properties of objects and objects, and implements formal representations of fields through relationships between classes. Knowledge can be reasoned based on certain logic [13].

Commonly used ontology editing tools are Protégé, OntoEdit, WebOnto, etc., which can build and improve ontology. In this paper, Protégé is used to build the overloaded logistics financial risk ontology. Protégé allows the embedding of Fact++ and Jena and other inference engines, which makes it easier to test the consistency of the ontology model and the derivation of implicit knowledge [14] theory as the guidance of ontology modeling methods, since ontology engineering is still in the development stage. At present, representative ontology modeling methods are: seven-step method [15], skeleton method, METHONLOGY method, IDEF5 method, TOVE method, KACTUS method, SENSUS method [16]. A comprehensive comparison of the above ontology modeling methods shows that the seven-step method is more mature than other ontology modeling methods and is more suitable for building domain ontology [17]. Therefore, in this paper, the seven-step method is applied to construct the logistics financial risk ontology.

III. LOGISTICS FINANCIAL RISK ONTOLOGY FRAMEWORK CONSTRUCTION

A. *Extraction and Analysis of the Core Concepts of Logistics Financial Risk*

According to the core concept terminology of the construction field, extracting and analyzing the core concept of logistics financial risk, such as risk and related properties of risk, based on the in-depth understanding of the logistics financial risk field. Then selecting these cores to create the core concept terminology of logistics financial risk according to certain classification criteria, and dividing the term set into two parts: the risk core concept term set and the risk attribute core concept term set. Logistics financial risks mainly include: management risk, assessment risk, supervise risk, pledge risk, customer credit risk and environmental risk. The specific risk core concept term set is shown in Figure 2. The properties of risk mainly include the terms of the core concepts of properties, static properties and dynamic properties. The specific risk properties core concept term set is shown in Figure 3.

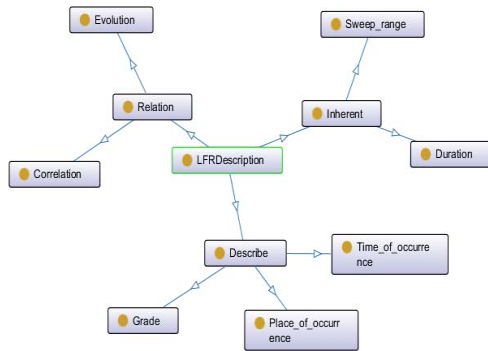


FIGURE VI. HIERARCHICAL STRUCTURE OF DESCRIPTIVE LOGISTICS FINANCIAL RISK CLASSES

B. Property Layer Construction

According to the core concepts of logistics financial risk terminology set and ontology meta-model of risk event causation, Building associated properties. So, the associated properties are as shown in table 1.

TABLE I. PART OF ASSOCIATION PROPERTIES

Object Property	Domain	Range	Description
hasEvolution	risk	riskAssociation	further evolution of risk
hasCorrelationMember(s)	risk	riskAssociation	associated risk member
hasCorrelationDegree	risk	riskAssociation	relevance to other risks

C. Individual Layer Construction

An individual of the logistics financial risk ontology model is the concrete realization of the logistics financial risk category. It is known from the causal mechanism of logistics financial risk that the occurrence of logistics financial risks is often not caused by a single risk factor, but the result of multiple associated risks. So, build a risk individual based on the risk event of the financing enterprise runaway with money, as shown in Figure 7.

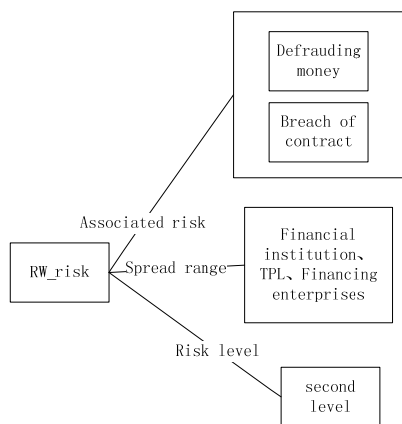


FIGURE VII. CONFIGURE OF RISK EVENTS INDIVIDUALS

V. SIMULATION EXAMPLE

Taking the risk event of the financing enterprise runaway with money as an example, using jena inference rules for carrying on the inference simulation of the logistics financial risk ontology model in Protégé software.

Jena uses the ModelFactory class method to implement reasoning. The associated risk reasoning in the logistics financial risk ontology model is mainly based on the associated attributes of each risk ontology. In combination with jena's ontology inference grammar, the recursive algorithm is used to find all the risks associated with the RW_risk risk event in eclipse.

RW_risk's associated risk reasoning simulation, firstly, import the OWL file OntoLFR.owl of the logistics financial risk ontology already built in Protégé in the eclipse project, and use the Ontology/Model API to find the associated risk ontology of the RW_risk risk individual by associated properties of imported model objects. Use the same method again to find the associated risk ontology of the next layer until the value of the hasCorrelationCount attribute of the associated risk ontology is 0.

According to the risk association rule obtained under eclipse to map the risk association diagram of the RW_risk risk event, as shown in Figure 8.

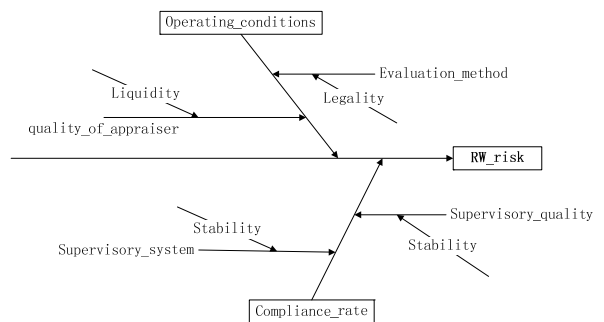


FIGURE VIII. RISK CORRELATION GRAPH OF RW_RISK RISK EVENTS

Through the above risk reasoning simulation, the semantic analysis and risk reasoning ability of the logistics financial risk ontology model are verified, and the feasibility of the logistics financial risk ontology model to provide decision-making services for logistics financial risk early warning is verified.

VI. CONCLUSION

Risk events in the field of logistics finance are often caused by multiple risk factors, and there are direct or indirect links among these risk factors. Therefore, to find out the associated risks of each logistics financial risk event, and to identify and control one by one, will help the healthy development of logistics finance. The risk ontology and risk properties in the logistics financial risk ontology model constructed in this paper are all from the relevant literature analysis and interviews with experts in the field of logistics finance. The representative logistics financial risk factors are selected for the ontology construction, and the ontology reasoning technology is applied to the logistics financial risk-

related knowledge discovery, which attempts to make warning of logistics financial risks. The future work of this paper is that more comprehensive and detailed understanding of the contents of logistics financial risk, in order to increase and refine the corresponding risk and risk attributes in the ontology model of logistics financial risk, thus enriching logistics finance Risk ontology model.

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