
UML-based Requirements Analysis on Risk Pre-control System in Coal Enterprise

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Abstract

Combining with the present situation of risk management in domestic coal enterprises, the overall flow of risk pre-control system of coal enterprise is designed on the basis of the ISO/FDIS31000 "Risk management-Principles and guidelines" released by the International Standards Organization and risk precontrol management system of safety in coal mine, UML(unified modeling language) is used as a tool to establish the model of system requirements analysis, risk management subsystem is taken as an example to elaborate the modeling process of system analysis, the merit of ensuring the accuracy and consistency of system analysis when using UML as the tool of object-oriented system requirements analysis is verified.

Keywords: coal enterprise, risk pre-control system, unified modeling language, requirement analysis

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1. Introduction

With the establishment and perfection of China's socialist market economy system, the market-oriented reform of the coal industry has made substantial progress. All kinds of market risks brought by the market economy exists in coal enterprises, especially in large state-owned coal enterprises. Enterprise risks extend from traditional production safety risk and financial risk to strategic risk, operational risk, legal risk and risks in other fields [1]. The central government pays much attention to improve the ability of enterprises to cope with risks. In June 2006, the State-owned Assets Supervision and Administration Commission of the State Council (SASAC) issued Central enterprises enterprise-wide risk management guidelines to instruct enterprises to establish risk management mechanism; In May 2008, the Ministry of Finance in conjunction with concerned ministries formulated Enterprise internal control basic norms to strengthen and standardize enterprise internal control, and to improve enterprise's ability to prevent risks [2]. Though central enterprises have made progress in risk management in recent years, the application rate of information technology in risk management is relative low. A survey conducted by SASAC in 2011 showed that 16 percent of investigated unites achieved quantitative analysis of risk management, only 3 percent of enterprises undertook risk management by means of information technology [3]. Therefore, the informatization degree of domestic enterprises in risk management needs to be enhanced urgently.

Risk pre-control management information system is in accordance with the risk pre-control management system, which is on the basis of risk source identification and risk assessment, risk pre-control as the core, achieves risk' effectively control by formulating management standards and measures of risks [4]. The goal of the information system is to complete a upper and lower interconnected, information sharing and unified managerial information platform, to standardize the process of risk identification, risk assessment, risk monitor and risk pre-control in the enterprise, to achieve the early warning of fatal risk as well as the emergency handling of emergent events, and to provide decision support for the risk management department and leaders of the company.

2. The Framework of the Risk Pre-Control Information System

2.1. A Brief Introduction to the Risk Pre-Control Information System

Risk pre-control information system is designed on the basis of the process of risk management, which is in accordance with the risk pre-control management system theory, and implements the PDCA closed-loop management. To satisfy the requirements of the three hierarchies of decision level, control level and business level, the construction of the system is divided into the senior management, risk management office and Secondary units functional departments three parts. The senior management mainly achieved integrated query and statistical analysis of information, including the risk source of enterprise and secondary units, early warning information of fatal risk, the risk management and assessment information of all units, emergency prepared for emergent events and risk events occurred in the enterprise. The risk management office is responsible for maintaining and updating the company's risk source database, issuing risk management mandate to secondary units (department), undertaking the evaluation of risk management and the operation condition of the risk management system and maintaining the emergency prepared database. The mandate of secondary units comes from two aspects, on the one hand they complete the risk management mandate that risk management office issues, on the other hand they identify, assess, and pre-control the risk exists in themselves' units.

2.2. The Overall Process of Risk Pre-Control Information System

Referencing the risk management process (Figure 1) and method in *ISO/FDIS 31000 Risk Management-Principles and Guide* that the International Standards Organization released in November, 2009 [5], we investigate the company's risk management processes, data requirement and organizational structure in depth, and design the anticipated function of the system, ultimately divide the system into seven functional modules: portal platform subsystem, basic data subsystem, risk management subsystem, examination and evaluation subsystem, event management subsystem, risk management culture subsystem and integrated query subsystem. The overall process of the system is shown in Figure 2.

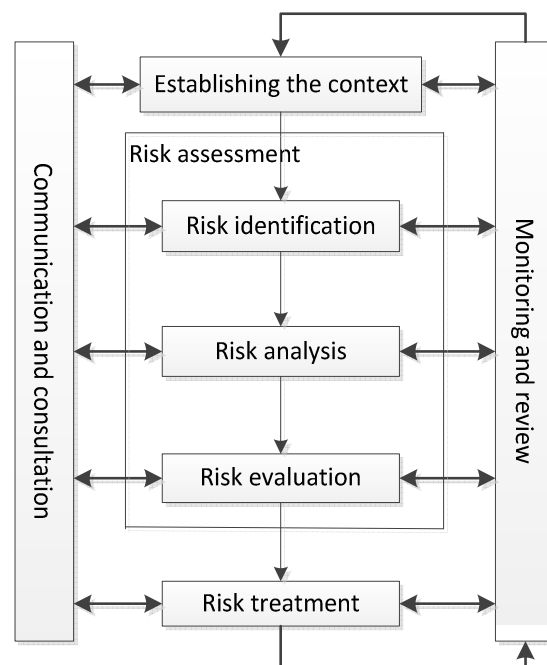


Figure. 1. Risk management process of ISO 31000

Organizations can get a clear understanding of its internal and external context as well as the scope and guidelines of risk management by establishing the context, which is reflected

in the entire process of risk management. Risk identification involves the identification of risk sources, risk events, their causes and their potential consequences. Risk analysis is to comprehend the consequences, the likelihood other properties and to determine the level of risk using qualitative and quantitative methods. Risk evaluation is a process of comparing the results of risk analysis with risk criteria to determine whether the risk and/or its magnitude is acceptable or tolerable. The process of risk identification, risk analysis and risk evaluation establishes the risk source database, which provides reference and guidelines for risk management [6] Risk treatment involves avoiding the risk, removing the risk source, changing the likelihood or the consequences, retaining the risk by informed choice and other measures. The users can choose risk treatment strategies, the internal and external stakeholders to communicate with, monitoring, observation and other methods to take according to the results of risk assessment, formulate detailed risk pre-control measures in the system. Due to the particularity of the coal mine enterprises, emergent events may result in heavy casualties and property loss, threatening the enterprise's production and operations as well as reputation. The early-warning mechanism of fatal risk realizes the collection and analysis of related information before emergent events occur, providing aids to take preventive measures to prevent risk events from occurring. The establishment of emergency prepared database as well as disposal procedures of emergent events ensures a timely and proper disposal of emergencies [7]. Monitoring and review reflect to be the assessment of risk management in effectiveness and the system operation evaluation according to the assessment standard of risk management system.

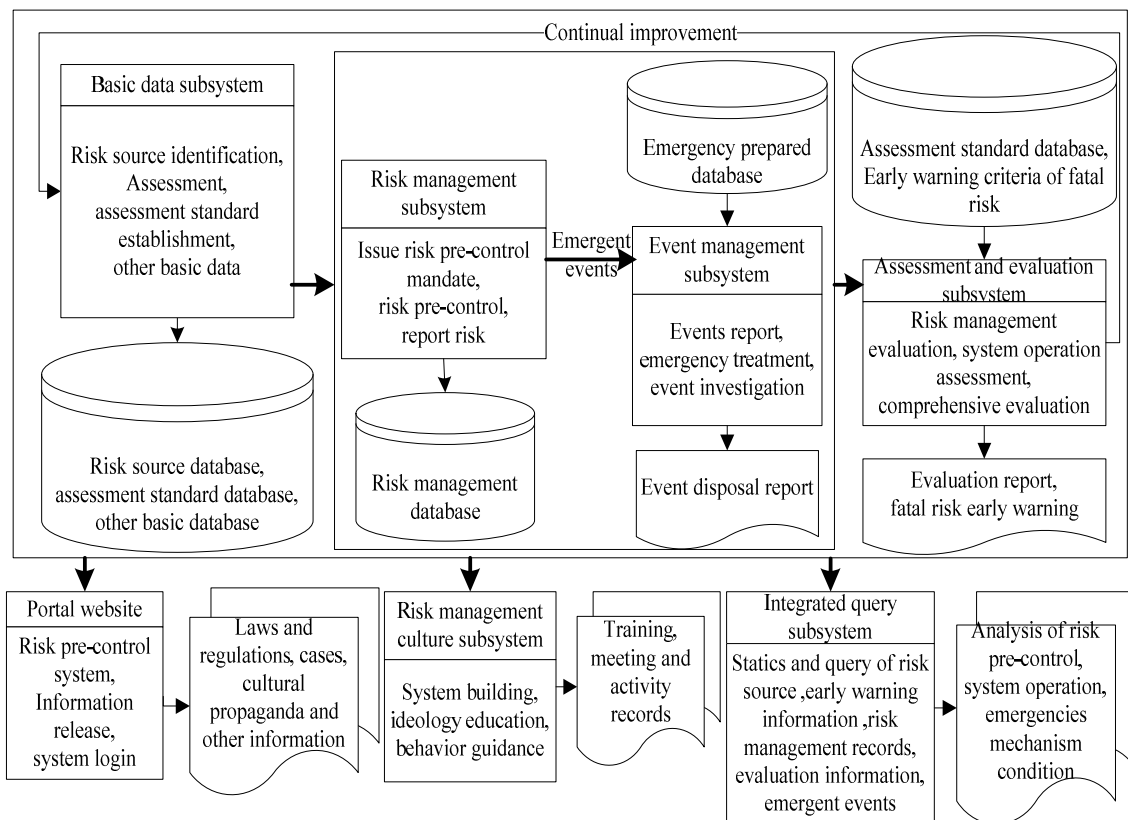


Figure. 2. The overall process of risk pre-control information system

3. System Requirement Analysis

The process of system requirement analysis is to carry out a detailed investigation according to the scope and requirements of the system design specification, describe the business processes, determine the objective and functions and establish the logical model of the target system. UML is a visual object-oriented standard modeling language, adopting

graphical symbol to denote the objects and relationships of the system. UML provides functional model, static structure model and dynamic behavior model three main types of models to describe the system to be developed from different angles. The iterative modeling process of UML ensures the consistency of the model.

Taking the risk management subsystem for example, it is described detailed how requirement analysis of risk pre-control information system is undertaken using UML.

3.1. Requirement Analysis of Risk Management Subsystem

3.1.1. Function Requirement

The function requirements of risk management subsystem involve issuing and execution risk pre-control mandate and submitting risk. The risk management office issues risk pre-control mandate to secondary units, which can be distributed to multiple units and associated with risk source by risk field and code two properties. After execution units input the risk pre-control strategy to take and specific treatment measures, execution units can view the evaluation and feedback information at the risk pre-control interface just as the evaluation information is effective. If risk lowers to an acceptable range, the units can choose to cease the control of risk to achieve risk's closed-loop management. The units can input inner risks and risk treatment measures. Risks beyond the ability of the unit itself are able to be reported to the risk management office.

3.1.2. Establish use Case Model

As an advanced view describing the system's function from the user's point of view, the use case model is extracted from the user's requirements. The first step of establishing use case model should specify the boundary and functions' operators, which are divided according to roles. There are two operators in the risk management subsystem, risk management office administrator and secondary unit administrator.

The process of establishing use the case model of risk management subsystem consists of three steps. First, detailed function requirements can be got through detailed breakdown of function requirements. Then, the attributes and operations of class are determined after allocating detailed functions among objects. The last step is to link the operator, event and operation of class together [8]. The use case model of risk management subsystem is finalized after the repeated discussions of requirement analysts, users and experts in the field, as shown in Figure 3.

The use case model cannot illustrate all the information system development needs. The function meaning and specific implementation steps of each use case need to be described with text in detail.

3.1.3. Establish Static Model

In order to identify entities in the system, the entity-relationship diagram is established to illustrate the system's static structure. The static model established in the requirement analysis phase is a rough structure model, which does not involve user interface and the system basic services completing at the design stage. E-R (entity-relationship) diagram refers to the conceptual model summarizing the basic structure of data with the three basic concepts of entities, relationships and attributes so as to describe the static data structure. The entity is a set of objects with common characteristics and behavior in the real world. The relationship between two entities consists of three types, namely one-to-one (1:1), one-to-many (1:n) and many-to-many (m:n). Analyzing the business requirements and use cases of risk management subsystem to identify the entities in the subsystem and to determine the relationships between them, the E-R diagram of risk management subsystem is shown in Figure 4.

The E-R diagram reveals several points as followed. The risk management office administrator issues multiple risk pre-control mandates. A risk pre-control mandate can only be associated with a risk source. Secondary units take measures to pre-control a risk for many times.

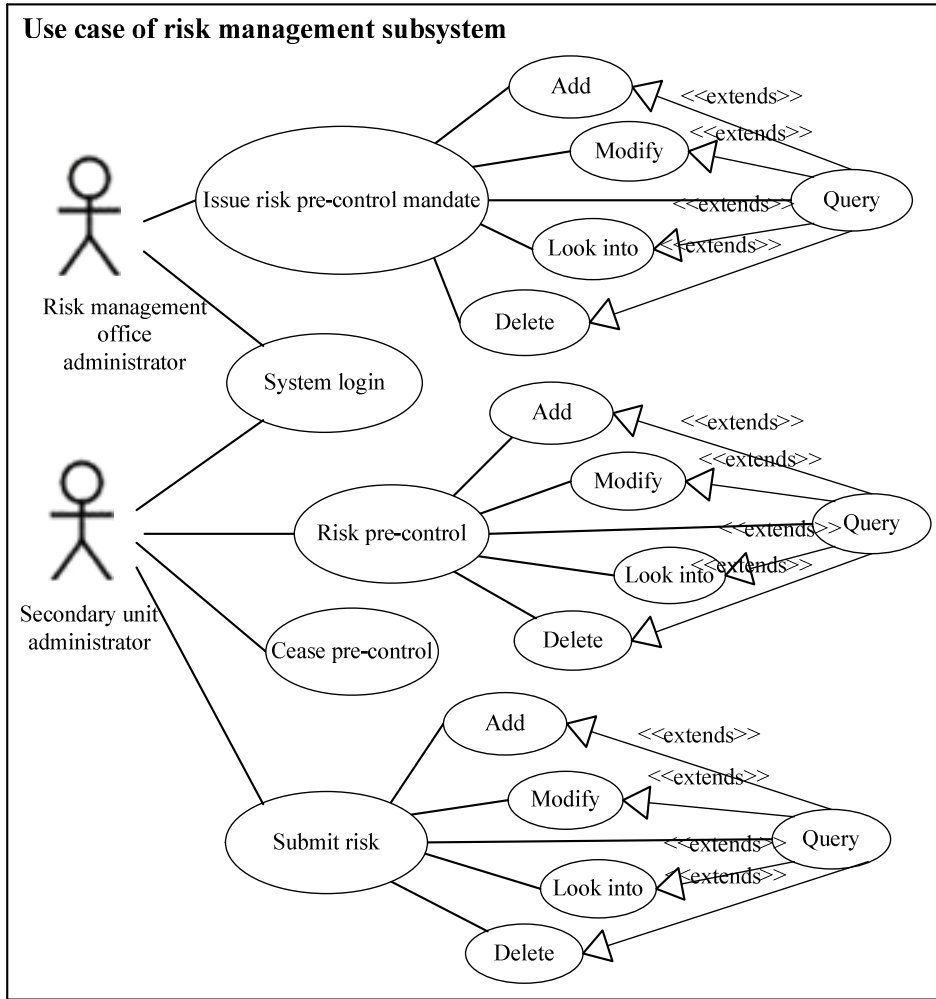


Figure 3. The use case model of risk management subsystem

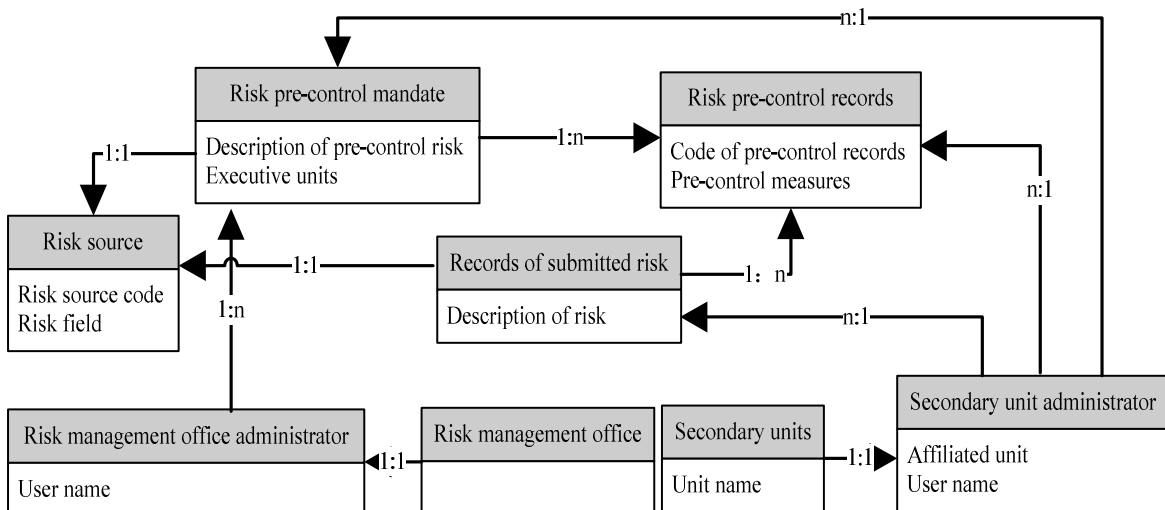


Figure 4. The E-R diagram of risk management subsystem

3.1.4. Function Allocation

Function allocation is to allocate functions the system is to complete among the objects to specify various classes, attributes and operations of each class as well as the relationship with other classes. For example, the attributes of risk pre-control mandate class include risk description, executive units and so on. The risk management office issues risk pre-control mandates, which must be associated with a risk source. The executive units take measures to deal with risks according to risk pre-control mandate.

3.1.5. Establish Dynamic Model

The system dynamic model is to develop when the system function model and the overall structure model is established. The dynamic model illustrates intuitively using sequence diagram, collaboration diagram, state diagram and activity diagram, which describe the objects' behavior and interaction among objects from different angles. Dynamic model claims not to draw all of the diagrams, but to choose necessary diagrams according to the actual modeling conditions. The diagrams we chose are state diagram and sequence diagram.

As the complement of class diagram, state diagram models for the dynamic behavior of single class or object. It describes the response of an entity to different events according to its current states. State diagram shows all possible states of an entity as well as the events and conditions to attain these states. It is not necessary to establish state diagram for each entity. Only those key objects and objects with complex state need to establish state diagrams. The state diagram of risk pre-control mandate entity is shown in Figure 5.

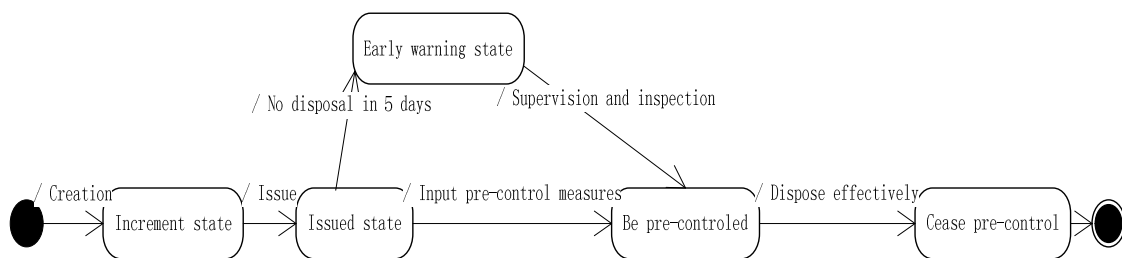


Figure 5. The state diagram of risk pre-control mandate

State diagram shows all the states of risk pre-control mandate in its entire life cycle from creation, execution to cease. The early warning mechanism is to be triggered if executive units do not input risk treatment measures in five days according to the risk pre-control mandate. Then, risk management office would urge relative units to take measures to control risks. The sequence diagram shows the interaction among objects in time sequence. In detail, it describes the sequence of sending messages as a use case completes a certain function among objects. The flow of messages among objects is emphasized in the sequence diagram. The sequence diagram of risk management office administrator issuing risk pre-control mandate is shown in Figure 6. The message delivery order among objects and the lifetime of objects can be clearly seen in the figure.

3.1.6. Check the Consistency of the Model

The modeling of system requirements is determined to be a repetitive process by the requirements' uncertainty and the business' complexity. With the requirement analysis going in depth, it is possible that a previous model needs to be modified when a latter model is established. The processes of continual modification and improvement ensure the integrity and consistency of system analysis.

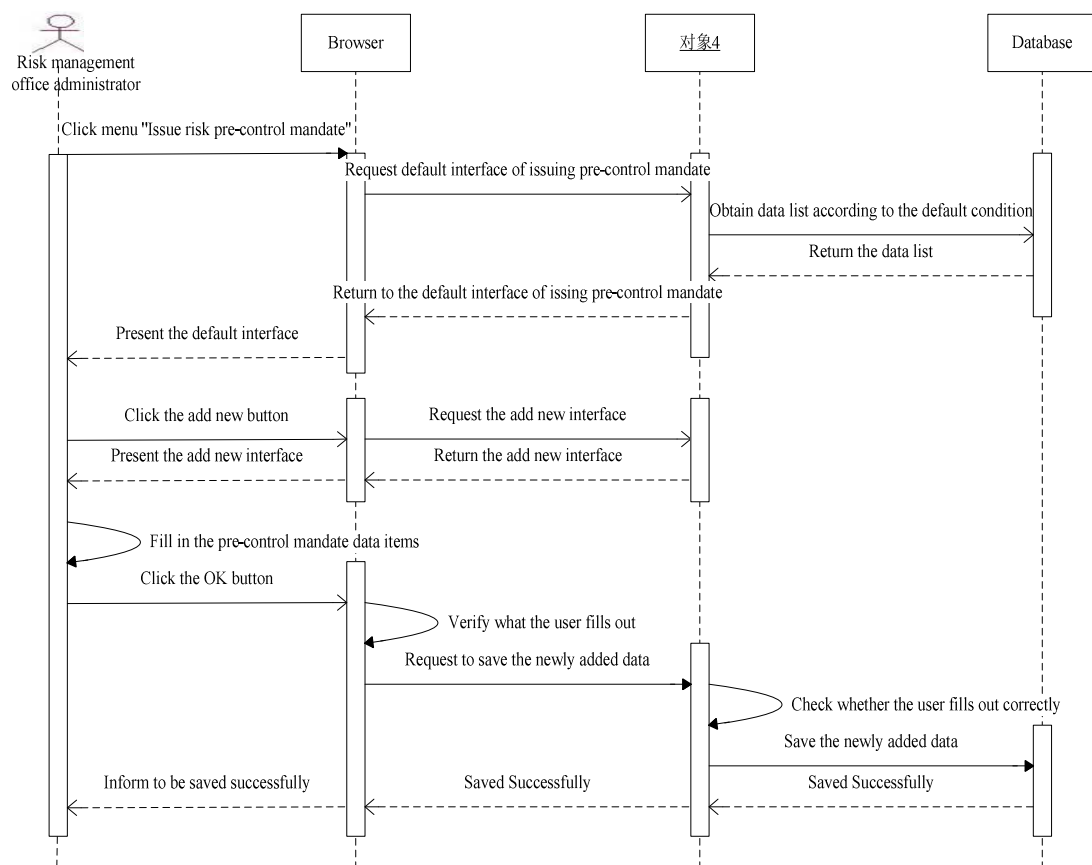


Figure 6. The sequence diagram of risk management office administrator issuing risk pre-control mandate

4. Conclusion

The static and dynamic modeling mechanisms of UML demonstrate the static structure and dynamic behavior of the system well. It helps analysts and users achieve good consistency to the understanding and description of the system, ensuring the accuracy of system requirement analysis. The views of UML bring great convenience to the system design. The use case diagram and E-R diagram provides accurate system function partition and detailed relationship description among entities for subsequent system design and reliable basis for code framework structure design and data design. As the design basis of class and interface, state diagram and sequence diagram is to be used in the definition of properties and methods of class and interface and the code logic design inner methods. The models UML establishes greatly facilitate the system's development process, enabling developers to develop sub-modules step by step.

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