

Research on Modeling Methods of Model-Driven Emergency Management Domain

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Abstract. This paper started with the software design method of emergency management domain, analyzed the shortcomings of traditional model-driven modeling methods, and then led to the model design method of emergency management domain, and introduced the advantages of model-driven design of emergency management domain.

Keywords: emergency management, model-driven, modeling method.

1. Introduction

It is widely known that emergencies such as sudden natural disasters, accident disasters, public health incidents, social security incidents, and international security incidents bring serious harm to human beings and society. How to effectively deal with emergencies and prevent and reduce the harm caused by emergencies are key research topics at home and abroad [1]. Since the establishment of the Ministry of Emergency Management of the People's Republic of China in 2018, it has played an important role in safety production, disaster prevention, alleviation and relief, emergency rescue, etc., it suggests that new mechanism of emergency management in China has been formed, and it has officially entered into the era of "big emergency".

2. Shortcomings of Traditional Model-Driven Modeling Methods

Emergency management is a work process involving multiple disciplines and factors, which needs a complete and good emergency management system to support. By building proper emergency management system model, analyzing requirements, drilling, finally, an effective and reasonable emergency plan is given. At present, traditional modeling methods generally use Unified Modeling Language (UML) to describe the model [2]. As a universal modeling language, UML has played a huge role in the development of visual modeling, but most of its concepts come from object-oriented programming languages, not the problem domain of application systems. UML and its extensions are used to build the general meta-model, and complete all modeling work, although the starting point of this method is theoretically feasible, real systems are often based on a specific business domain, in this case, UML does not fully describe the system effectively. Combining the complexity of the emergency management system and the difficulty of building the system architecture and organization, it is difficult to describe the complex internal structure and behavior of the system by using the general system modeling method, therefore, a more suitable system modeling method need to be found for model expression.

Therefore, in some specific business domains, a non-universal domain meta-model is needed for easy extraction of domain knowledge and business logic in the domain into the meta-model. For example, in emergency management domain, the abstraction level of domain knowledge can be improved in the software design stage, and it greatly improves the efficiency and accuracy of modeling while it is easy for reuse.

3. Model Design of Emergency Management Domain

Systems Modeling Language (SysML) is a versatile standard modeling language proposed under such requirements [3]. SysML is the continuation and extension of SysML is UML used in visual

modeling of software-intensive system in systems engineering applications, it is a versatile modeling language of system architecture design proposed in recent years, it is used for the description, analysis, design and verification of integrated architecture in complex systems synthesized by software and hardware, data and people, it can model various problems of system engineering in a specific domain and is suitable for different stages of systems engineering.

3.1 Domain Model of Emergency Management

Emergency management is put forward to deal with the dangerous problems of particularly serious accidents and disasters, when government and other public institutions preventing emergencies in advance, dealing with emergencies and recovering from emergencies, they are related activities which protects the life, health and property safety of the public by building necessary coping mechanisms, taking a series of necessary measures, applying science, technology, planning and management and other means, and promote the harmonious and healthy development of society. Emergencies mainly include natural disasters, accident disasters, public health events and social security events. Emergency management is the management of the whole process from emergency preparation, monitoring and early warning, emergency response to emergency recovery and reconstruction for these four types of emergencies. The emergency management system is the systematic and procedural model to realize the above-mentioned emergency management mechanism. According to the relevant laws and regulations and emergency management related theories made by the state for emergencies, and the theoretical modelling of general emergency management system based on the model, including demand modeling, static structure modeling, dynamic behavior modeling, and the corresponding models used are: demand model, structure model, behavior model [4].

3.2 Demand Model

The demand model of the emergency management system should take the demand analysis of emergency management as aim, refine one by one for the development process of the emergencies, and form more specific needs. According to the staged features of emergencies, the emergency management system is also divided into four sections for demand analysis. Each period of development can be divided, thus helping the development of specific emergency strategies in specific periods.

According to the features of emergencies in the emergency management domain, the use cases are divided into the afflicted people and the people who will be afflicted. The emergency management system derives four sub-requirements: prevention, monitoring and early warning, emergency response, and restoration and reconstruction, each time period has its own corresponding emergency mechanism and task contents. The relationship between use cases and emergency management systems is a refines relationship.

3.3 Structure Model

The system model of the emergency management system takes the operation process of emergency management as the main line, and it can be correspondingly decomposed into four subsystems: emergency preparation, monitoring and early warning, emergency response and emergency recovery.

The emergency preparation subsystem defines attributes such as society, public, risk, emergency plan, and emergency resources, and the access rights to attributes are all private. Methods include establishing and maintaining emergency preparation systems, improving planning system and communication and coordination mechanism, establishing and maintaining emergency response capacity, verifying and updating emergency response capacity.

The monitoring and early warning subsystem defines attributes such as danger sources, public, intelligence information, decision-making departments, and early warning signals, and the access rights to attributes are all private. The methods include emergency monitoring and early warning, intelligence information fusion and comprehensive early warning.

The emergency response subsystem defines attributes such as the afflicted people, the afflicted area, the assessment department, the decision-making command department, and emergency resources, and the access rights to attributes are all private. Methods include rescuing and protecting lives, meeting basic public needs, protecting property and environment, eliminating site risk factors, and incident management and coordination.

The emergency recovery subsystem defines attributes such as afflicted people, remedial resources, people's psychology, event assessment results, and responsibilities, and the access rights to attributes are all private. Methods include public assistance and care, restoration of infrastructure and buildings, restoration of the environment and natural resources, and restoration of the economy and society.

3.4 Behavior Model

The behavior model includes four stages: emergency preparation, monitoring and early warning, emergency response, and restoration and reconstruction, and each stage has its own life cycle. There is messaging during the life cycle of each stage, and the messaging all are synchronous messages.

When receiving the emergency synchronization message, the emergency management system starts, the emergency preparation starts, each process is activated, carry out sending of messages in turn, and activate the subsequent stages. First, collect relevant regulatory data and activate the monitoring and early warning stage. Second, activate the emergency response phase through assessment and information release. Thirdly, by completing the emergency rescue activities, activate the emergency recovery phase. The emergency preparation phase provides various resource information for reconstruction at any time for emergency recovery. By evaluating the results of emergency recovery, further improve the emergency preparation stage.

4. Advantages of Model-Driven Design in the Emergency Management Domain

Compared to the traditional model-driven development platform based on UML, there are the following features in model-driven development for emergency management:

4.1 Realize the High Efficiency of Software Development

The model-driven development model towards domain engineering improved the modeling stage in the traditional Model Driven Architecture (MDA) development model, integrated with the concept of domain engineering, and joins the emergency management domain meta-model and domain model, so that the model building is more convenient and faster, and it is close to the business needs. The software code is automatically generated based on the model, which further shortens the software development cycle and improves the efficiency of software development.

4.2 Easy for the Change and Expansion of the Business

A complete development platform for emergency management domain can not only build complex applications in a short time, but also quickly respond to various needs of users, and meet the needs of business change and expansion in specific domains.

4.3 Improve the Abstraction Level and Reusability of the Model, It Is Easy for the Reuse of Knowledge in the Domain of Emergency Management

By building common framework of the domain, domain knowledge is preserved. Combining the domain general framework with the development process of MDA, it has the advantage of reusing domain knowledge in comparison with the traditional MDA development mode.

5. Conclusion

By comparing and analyzing the shortcomings of traditional model-driven modeling methods, the domain model of emergency management is designed based on SysML, the demand model, structure

model and behavior model are described, respectively, which provides theoretical basis for the next software design work in the emergency management domain.

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