Research on the construction technology of marine environmental safety knowledge Base

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Abstract. China is a large marine country with a large number of populations living along the coastal area. More attention has been paid to marine disasters along with the rapid development of marine economy. On the basis of the demand for the risk prevention and control of marine security events, it is imperative to study the technology of building risk prevention and control knowledge base of marine security, sort the marine knowledge base system according to the relevant knowledge of marine environmental security events, such as storm surge, enteromorpha, oil spill, etc., and build comprehensive risk prevention and control knowledge base of marine environmental security and the specific element set based on the knowledge map, multi-type knowledge coupling, risk prevention and control digitalization, etc. so as to form an entity for risk prevention and control knowledge base.

1. Introduction
Marine environmental security mainly includes marine natural environment, resource development environment and right safeguarding for environmental security. The marine environmental security events include marine dynamic disasters, marine ecological disasters, marine emergencies, etc. Some major marine disasters and emergencies, such as storm surge, tsunami, enteromorpha, oil spill, shipwreck, have occurred frequently and marine environmental security problems become prominent in recent years, which are related to not only the sovereignty and security of the country, but also the country’s future development. At present, the marine powers in the world attach great importance to the formulation and implementation of national marine environmental security strategies, and systematically study the theories, methods, key technologies and equipment related to marine environmental security, so as to enhance their overall marine strength.[1-3]

Most emergency participants have to face the dilemma of "knowledge ocean" and "knowledge deficiency" in the process of emergency response under the current background of big data, which is difficult to quickly obtain and effectively use relevant knowledge for marine environmental security events.[4] By taking the emergency decision-making process as an example, it is often necessary to hold an emergency meeting upon the occurrence of a real emergency event, in order to make a judgment based on the experience of experts and leaders and form an action plan. The process above, however, makes the decision-making process inefficient and the decision-making results less scientific.[5]

The biggest difference between knowledge base and database is that the former needs to process and store the procedural and heuristic data, and flexibly applies knowledge to the analysis and solution of practical problems, besides storing fact data. The primary purpose of knowledge base is to improve
the scientificity and efficiency of emergency decision-making in emergency field so as to provide more rapid and accurate knowledge content and services for knowledge base users.\cite{6}

The decision-making method based on knowledge base provides a new idea for the emergency response process. It applies the relevant knowledge to the emergency prevention and preparation, monitoring and early warning, disposal and rescue, recovery and reconstruction, etc., which can not only improve the efficiency of the emergency process and realize the scientific organization of relevant knowledge and storage process optimization, but also expand the application of knowledge base and research scope.\cite{7} The knowledge related to emergencies and emergency response can be stored, the efficiency of emergency knowledge sharing and utilization can be improved, the problem of emergency efficiency differentiation caused by knowledge asymmetry can be solved and the loss and negative impact caused by emergencies can be lowered by constructing the knowledge base.\cite{8-9}

2. Role Analysis and Function Orientation of Knowledge Base

2.1. Role analysis of marine knowledge base based on emergency knowledge flow

Emergency knowledge flow refers to the path by which emergency event and emergency response knowledge flow from knowledge source to receiver in the process of transmission. By summarizing the marine environmental security business, it can be concluded that there are three main roles involved in the knowledge flow serving the response of marine environmental security event, namely, knowledge owner, knowledge user and knowledge manager.

**Figure 1. Role analysis of marine knowledge base**

2.1.1. Emergency knowledge owner

Emergency knowledge owners include academic experts and business personnel (State Oceanic Administration, Operation Division, sub-bureau and affiliated units, coastal provinces and cities, ministries and commissions involving marine businesses) that master the emergency knowledge of typical marine environmental security events such as storm surge, enteromorpha, oil spill, etc. in the fields of ocean, public security, natural disasters, etc.

There are mainly two ways for the owners to acquire knowledge. One is to learn relevant knowledge from paper documents, audio, webpages and other types of knowledge carriers, which can be called primary knowledge learning; the other is to process and reorganize the original knowledge by studying the occurrence and evolution of marine environmental security events such as storm surge, enteromorpha, oil spill, etc., which can be regarded as the regeneration knowledge of the original emergency knowledge.
There are mainly two ways for the owners to spread emergency knowledge. One is to provide knowledge users with their own knowledge directly through expert emergency consultation; according to the other way, knowledge owners can transfer the emergency knowledge to the knowledge carrier outside the knowledge base and store it in the knowledge base through knowledge acquisition, knowledge extraction, knowledge representation, etc. so as to serve the knowledge users such as emergency decision makers, the public, etc. through certain ways to help them develop their emergency actions.

2.1.2. Knowledge users
Knowledge users are somewhat equal to emergency decision makers and can quickly analyze the knowledge acquired by considering the realities of emergency and apply it to the emergency decision-making so as to help with the emergency disposal.

Positioned based on the marine platform constructed by considering the emergency disposal of marine environmental security events and this Project, the marine knowledge base built by the subject can offer different types of services for different users.

There are mainly three ways for knowledge users to acquire knowledge. The first is to obtain relevant knowledge directly from the knowledge owner through expert emergency consultation; the second is to extract emergency knowledge by consulting a variety of traditional emergency knowledge carriers; the third is to extract the required emergency knowledge through the emergency knowledge base.

2.1.3. Knowledge manager
Emergency knowledge manager, which plays a pivotal role in constructing an emergency knowledge base, is mainly responsible for the construction, updating and maintenance of emergency knowledge base to ensure its normal operation.

2.2. Function orientation of knowledge base
The primary and final goal of building emergency knowledge base to provide the knowledge users in emergency environment with knowledge content and services that meet their requirements, solve the problems in emergency disposal and assist emergency decision-making. In the early research, knowledge base was regarded as a computer-based storage tool of emergency professional knowledge for most of the time, but little attention was paid to the application of knowledge base into the actual emergency disposal.
In conclusion, the functions of the emergency knowledge base mainly include the following three points after considering the current intelligent emergency needs:

- Store the knowledge of such types as government plan, emergency case, etc. in a more scientific form;
- Help the government with disaster assessment, emergency plan formulation, scheduling of disaster relief resources, disaster recovery, etc;
- Provide knowledge popularization and service for the public, and improve the scientificity of disaster relief actions of all sectors of society in the process of emergency response.

3. Key Problems of Knowledge Base Construction
There are three key problems to be solved in the process of knowledge base construction: Emergency knowledge demand and source analysis, knowledge representation and organization, knowledge service mode.

3.1. Knowledge demand and source
It is imperative to analyze the knowledge involved in the formation, development, evolution, decay and post evaluation of emergencies before constructing the knowledge base formally. The main problems analyzed in this step:

- The knowledge demand subjects in the normal and wartime emergency response process of events by taking storm surge, enteromorpha and oil spill as examples;
- Knowledge required by these subjects in different stages of emergencies;
- Origin of the knowledge (knowledge source and its carrier); and how to acquire and deal with these knowledge resources.
3.2. Knowledge representation and organization
It is necessary to define the representation and organization methods of emergency knowledge after defining the knowledge requirements, including how to represent, store and organize different types of knowledge in order, so as to better realize the knowledge service for emergency response process.

3.2.1. Knowledge representation
The premise and foundation of knowledge storage and organization are to transform the domain knowledge into a data structure that can be recognized and called by computer. Common knowledge representation methods are as follows: frame representation, ontology representation, predicate logic representation, etc.

3.2.2. Knowledge organization
The knowledge base for emergency response stores many types of different knowledge, which is different in terms of presentation and storage method and plays a different role. At this time, the storage paths and access interfaces of different types of knowledge files can be recorded in the database, and all types of knowledge can be centrally organized and managed by the database to form a complete knowledge structure.

3.3. Emergency knowledge service mode
The significance of knowledge base construction lies in the flexible application of knowledge to emergency solution and it does not mean simply storing relevant knowledge. Therefore, knowledge reasoning and retrieval are two main ways of emergency knowledge service.

3.3.1. Knowledge retrieval
The connotation of knowledge retrieval can be understood from two different ways. One is knowledge-based retrievals, that is, integrating semantic knowledge into traditional information retrieval process to realize intelligent retrieval process. The other is to index the contents of the knowledge base to realize fast query based on user's needs. These two understandings explain the application of knowledge in retrieval from different perspectives. The former focuses on retrieval process, while the latter pays more attention to retrieval results.

3.3.2. Knowledge reasoning
Knowledge reasoning can be divided into two types according to the specific purposes:
- Infer new knowledge from existing knowledge in order to improve the completeness of knowledge structure, which can be seen as a kind of knowledge innovation process;
- Make analysis by combining knowledge with the problem and infer the cause and the corresponding solution in order to solve problem directly. Knowledge reasoning can be divided into two types based on the knowledge used in the process: Rule-Based Reasoning (RBR) and Case-Based Reasoning (CBR).

4. Knowledge Demand Analysis in Event Emergency Management
In the process of an emergency, knowledge users usually have urgent time and are under high mental stress. It also takes a lot of time to find and construct an emergency expert team or query knowledge from other types of knowledge carriers. Therefore, the emergency knowledge base based on information technology plays a key role in the rapid acquisition and efficient application of emergency knowledge. From this perspective, knowledge items and library functional requirements of knowledge users are the core basis of emergency knowledge base construction.

This paper studies the knowledge system in emergency management from the perspective of demand, which covers the knowledge and information demand characteristics of risk assessment and prevention, emergency disposal and decision support in emergency management. Knowledge demand
analysis involves five key elements, namely, knowledge demand subject, demand motivation, demand content, demand activity and demand stage.

4.1. Knowledge demand subject
Knowledge demand subjects mainly include four roles in the process of event prevention and disposal: decision maker, manager, operator and assistant. Decision makers include individuals or organizations; the manager is responsible for the organization, coordination and monitoring of emergency management activities; the operator is the executive and operator of decision-making order; assistant refers to relevant personnel and organizations for decision-making consultation and information reporting, such as experts, scholars, professional technicians.

The decision-maker is the most critical factor, which plays a decisive role in the success of emergency management mainly. From the perspective of management, decision-makers can be divided into three categories according to the general process characteristics of emergency handling, namely, grassroots decision-makers, middle-level decision-makers and high-level decision-makers. Decision-makers will transfer along with the change of emergency. Each level of decision-maker focuses on different decision-making problems and objectives and issues different decision-making orders and with different work emphases.

4.2. Knowledge demand motivation
The knowledge demand motivation in the process of event prevention and control and disposal can also be called demand goal, including the prevention and control of emergencies, the rescue of the affected people, the treatment of the wounded, life settlement, and aftermath treatment. Motivation guides the behaviour of information demand which then realizes information demand.

4.3. Knowledge demand content
The content of emergency knowledge demand (demand information) mainly includes emergency information, surrounding environment information, emergency human resources, emergency material resources, emergency financial resources, relevant models of emergency disposal, as well as emergency knowledge and lessons drawn from plans and cases.

4.4. Knowledge demand activities
Emergency information demand activities (information demand behaviour) mainly refer to the rescue, medical care, placement, rescue, scheduling, management and information behaviour and activities for obtaining demand information in the emergency process, which can be understood as knowledge acquisition behaviour.

4.5. Knowledge demand stage
The emergency information demand stage is the emergency management stage, which has different subjects, different objectives and different information needs in different stages.

The life cycle of knowledge in the emergency management process is established, and the emergency knowledge content required in each stage of emergency management is defined depending on the emergency management process stage and combining the decision-making subject and decision-making goal.

5. General Design of Knowledge Base

5.1. General design idea
The marine knowledge base should also provide the corresponding functions such as rapid acquisition and matching of prevention and control and emergency knowledge for the generation and evaluation of risk prevention and control plans and emergency response plans, besides serving platform users to view and browse knowledge.
5.2. Knowledge base system design

The knowledge system related to marine environmental security is sorted out from such aspects as the basic knowledge, prevention and preparation, monitoring and early warning, disposal and rescue, recovery and reconstruction, case base, emergency plan, laws and regulations, standards and specifications, etc. Based on the typical marine environmental security emergency plan that has been widely operated at present, the decision-making supportive scheme related to risk prevention and control and emergency disposal of other projects of this project, experts’ experience, business departments’ actual needs, event dynamics and complexity and multi-stage of risk prevention and control.
6. conclusion

This paper studies the construction technology of marine security knowledge base from the perspective of risk prevention and control. The critical role of knowledge owners, knowledge users and knowledge managers in coping with marine security events is defined explicitly through analyzing the roles of knowledge base.

The need for knowledge runs through the whole process of emergency management while coping with marine security events, including risk prevention and preparation, monitoring and early warning, disposal and rescue, recovery and reconstruction. The marine security knowledge system includes 8 first-level directories and 23 second-level directories. This paper is aimed to support the management and application of marine security knowledge by sorting the entire system.

As the nerve center for coping with marine security event, the construction of marine security knowledge base can offer knowledge to decision-makers under an emergent status, solve emergency disposal problems and contribute to emergency decision-making.

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