

Research on Organization and Storage of Digital Resources for Major Emergencies in the Construction of Thematic Databases: Postprint

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Abstract

[Purpose/Significance] Developing an ontological organization model for digital resources of major emergency events oriented towards thematic databases facilitates the preservation and transmission of disaster historical memory, and enables the realization of the historical value and practical utility of such digital resources. [Method/Process] By analyzing the current status of digital resource construction for major emergency events, examining the relevant characteristics and organizational requirements of various digital resources, and extending the “5W1H” analytical method to construct a “5W1H1R” framework, this study designs a conceptual model for digital resource ontology and implements the organization and storage of major emergency event digital resources. [Results/Conclusion] The study designs an ontology model for major emergency event digital resources that incorporates elements of time, location, person, event, cause, method, and relationship, and verifies the feasibility of the model through case studies. Future research will collaborate with domain experts to further improve the resource collection mechanism, advance the practical construction of digital resource databases and service platforms, and deepen the application research of knowledge organization systems in emergency management.

Full Text

Research on Organization and Storage of Digital Resources for Major Emergencies Oriented to Specialized Database Construction

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Abstract:

[Purpose/Significance] The ontological organizational model of digital resources for major emergencies, oriented toward specialized database construction, is conducive to preserving and transmitting historical disaster memory while leveraging the historical value and practical utility of these digital resources. **[Method/Process]** By analyzing the current state of digital resource construction for major emergencies and examining the relevant characteristics and organizational requirements of various digital resources, this study extends the traditional “5W1H” analytical framework to develop a “5W1H1R” framework. Based on this framework, we design a conceptual ontology model for digital resources and implement an organization and storage system for major emergency digital resources. **[Result/Conclusion]** The study establishes an ontological model for major emergency digital resources encompassing seven core components: time, location, person, event, cause, method, and relationship. The feasibility of the model is demonstrated through case validation. Future research will collaborate with domain experts to further refine the resource collection mechanism, advance the practical construction of digital resource databases and service platforms, and deepen applied research on knowledge organization systems in emergency management.

Keywords: Major emergencies; Database construction; Digital resources; Organizational model; Data storage

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Digital resources of major emergency archives serve as carriers and evidence of disaster memory, documenting the entire process of emergencies with rich manifestations and providing important references for emergency decision-making. The revised Archives Law of the People’s Republic of China on June 20, 2020, Article 26, stipulates that research, organization, and development of archives related to emergency response activities should be strengthened to provide literature references and decision-making support for such activities [1]. In December 2022, the General Office of the CPC Central Committee and the State Council issued the Notice on Strengthening the Management of Archives for Major and Extraordinary Events, which emphasizes the need to make full use of modern information technology to scientifically promote the construction of databases for major and extraordinary event archives and facilitate the integration of archival resources [2]. These policy directives underscore the active role that digital resources of major emergency archives play in advancing the modernization of national governance systems and capabilities. In light of this, this paper explores the organization and storage system for digital resources of major emergencies from the perspective of specialized database construction, aiming to provide references for the development of related emergency digital resources.

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1.1 Research Status of Information Resource Organization

Information resource organization constitutes a crucial research area in information resource management, playing a significant role in database construction and information resource sharing. Han et al. [3] constructed a knowledge service model oriented toward high-quality medical and health knowledge needs, achieving innovation in medical resource service models. Xu et al. [4] took water engineering cultural heritage digital resources as their research object and built an active organization model. Zhang and Zhang [5] utilized the Resource Description Framework (RDF) as a tool to construct a logical dataset for ancient Chinese medical texts by structurally processing unstructured knowledge. Fan et al. [6] formed resource classifications based on different attributes such as thematic content, achieving description and application of digital cultural resources through data association and publication of cultural resources.

With the development of artificial intelligence technologies such as Artificial Intelligence Generated Content (AIGC), approaches to information resource organization are continuously evolving. AIGC significantly enhances the efficiency of information resource organization and utilization through automatic classification and annotation, personalized recommendation and retrieval, and other methods [7]. Future information resource organization will require further empowerment from AIGC, relying on generative artificial intelligence to achieve self-growing, self-adaptive, and self-explanatory intelligent architectures.

1.2 Research Status of Emergency Event Digital Resource Organization

Metadata and ontology constitute the core methodological systems for digital resource description and organization [8-10]. Regarding metadata standard development for emergency event digital resources, major initiatives include the Common Alerting Protocol (CAP) [11] and Emergency Data Exchange Language (EDXL) [12] developed by the Organization for the Advancement of Structured Information Standards (OASIS), the Geoscience Australia Metadata description fields [13], and the national standard Technical Requirements for Data Sharing

in Earthquake Emergency Command on Site (GB/T 24888-2010) issued by the China Earthquake Administration in 2010 [14]. Ontology is commonly used to describe and represent relationships between concepts and terminology in various events, completing knowledge discovery and event reasoning tasks. Currently, scholars both domestically and internationally have conducted research on emergency domain ontologies from perspectives including ontology construction methods, representation languages, and construction tools. Luan et al. [15] proposed the concept of super-ontology, analyzing and constructing an emergency super-ontology model by incorporating heterogeneity of complex systems and “hyper-connection” characteristics. Wang and Zhu [16] established an ecological environment law enforcement event ontology model by setting unified semantic conventions for relevant concepts in different law enforcement stages. Phengsuwan et al. [17] analyzed the correlation relationships between various elements for common natural disasters, constructing an association knowledge model between landslide disasters and urban data sources.

1.3 Research Status of Emergency Event Database Construction

Emergency event database construction primarily involves analyzing the characteristics and management requirements of digital resources such as archives, completing resource collection and utilization processes, and enhancing the scientific nature and sustainability of emergency digital resources. In the resource value cognition stage, Li [18] focused on public health emergency archives, emphasizing the need to excavate their potential value to meet diverse utilization requirements, thereby establishing the value foundation for archival emergency services. In terms of optimizing resource construction paths, Xing [19] and Gui and Chen [20] proposed systematic frameworks for resource construction from the perspective of archival emergency service effectiveness; Ku [21] further pointed out the need for cross-departmental collaboration to construct a national emergency thematic database while balancing the practical tension between archival “management” and “utilization.” Meanwhile, Qiu et al. [22], Fan et al. [23], Nie and Zheng [24], and Kang [25] revealed through empirical analysis current issues such as lagging archival collection and fragmented management, advocating for the establishment of a multi-stakeholder collaboration mechanism among “government-agencies-public” and implementing multi-channel dynamic collection strategies for resource construction. In research on knowledge service-oriented databases, Cai [26] systematically explored the construction logic of emergency archival thematic databases, clarifying content structure, construction steps, and utilization scenarios from a knowledge service perspective; Zhu and Luo [27] supplemented the need for joint standard formulation, dynamic data updates, and expanded development subjects to activate the archival value chain. In case practice and knowledge base exploration, Cao [28] and Zhao and Fang [29] analyzed the strategic adaptability and organizational structure of database construction using the COVID-19 pandemic prevention and control as an empirical scenario; Geng and Chen [30] broke through traditional database paradigms by proposing a framework design for emergency archival knowledge

bases, promoting the knowledge-based upgrading of emergency decision support.

While these studies provide references for the collection, description, storage, utilization, and database construction of emergency digital resources, they have not comprehensively examined emergency digital resources and their attributes from the underlying database perspective. This paper takes major emergencies as an example, analyzes the current situation of digital resource construction for major emergencies, examines the relevant characteristics and organizational requirements of digital resources, and proposes a digital resource organization approach from the perspective of “5W1H1R” (What, Who, Where, When, How, Why, Relation) to construct a corresponding digital resource organization model and design database table structures, providing references for advancing research and practice in the organization and storage of digital resources for major emergencies.

2.1 Current State of Emergency Digital Resource Organization in China

Currently, China’s Ministry of Emergency Management and provincial emergency management departments have established numerous thematic and general-purpose websites or databases for emergencies using digital resources. This study conducted retrieval and investigation on the Ministry of Emergency Management’s website using keywords such as “emergency,” “sudden incident,” and “flood,” finding that the website publishes brief introductions to various disaster and accident information in its news section; provides warning information, laws and regulations, and general and special emergency plans in its service section; and disseminates various emergency science popularization knowledge in its emergency science section. However, the organizational granularity of these digital resources is relatively coarse, and the digital resource formats vary. Further investigation of provincial emergency management department websites and relevant media official emergency websites revealed that the organization of digital resources on various emergency website platforms can be summarized as follows.

2.1.1 Provincial and Municipal Emergency Management Department Websites The digital resources stored on provincial and municipal emergency management department websites mainly include emergency news, laws and regulations, emergency plans, accident information, accident investigation reports, and emergency guidelines and common knowledge. Most websites are updated frequently and contain rich resource types, including documents in PDF, WORD, EXCEL formats, as well as images, audio, and video digital resources. The majority of websites have established special columns for emergency event information, emergency plans, and accident investigation reports in their government information disclosure sections, making digital resource retrieval relatively convenient. Among them, the emergency management department websites of Jiangxi, Hubei, Guangxi Zhuang Autonomous Region, and Guizhou have dedi-

cated accident statistical analysis columns.

2.1.2 Relevant Media and Other Websites In addition, websites such as China Work Safety Net, Coal Mine Safety Net, China Coal Net, and China Emergency Information Net all feature news announcements, laws and regulations, emergency plans, and accident information for emergencies. Currently, the digital resources provided by these websites exhibit two main characteristics: first, relatively concentrated resource types, primarily structured data such as news announcements, policies and regulations, and accident reports; second, thematic coverage with industry-specific characteristics. For example, the earthquake column on the official website of the China Earthquake Administration focuses on natural disaster domains (such as major earthquake statistics, earthquake common knowledge, and earthquake knowledge service systems), demonstrating outstanding professional depth, while cross-domain emergency resources are relatively limited.

Overall, the two types of websites (or databases) mentioned above have established a certain organizational foundation for emergency digital resource construction, with relatively abundant digital resources to a certain extent, and most provide retrieval methods such as title search, full-text search, resource format selection, publication time sorting, and keyword search. However, both still have deficiencies in retrieval and utilization, as various digital resources lack deep semantic association. For instance, when retrieving a specific emergency event, no well-established associative relationships exist among different digital resources, preventing multi-perspective descriptions of a particular emergency and necessitating further column establishment and in-depth semantic association.

2.2 Characteristics of Emergency Digital Resources

2.2.1 Diversity of Emergency Digital Resources Throughout the entire lifecycle of emergency outbreak and emergency response, commonly used digital resources include basic descriptive information of emergencies, emergency rescue information, and government regulations and decrees. These digital resources manifest in diverse forms with characteristics of multimodality, heterogeneity, and multi-sourcing. Such resources typically originate from multiple websites and databases, including government agencies, social media, and early warning platform monitoring records, and may employ different data storage formats and encoding standards.

2.2.2 Complexity of Emergency Digital Resources The generation mechanism of emergencies is complex, caused by multiple factors. According to the Emergency Response Law of the People's Republic of China and the National Overall Emergency Plan for Public Emergencies, emergencies include four first-level categories: public health, natural disasters, accidental disasters, and social security incidents [31]. On this basis, these first-level

emergencies can be further divided into sub-categories and finer classifications. Simultaneously, each event has different level classifications, and various associative relationships exist between events, requiring multi-departmental collaboration for effective response. The outbreak of emergencies generally undergoes an evolutionary process from gestation, occurrence, and development to conclusion. During this process, due to the uncertainty and destructiveness of emergencies, they themselves can spawn other emergencies, making the digital resources of emergencies inherently complex.

2.2.3 Knowledge Nature of Emergency Digital Resources Emergency digital resources are not only fundamental data for emergency decision-making but also archives that store social memory. Such data records historical experiences of humanity overcoming various disasters, providing valuable documentation for preventing and responding to various emergencies. The main components of emergency archives include: emergency rescue plans at all levels and types; basic information on emergencies at all levels and types; disposal information for emergencies at all levels and types; and classification and staging information for emergencies at all levels and types. In these emergency digital resources, diverse manifestations preserve various textual and visual records containing information about stakeholders in various emergencies, the generation mechanisms of major emergencies, and the location, time, background, process, and relevant countermeasures of events. Therefore, there is an urgent need to utilize resource organization technologies to complete semantic association work, enrich relevant reserve knowledge for government departments in responding to emergencies, assist government departments in emergency decision-making, and mitigate the harm caused by emergencies to society.

2.3 Requirements for Emergency Digital Resource Organization

2.3.1 Resource Description Requirements By describing elements such as the time, location, personnel, causes, and lifecycle of emergencies, the development process of an event can be completely characterized, laying the foundation for subsequent digital resource knowledge mining and utilization. When describing emergency digital resources, it is necessary to cover multi-channel and multi-type data, including policies and regulations, emergency plans, public opinion, and cases [32-33]. Furthermore, due to the multimodal and multi-source characteristics of emergency digital resources, it is essential to adopt a data governance perspective to fully describe multimedia resources such as textual resource cataloging information, graphical resource morphological information, and audio-visual resource features. For example, drawing on the concept of resource encoding from other fields to classify and encode elements such as time, location, scenario, cause, type, and participating personnel involved in emergencies can achieve standardization of resource description and enhance the use value of digital resources [31].

2.3.2 Resource Storage Requirements In recent years, the scale, variety, and complexity of emergency digital resources have increased, and the relationships and topological structures among data have become increasingly complex. Digital resource storage has expanded from traditional relational databases to graph databases. During the resource storage process, it is first necessary to classify and encode emergencies, then discover attribute relationships or event associations among various events through efficient resource organization, and mine the knowledge contained therein [34].

Textual data on emergencies can be stored in structured two-dimensional table formats in relational databases, while scene images related to emergency occurrences can be stored using graph databases (such as Neo4j) while maintaining interconnection between the two types of databases. Since emergency data includes policies, laws and regulations, public opinion, basic cases, and emergency plans, resource storage must fully consider the association requirements among emergency data, adhering to the principle of focusing on a specific “emergency event” or category to fully associate various types of data, thereby more comprehensively characterizing a particular emergency event or category and providing clues for subsequent retrieval and utilization. Additionally, the multimodal characteristics of digital resources should be fully considered, utilizing image, audio, video, and other file types or formats to describe and depict emergencies in greater detail, improving the efficient storage and management of such digital resources [34].

2.3.3 Subsequent Knowledge Utilization Requirements The organization of emergency digital resources is a prerequisite for knowledge utilization, which requires the incorporation of certain rules and analytical work based on existing organizational models [35-36]. On the basis of analyzing the characteristics of emergency digital resources and constructing organizational models, full storage and utilization of these resources can lay the foundation for subsequent knowledge base construction and decision-making knowledge services. In emergency management, data such as accident cause analysis and post-incident disposal measures represent experience summaries formed during the emergency management process, providing valuable experiential knowledge for future emergency management.

3 Construction of the Major Emergency Digital Resource Organization Model

This paper adopts a combination of hierarchical and flattened approaches to design the major emergency digital resource organization model and constructs models for three types of digital resources: case data, policy and regulation data, and public opinion data. The specific model can be divided into three layers: the data resource layer, the resource storage and association layer, and the application service layer.

Case data, policy and regulation data, public opinion data, and the associa-

tion system among the three constitute the foundational digital resources of the data resource layer. This paper categorizes the source channels of major emergency digital resources into three types: institutional websites, news websites, and user-generated content platforms. These three types of digital resources are composed of different modalities and elements, each containing content related to one or more major emergencies. Consequently, complex relationships are formed between the events themselves and among the three types of digital resources. The public opinion data in this study originates from public opinion events, representing data formed by the mapping of public opinion events in cyberspace, which possesses the general patterns and elements of emergencies and can be semantically interpreted using emergency description methods. Policies and regulations are often used to provide relevant guidance during emergencies, with content formulated by relevant personnel, and their data organization can also be described according to relevant attributes of emergencies. In the resource association layer, by organizing multi-modal and multi-source event case data, policy and regulation data, and public opinion data related to each event, we use event coding to associate them, exploring their essential elements. Semantic association is performed based on attribute meanings to form a network structure centered around events, providing certain knowledge services for resolving subsequent difficulties and contradictions [37]. The application service layer is primarily based on the data resource layer and resource storage and association layer, serving as an indirect display of the knowledge association system on the user interface. It mainly provides navigation for users to retrieve a specific (or category of) major emergency and its related digital resources, while offering digital resource access portals to facilitate users' secondary processing of digital resources and mining of deep-level knowledge.

3.1 Major Emergency Digital Resource Organization Process Ontology, as an important tool for resource organization, primarily functions to organize and associate resource content. By constructing an ontology model, effective association among various knowledge units of major emergency digital resources can be achieved, providing effective pathways for integrating, sharing, and utilizing diverse, heterogeneous, and scattered digital resources. Building upon previous research on metadata information models [38], this paper takes major emergency digital resource conceptual entities as the entry point, references mature ontology standards in the domain, and constructs the organizational model described herein in a targeted manner to complete resource description and organization.

3.1.1 Analysis of Major Emergency Conceptual Entities Throughout the entire lifecycle of major emergencies, massive digital resources are generated at each stage. These digital resources explicitly or implicitly reflect the characteristics of the emergencies themselves and are of significant importance for government emergency decision-making. When integrating major emergency digital resources, it is necessary to focus not only on resource external features

related to digital resource preservation but also to describe their content features, effectively organizing resource content to enable subsequent knowledge discovery. This paper references the “5W1H” analysis method (What, Who, Where, When, How, Why) and adds “1R” (Relation) to analyze the conceptual entities and relationships of major emergency digital resources, defining six conceptual entities: Event Entity, Person Entity, Time Entity, Place Entity, Reason Entity, and Measure Entity. Through these six conceptual entities, the connotation of major emergencies can be analyzed in a multi-dimensional, three-dimensional, and systematic manner, enabling more comprehensive description of major emergency digital resources.

3.1.2 Major Emergency Domain Ontology Construction Tools and Steps

Currently, major emergency ontology construction methods are mainly divided into two categories: thesaurus-based and ontology engineering-based approaches [39]. This paper selects the ontology engineering-based approach, combining the characteristics of emergency digital resources, the applicability of ontology construction methods, and the purpose of resource semantic organization and description, and adopts the “Seven-Step Method” published by Stanford University to complete the construction of the emergency domain ontology.

Step 1: Determine the knowledge scope and application scope of the emergency ontology specialty, and collect relevant domain knowledge in a targeted manner.

Step 2: Investigate existing knowledge ontologies in the domain and consider the possibility of reusing existing ontologies. Reference ontologies such as the W3C-constructed Time Ontology in OWL [40] and other organization-constructed person and location ontologies, and supplement some classifications and relevant attributes according to event characteristics.

Step 3: Identify important core terms and concepts in the domain, establish their ontology core concept sets and explanatory notes, and add concept attributes and attribute values.

Step 4: Define classes themselves and hierarchical relationships between classes. This step can be completed using three approaches: top-down, bottom-up, and hybrid methods. In this process, the top-level ontology and core classes for major emergency digital resources can first be determined, then gradually improved upon this foundation.

Step 5: Define relevant properties and constraints of classes. Properties are descriptions of conceptual entity characteristics, primarily including data properties and object properties.

Step 6: Define property facets. After defining data properties and object properties, specific property values need to be added.

Step 7: Create instances and conduct ontology evaluation. Instance creation is an ongoing process that not only verifies previously defined conceptual entities and properties but also enriches specific entity relationships.

3.2.1 Determination of Core Concepts and Hierarchical Structure By reusing some subclasses and properties from the W3C organization's time ontology and mature ontology classes in the emergency domain [15, 41-52], the ontology model is ultimately defined as seven first-level categories, described from the perspectives of time, location, person, event, cause, method, and relationship. The ontology classes for major emergency digital resources defined in this paper are shown in Table 1.

3.2.2 Properties of Classes in the Ontology Model The same property can exist as either a unique property of a class or as a common property of multiple classes. Properties of classes in the ontology can be divided into two major categories: data properties and object properties.

(1) Data Properties

Data properties are used to describe different dimensional characteristics of a class, indicating the relationship between instances and values, similar to the relationship between data items and specific values in database tables. Such properties typically have restrictions such as data format and value domain to better serve data storage in databases. The main data properties in this paper are shown in Table 2.

(2) Object Properties

Object properties are a type of data relationship that focuses more on describing and analyzing class characteristics. Common object properties in the major emergency digital resource ontology model mainly include event ID, event name, event level, etc. The main object properties of major emergency digital resources are shown in Table 3.

It is worth noting that the data properties and object properties in the ontology model constructed in this paper are not static. This is closely related to the development of the major emergency domain and technological advancements in the information resource management field. Over time, different individuals will have different semantic understandings of events, and different types of events will contain different semantic relationships. How to continuously improve the conceptual system in subsequent ontology construction, dynamically interpret conceptual properties, and achieve semantic relationship reuse to adapt to social development and evolving emergency needs is a key issue that urgently needs to be addressed.

3.2.3 Definition and Design of Inter-Class Relationships After defining data properties and object properties, it is necessary to further define inter-class relationships to describe richer semantic relationships within the domain. In the major emergency digital resource domain, the six conceptual entities can have associative relationships such as composition, causation, and purpose. Common inter-class relationships in the major emergency digital resource ontology are shown in Table 4.

By analyzing classes, data properties, object properties, and inter-class relationships, a corresponding relational database table structure is designed to facilitate temporary categorical storage during subsequent data collection. The relational database table structure design in this paper is shown in Figure 1 [Figure 1: see original paper].

In Figure 1, the database tables include Tables A through F. Table A is primarily used to store inter-class relationships of major emergency digital resources—for example, the relationship name “subclass” associates the categories “Person Class” and “Affected Subject.” Table B is mainly used to store the Person, Time, Place, Event, Method, and Reason classes of major emergency digital resources—for instance, when ClassID is Class-01, the name is “Event Core Class,” and when ClassID is Class-02, the name is “Person/Object Class.” Table C is primarily used to store instances of major emergency digital resource classes—for example, “Lianyungang Fire Rescue Detachment” is an instantiation of the “Emergency Subject Class.” Table D is mainly used to store properties of major emergency digital resource classes—for example, the data property “Event Level” belongs to the “Event Core Class,” with its domain being “Event Core Class,” or the object property “Event Category Is.” Similarly, the inter-class relationship property “Implemented By” belongs to the “Event Core Class,” with its domain being “Event Core Class” and range being “Person/Object Class.” Table E is used to represent data property values of a specific instance—for example, the instance “12·9 Lianyungang Workshop Explosion Accident” has the data property “Event Level” with the value “Major.” Table F is used to represent relationships between two instances—for example, the relationship between the instance “Zhejiang Daily” and the instance “45 People Held Accountable! Investigation Results of Lianyungang 12·9 Major Explosion Accident Announced” is “Announced.”

3.3 Ontology Storage and Organization Model Validation

After clarifying the major emergency digital resource ontology model, Protégé 5.5.0 software [54] was selected for its formal representation. In this tool, the superclass “owl:Thing” represents the superclass of the major emergency digital resource ontology. Under this class, first-level categories and their subclasses are established, including Event Core Class, Location Class, Time Class, Person/Object Class, Reason Class, and Method Class. After completing the addition of ontology classes, data properties and object properties are added.

On this basis, the major hazardous chemical accident “12·9 Lianyungang Workshop Explosion Accident” (hereinafter referred to as “this case accident”) is used as an example to validate the organization model.

This study obtained textual information about this case accident from sources including the Safety Management Network, authoritative literature, the Ministry of Emergency Management website, and the China Chemical Safety Association website. To ensure that the collected event texts could validate the constructed organization model, it was necessary to confirm that they contained detailed

event processes, results, causes, timing, relevant laws and regulations, and public opinion data. Additionally, digital resources related to major emergencies should include multiple forms such as text, images, audio, and video to better display rich digital resources. On this basis, through data preprocessing to remove duplicate data, eliminate naming and structural conflicts, and clean noisy data, relevant information was organized and stored using relational database tables. Partial instance data and property data of the latter are shown in Table 5 and Table 6, respectively.

By importing the case data from Tables 5 and 6 into Protégé, the application of the organization model was completed. Partial results after import are shown in Figure 2 [Figure 2: see original paper].

As can be seen from Figure 2, the public opinion data item “45 People Held Accountable! Investigation Results of Lianyungang 12•9 Major Explosion Accident Announced” (Event Core Class) was published by “Zhejiang Daily” (Location Class) and is associated with this case accident (Event Core Class). Its own data properties such as “URL Link” and creator “Zhejiang Daily” can be intuitively displayed. In addition, relevant data related to persons, objects, and locations associated with this event can also be obtained. Thus, using ontology to further associate relevant concepts of digital resources and make explicit the implicit associations expressed by various properties can better describe major emergency digital resources and reuse their relevant elements. When organizing major emergency digital resources, establishing certain connections with the major emergencies themselves and supplementing their data properties can enable users to retrieve digital resources of major emergencies.

The above example demonstrates that the ontology model and database table structure designed in this paper, under certain conditions, facilitate the organization and storage of relevant digital resources and constituent elements of major emergencies. The core conceptual entities in this ontology model (such as event, time, location, person, cause, and method) are universal, and its core conceptual entity and semantic association framework are highly extensible, capable of covering the core elements of various emergencies.

Conclusion

Major emergency digital resources, as original historical records and evidence of emergency management activities, constitute an important component of the digital memory resource system and serve as a potential database and knowledge base for emergency management and decision-making. They offer significant advantages in responding to major emergencies and play an active role in advancing the modernization of national governance systems and capabilities. Major emergencies are characterized by suddenness, complexity, and strong destructiveness, with relatively dispersed related digital resources and complex resource organization. Ontology, as an effective tool for resource organization and semantic association, can assist in the construction of emergency digital resources, pro-

mote digital resource ordering, improve resource sharing, and accelerate the inheritance and development of digital memory resources for emergencies.

This paper analyzed the characteristics of major emergency digital resources and constructed a “5W1H1R” ontology model based on the “5W1H” method, comprising six core entities (time, location, person, event, cause, method) and their relationships “1R,” initially achieving knowledge organization and storage of case data, policy and regulation data, and public opinion data. However, this study still has limitations, including coarse ontology granularity, lack of dynamic update mechanisms, and inability to fully organize multimodal digital resources. Future research should be deepened in three aspects: first, improving the ontology model through collaboration with cross-domain experts, jointly involving digital resource and emergency management experts; second, expanding the model to adapt to the organizational needs of heterogeneous data such as text, images, and video through multimodal resource integration; and third, constructing a dynamically updatable knowledge platform that supports real-time retrieval and knowledge discovery for large-scale data.

References

- [1] National Archives Administration. Archives Law of the People’s Republic of China [EB/OL]. [2025-04-30]. <https://www.saac.gov.cn/daj/falv/202006/79ca4f151fde470c996bec0d50601505.s>
- [2] Xinhua News Agency. General Office of the CPC Central Committee and State Council Issue Notice on Strengthening Management of Archives for Major and Extraordinary Events [EB/OL]. [2025-04-30]. https://www.gov.cn/xinwen/2022-12/12/content_{5731572}.htm.
- [3] Han P, Li X, Liu S, et al. Research on Knowledge Service Model in Medical and Health Field Based on Large Language Models [J]. Journal of Xihua University (Philosophy & Social Sciences), 2025, 44(1): 24-35.
- [4] Xu X, Su Y, Zhou D, et al. Research on Proactive Organization of Digital Resources for Water Engineering Cultural Heritage Based on Ontology [J]. Information Science, 2024, 42(1): 76-83, 114.
- [5] Zhang W, Zhang X. Research on Knowledge Organization and Visualization of Digital Resources of Traditional Chinese Medicine Ancient Books—Taking “Jin Gui Yao Lue” as an Example [J]. Information Science, 2022, 40(8): 107-117.
- [6] Fan Q, Tan G, Zhang W. Research on Description and Application of Digital Cultural Resources Based on Metadata—Taking Hubei Digital Culture Center as an Example [J]. Library Science Research, 2022(2): 48-59.
- [7] Zhang R. Qualitative Analysis and Reflection on Generative AI-Driven Information Resource Organization and Service Research [J]. Archives Management, 2024(3): 19-21.
- [8] Niu L, Huang L, Jia J, et al. Research on Design and Application of Ontology-Driven Archival Document Heritage Metadata—Taking Suzhou Silk Archives as an Example [J]. Journal of Information Resources Management, 2023, 13(5): 15-31.
- [9] Wu S, He L, Yang H, et al. Research on Construction of Red Literature Metadata Representation System from Perspective of Transfer Learning [J].

Information and Documentation Services, 2024, 45(6): 84-92.

- [10] Cao S, Ma H. Brief Introduction to Theoretical Basis and Method Classification of Domain Knowledge Organization [J]. Information and Documentation Services, 2021, 42(5): 14-22.
- [11] OASIS. Common Alerting Protocol Version 1.2 [EB/OL]. [2025-04-30]. <https://docs.oasis-open.org/emergency/cap/v1.2/CAP-v1.2-os.html>.
- [12] OASIS. Emergency Data Exchange Language (EDXL) [EB/OL]. [2025-04-30]. <http://xml.coverpages.org/EDXL-DEv10-Standard20060501.pdf>.
- [13] Bastrakova I V, Ardlie N, Regan J. Geoscience Australia Community Metadata Profile of ISO19115: 2005 [EB/OL]. [2025-04-30]. <https://www.ga.gov.au/data-pubs/datastandards/cataloguestandard>.
- [14] General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China, Standardization Administration of the People's Republic of China. Technical Requirements for Data Sharing in Earthquake Emergency Command on Site: GB/T 24888-2010 [S]. Beijing: Standards Press of China, 2010.
- [15] Luan Y, Zhang H, Liu W, et al. Emergency Super-Ontology: Structural Model and Construction Method [J]. Information Studies: Theory & Application, 2023, 46(3): 43-50.
- [16] Wang X, Zhu Y. Research and Practical Application of Ecological Environment Law Enforcement Event Ontology Construction [J]. Environmental Pollution & Control, 2022, 44(1): 117-122.
- [17] Phengsuwan J, Shah T, James P, et al. Ontology-Based Discovery of Time-Series Data Sources for Landslide Early Warning System [J]. Computing, 2019, 102(3): 745-763.
- [18] Li P. Brief Discussion on Collection and Utilization of Archives for Public Health Emergencies [J]. Archives and Construction, 2016(8): 90-91.
- [19] Xing B. Research on Improving Emergency Service Capability of Archives Departments in Major Public Emergencies [J]. Zhejiang Archives, 2020(9): 32-33.
- [20] Gui J, Chen W. Research on Construction of Information Service Capability of Health and Epidemic Prevention Archives for Emergency Decision-Making [J]. Archives Science Study, 2021(5): 66-72.
- [21] Ku J. Research on Emergency Event Archives Work from Perspective of Epidemic Prevention and Control [J]. Archives Management, 2021(4): 85-86.
- [22] Qiu Z, Liu Y, Wu Y. Research on Emergency Management of Archives for Major Emergencies [J]. Archives Management, 2021(5): 65-67.
- [23] Fan M, Ran C, Song H. Discussion on Dilemmas and Strategies of Collecting Archives for Major Emergencies [J]. Archives Management, 2015(4): 52-53.
- [24] Nie Y, Zheng J. Construction of Digital Archival Resources for Major Emergencies from Perspective of Social Co-construction [J]. Archives Science Study, 2021(1): 96-102.
- [25] Kang P. Construction of COVID-19 Archives Data Sharing Platform in Post-Pandemic Era [J]. Archives World, 2021(6): 36-40.
- [26] Cai Y. Idea on Establishing National Emergency Event Archives Thematic

- Database [N]. China Archives News, 2020-02-20(003).
- [27] Zhu L, Luo D. Research on Development and Utilization Status and Strategies of Public Health Emergency Archives [J]. Beijing Archives, 2021(2): 30-32.
- [28] Cao Y. Collection and Management of Emergency Event Archives—Taking COVID-19 Emergency Archives as Example [J]. Heilongjiang Archives, 2020(4): 32-33.
- [29] Zhao X, Fang L. Preliminary Study on Construction of COVID-19 Archives Thematic Database [J]. Archives Management, 2020(5): 56-57.
- [30] Geng Z, Chen J. Idea on Construction of Emergency Event Archives Knowledge Base [J]. Archives Science Bulletin, 2021(3): 63-70.
- [31] General Office of the Standing Committee of the National People's Congress. Gazette of the Standing Committee of the National People's Congress of the People's Republic of China No. 4, 2024 [R/OL]. (2024-07-15) [2025-04-30]. <http://www.npc.gov.cn/npc/c2/c30834/202412/P020241223578514715967.pdf>.
- [32] Ge Y. Research on Emergency Knowledge Representation and Knowledge Reasoning for Sudden Incidents [D]. Jilin: Jilin University, 2024.
- [33] Xiang Y, Liu D, Ma X, et al. Construction of Knowledge Representation Model for Public Health Emergencies Oriented to Information Disclosure [J]. Journal of the China Society for Scientific and Technical Information, 2024, 43(5): 538-552.
- [34] Ma C. Research on Emergency Information Organization in Multi-Modal Environment [D]. Wuhan: Wuhan University, 2020.
- [35] Jiang X, Zhu X. Development and Prospect of Domain Knowledge Organization in Big Data Environment [J]. Scientific Information Research, 2022, 4(2): 29-36.
- [36] Zhou H, Zhang H, Liu W, et al. Construction and Scenario Application of Event Knowledge Graph for Major Emergency Management [J]. Journal of the China Society for Scientific and Technical Information, 2024, 43(12): 1453-1466.
- [37] Li G, Xu J, Ba Z, et al. Research on Key Issues and Module Division in Construction of Emergency Knowledge Base System [J]. Information Studies: Theory & Application, 2018, 41(3): 123-128.
- [38] Wang S, Yang C, Liu J, et al. Research on Metadata Framework for Network Public Opinion of Major Emergencies [J]. Journal of Intelligence, 2023, 42(11): 105-112.
- [39] Li A, Xu Y, Chi Y. Overview of Ontology Construction and Application [J]. Information Studies: Theory & Application, 2023, 46(11): 189-195.
- [40] Hobbs J R, Pan F. Time Ontology in OWL [J]. W3C Working Draft, 2006, 27(133): 3-36.
- [41] Raimond Y, Abdallah S. The Event Ontology [EB/OL]. [2025-04-30]. <https://motools.sourceforge.net/event/event.html>.
- [42] CIDOC CRM Special Interest Group. Definition of the CIDOC Conceptual Reference Model [EB/OL]. [2025-04-30]. <http://old.cidoc-crm.org/>.
- [43] Doerr M. The CIDOC Conceptual Reference Module: An Ontological Approach to Semantic Interoperability of Metadata [J]. AI Magazine, 2003,

24(3): 75-92.

[44] Zhang H, Li J, Liu W, et al. Research on Construction of Event Logic Graph for Major Emergencies [J]. Library and Information Service, 2021, 65(18): 133-140.

[45] Zhang Y, Guo Y, Li K, et al. An Ontology Modeling Method for Emergency Domain [J]. China CIO News, 2020(5): 134-136, 138.

[46] Zhang H, Liu W, Luan Y, et al. Construction of Scenario Graph for Major Emergencies [J]. Journal of the China Society for Scientific and Technical Information, 2021, 40(9): 924-933.

[47] Zhu W, Liu Z. Domain Knowledge Modeling for Sudden Incidents Based on Event Ontology [J]. Computer Engineering and Applications, 2018, 54(21): 242-247.

[48] Wang L. Research on Ontology Construction of Food Emergency Case Base for Emergencies [J]. Journal of Intelligence, 2020, 39(5): 162-167.

[49] Wang F, Yang J, Xu L. Research on Ontology Construction for Fire Emergency Management [J]. Journal of the China Society for Scientific and Technical Information, 2020, 39(9): 914-925.

[50] Huang W, Wu M, Hong X. Research on Knowledge Representation of Food Safety Emergency Management Based on Ontology [J]. Computer Technology and Development, 2015, 25(3): 223-227.

[51] Wang X, Zhu Y. Research and Practical Application of Ecological Environment Law Enforcement Event Ontology Construction [J]. Environmental Pollution & Control, 2022, 44(1): 117-122.

[52] Hu J, Zhao J. Research on Construction Method of Ontology Knowledge Base for Sudden Crisis Events [J]. Library Science Research, 2012(4): 58-62.

[53] Wang S, Liu J. Research on Data Model of Network Public Opinion Case Database for Major Emergencies Based on Ontology [J]. Information Studies: Theory & Application, 2023, 46(10): 163-173.

[54] Stanford University. About Protégé [EB/OL]. [2025-04-30]. <https://protege.stanford.edu/about.php>.

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