Research on the Construction of Archival Information Service Platforms for Public Emergencies

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Abstract

The construction of archival information service platforms for public emergencies is of great significance in the development of China's emergency decision-making capability system. Employing literature research and system planning methodologies, this paper analyzes the construction requirements and current status of such platforms. Based on this analysis, it proposes a construction framework from three perspectives: system functional analysis, system architecture design, and system construction promotion mechanism, aiming to explore a feasible path for building archival information service platforms, leverage the value of archives in national emergency management, improve decision-making efficiency, and facilitate cross-departmental and cross-regional sharing of archival information resources for public emergencies.

Full Text

Research on the Construction of an Archives Information Service Platform for Public Emergencies

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Abstract: The construction of an archives information service platform for public emergencies holds significant importance in developing China' s emergency decision-making capability system. Employing literature research and systematic planning methods, this study analyzes the construction requirements and current status of such platforms. Building upon this analysis, the paper proposes a construction framework from three perspectives: system function analysis, system architecture design, and platform construction promotion mechanisms. The aim is to explore a feasible path for building archives information service platforms that leverages the value of archives in national emergency management, enhances decision-making efficiency, and promotes cross-departmental

utilization and cross-regional sharing of archival information resources for public emergencies.

Keywords: Public emergency; Information system; Archival service; System design

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The COVID-19 pandemic that erupted in early 2020 has drawn considerable academic attention to the concept of "public emergencies." Public emergencies refer to sudden incidents that cause or may cause significant casualties, property damage, ecological destruction, and serious social harm, endangering public safety. These events are characterized by complexity, destructiveness, and persistence [1]. Archives, as original records of human practical activities, faithfully document the entire process of how various regions, departments, and industries respond to public emergencies, holding important historical and intelligence value. Strengthening the management of public emergency archives and fully leveraging their decision-support function in emergency prevention, monitoring, response, and recovery can provide government departments with decision-making basis and empirical references, which is crucial for enhancing China's public emergency response capability system.

Current research in archival science on public emergency archives work concentrates on several aspects: Li Siyu [2] and Wu Jianhua [3] have explored fundamental operational issues such as collection, organization, and utilization of public emergency archives; Guo Ruohan [4] has proposed institutional frameworks for public emergency archives management from a theoretical perspective; Chen Yang [5] and Wen Quan [6] have analyzed and summarized beneficial experiences from foreign public emergency archives work; Fang Xiaoli [7] and Geng Zhijie [8] have respectively proposed concepts for constructing emergency archives databases and knowledge bases, though their discussions remain at the conceptual and importance-explication level. Evidently, archival research has focused on institutional, operational, procedural, and methodological aspects of physical archives management, paying insufficient attention to archives information services.

During the initial COVID-19 outbreak, construction drawings for Beijing Xiaotangshan Hospital were transmitted to Wuhan's Urban Construction Bureau within one hour, significantly accelerating the construction of Huoshenshan and Leishenshan hospitals, which demonstrates China's remarkable achievements in physical archives management for public emergencies [9]. However, at the data and information level, health and epidemic prevention archives failed to play their due role, with their emergency service capabilities not fully realized. Data and information blockages directly contributed to sluggish decision-making efficiency in early epidemic prevention and control. Moreover, China has yet to establish a national-level integrated platform for emergency archives information, and the dispersion and limited availability of archival information resources have become major challenges for decision support. Based on these observations, this

paper employs basic principles and methods of information systems engineering to propose a construction framework for a public emergency archives information service platform from four perspectives: requirements analysis, functional analysis, architecture design, and promotion mechanisms, aiming to achieve nationwide integration and sharing of public emergency archives information resources and enhance government decision-making efficiency.

2.1.1 Real Information Acquisition Requirements

With the development of computer network technology, information is growing exponentially, making it difficult to distinguish false information from truth. For government departments, capturing authentic information presents even greater challenges. Once misled by false information and making erroneous decisions, the losses would be immeasurable. Only by obtaining original, accurate, first-hand information can the basic trajectory of public emergencies be accurately grasped and decision-making scientificity enhanced. Archives preserved by various departments, due to their nature as original records, possess objectivity and comprehensiveness that align with fundamental requirements for information authenticity. Therefore, the primary requirement for building a public emergency archives information service platform is to timely capture and collect first-hand archival information generated by various departments during emergency response, ensuring data authenticity and reliability from the source, helping government departments distinguish truth from falsehood, see facts clearly, and base all work deployments on solid evidence.

2.1.2 Information Interaction and Linkage Requirements

The core functional requirement of a public emergency archives information service platform is to enable information interaction and sharing. Centered on public emergencies, the platform integrates original data and decision-making information from various departments across event warning, handling, and recovery phases, breaking down the "information silo"dilemma of poor inter-departmental communication and improving the efficiency of archival resource retrieval and communication. Relying on a unified information sharing platform, various regions and departments can exchange archival information, enhance emergency decision-making capabilities for public emergencies, and contribute to forming a unified national emergency response framework.

At the 2014 National Archives Directors and Curators Conference, Yang Dongquan proposed that archival departments should adopt a proactive mindset, "abandoning the end-position concept, actively serving, and intervening in management decision-making in advance" [10]. Intelligence and knowledge services represent important functions for management information systems to deepen and expand their business scope and extend their value. In the knowledge economy era, intelligence and knowledge hold higher value than raw data. Traditional archival services operate on a model where users actively request access, and archival departments such as archives or record-creating

units provide targeted information based on user needs. However, the depth of information processing in this model requires further improvement. Public emergencies are often unpredictable, making the traditional "passive" archives information service model ill-equipped to meet complex and changing event conditions. This reality necessitates transforming the platform' s service model, extending data and information presentation functions into knowledge services. The platform construction must aim to provide knowledge services as the ultimate goal, converting archival data and information into knowledge, breaking through the constraints of traditional service models, and taking proactive initiatives to intervene early in event prediction, case 推送, and decision-making recommendations, thereby achieving innovative upgrades in service content and form.

2.2.1 Resource Dispersion and Prominent Island Phenomenon

For a long time, China has adopted a localized management model for public emergency archives, where records are preserved by the event-location' s record-creating institutions and transferred to local state archives at the same level after meeting stipulated retention periods according to the Archives Law of the People' s Republic of China. While this model offers advantages of low cost, convenient transfer, and easy utilization, it also results in large quantities of archives reflecting the same event theme being scattered across different regions, organizational fonds, and categories. The archival resources available within a single region are extremely limited, lacking cross-regional circulation and sharing. Regional archival departments rely solely on local archives for compilation work, and due to insufficient reference materials, their compilation achievements lack prominent representativeness. As archival quantities increase, the phenomenon of archival "information silos" becomes more pronounced in the absence of cross-regional resource sharing platforms.

2.2.2 Manual Organization and Sluggish Decision-Making Speed

Public emergencies develop rapidly, with weak controllability and strong randomness, imposing high requirements on decision-making timeliness. Decision-making institutions must implement targeted measures within the shortest possible time to minimize losses from emergencies. During the 2003 SARS outbreak and the 2020 COVID-19 pandemic, various archives primarily relied on manual screening, organization, and compilation of archival materials to produce "Policy Advisory References" or "Data Compilations" for government decision support [11]. However, archival collections are vast; relying entirely on manual organization entails considerable workload. Accurately extracting information of practical value for decision-making from archives demands high professional competence from archivists and consumes substantial time and energy. Under time constraints, this process cannot meet the rapid and efficient requirements of emergency decision-making for public emergencies. Therefore, there is an urgent need to introduce management information systems into archival resource

processing to provide convenient information services for decision-making departments.

2.2.3 Unidirectional Flow and Single Service Form

Based on existing research findings, most comprehensive archives transmit public emergency archival compilation achievements to government departments through direct reporting. This information transmission represents a typical unidirectional "Archives → Government Department" model that makes it difficult to establish two-way feedback and exchange mechanisms. Archival policy advisory services should be built upon demand feedback and information interaction. However, current archival departments primarily rely on their own experience and judgment rather than government department requirements when compiling policy advisory materials, which can easily lead to mismatches between provided information and actual decision-making department needs. This misalignment between archival information supply and demand constrains decision-making effectiveness improvement. Moreover, compilation achievements mostly take the form of archival data compilations with relatively single formats, lacking diversified policy advisory products. A public emergency archives information service platform is expected to establish two-way communication mechanisms, improve supply-demand alignment, and simultaneously achieve diversification of product and service types.

Based on the above needs and status analysis, this paper proposes construction concepts for a public emergency archives information service platform from three aspects—system functions, system architecture, and promotion mechanisms—to address the supply-demand mismatch problem facing both archival and decision-making departments and enhance emergency response capabilities from an information systems construction perspective.

3 System Function Analysis

The primary task of a public emergency archives information service platform is to collect and organize archival resources formed by various regions and departments during emergency response and process them into knowledge that aids decision-making. Combining general functions of management information systems with specific requirements of archives management, the platform' s functions can be divided into four categories: system management control, archives information collection, archives information management, and archives decision service functions. Each basic function can be further subdivided, forming a total of 11 core functional modules as shown below:

[Figure 1: see original paper] Core Functional Modules of the Public Emergency Archives Information Service Platform

3.1 System Management Control Function

The system management control function is fundamental to the public emergency archives information service platform, directly determining whether the system can operate according to predetermined functions. It mainly includes three modules: system permission management, operation log management, and system risk management. System permission management grants different access rights to users at different levels to prevent unauthorized access to system content or functions. Operation logs record system operation processes, enabling understanding of completed operations, analysis and handling of errors, and subsequent system function improvements. System risk management involves real-time monitoring of system operations. Public emergency archives themselves possess strong confidentiality and sensitivity, making it essential to minimize various risks during system operation and implement targeted measures to strengthen system security, avoiding data leaks, illegal intrusions, and other incidents. The system management control function directly determines system security and reliability, requiring holistic and forward-thinking planning during functional design to ensure safe and stable operation.

3.2 Archives Information Collection Function

Archives information collection occupies the front-end position in public emergency archives management activities, directly determining the quality of subsequent work. This function comprises three modules: information import and acquisition, information extraction, and information representation. Archives information import and acquisition mainly includes three channels: first, transmission from departments' or enterprises' OA or ERP systems to the archives management system via unified interfaces; second, manual import and reporting from departments; and third, periodic automatic capture by the information service platform of publicly released information from departmental websites for archival preservation. Information extraction identifies and extracts elements from imported structured, semi-structured, or unstructured data, converting them into uniformly formatted structured data processable by computers and organizing them into information units according to specific logic. Information representation organizes and presents processed information units according to certain themes using specific technologies, making them intuitively understandable to users through natural thinking. During system architecture design and code implementation, the information collection function must receive high attention from designers and developers; otherwise, it will affect the overall work quality of the information service platform.

3.3 Archives Information Management Function

Information management involves information organization and storage based on collection and acquisition, including information authentication/assessment and information classification/storage modules. After collection and processing, information must first be authenticated and assessed by the information authen-

tication and assessment module regarding its practical significance, authenticity, and long-term or permanent preservation value. This process is primarily implemented automatically by the system through artificial intelligence and machine learning, supplemented by expert manual review when necessary. Additionally, the scientificity and operability of archival information in emergency decision-making and its ability to meet departmental decision-making needs must be evaluated. This process uses actual requirements proposed by decision-making institutions as criteria, determining whether archival information should be retained. The information classification and storage module mainly stores approved and authenticated information content in databases according to the basic categories of emergencies stipulated by the state, organized by subject for future reference and utilization.

3.4 Archives Decision Service Function

The archives decision service function directly faces decision-making departments and institutions, providing an interactive platform and interface between system and users. It mainly includes information retrieval, information transmission, and emergency plan recommendation services. Retrieval service is a commonly used function that should provide multi-path retrieval and full-text retrieval services while recording user search and browsing history. Information transmission service transforms the traditional one-way information reporting model, with decision-making institutions proposing needs and the information service platform organizing archival information transmission accordingly, shifting the process from offline to online and improving transmission efficiency. Emergency plan recommendation occupies the core position in decision service functions and represents a major feature of the service platform. Based on existing archival information, it employs technologies such as case-based reasoning to provide targeted decision-making solutions for decision-making departments, proactively intervening in emergency management decision-making activities. This changes the archives departments' long-standing "passive custody" role in emergency archives management, enabling proactive action and early intervention to minimize potential losses from emergencies while providing reliable archival information support.

4 System Architecture Design

Based on general principles of information system architecture design, the hierarchical architecture of the public emergency archives information service platform can be divided from bottom to top into four layers: resource collection layer, resource processing layer, resource storage layer, and resource service layer. The logical relationships among these four hierarchical structures are shown below:

[Figure 2: see original paper] Hierarchical Architecture of the Public Emergency Archives Information Service Platform

4.1 Resource Collection Layer

As discussed previously, archival information resources are primarily collected into the information service platform through a combination of automatic and manual collection. In terms of subjects, the resource collection layer involves government department archives, comprehensive archives, emergency management departments, emergency event competent authorities (such as earthquake bureaus, health commissions, etc.), and enterprises or social groups participating in emergency response. The archival competent authorities must take the lead in actively coordinating various subjects' participation in platform resource construction through forms such as joint meetings. Regarding content, archival information mainly includes various forms of original records generated during emergency response and disposal, such as decision documents, regulations, audio-visual materials, and statistical monitoring data. Methodologically, manual import is primarily suitable for institutions without established OA or ERP systems, where these institutions digitize original materials and manually import them into the information service platform according to unified format requirements. Automatic import employs web crawlers to periodically capture information published on websites of various institutions and enterprises, or uses unified interfaces for regular transmission from institutions with OA or ERP systems, thereby enriching and 充实 ing the resource database and achieving continuous acquisition and dynamic updating of resource content.

4.2 Resource Processing Layer

Archives information resource processing mainly includes five stages: information recognition, information extraction, information representation, information assessment, and information classification. The service platform employs technologies such as text mining, image and audio semantic recognition, and OCR to analyze and extract fine-grained elements including event names, times, locations, persons, institutions, and behaviors from semi-structured and unstructured data. These elements form specific scenarios centered on events, which are then 串联 ed chronologically to create scenario chains or scenario networks. Extracted elements can also be organized into knowledge units according to a "fact-concept-rule" model, forming structured data recognizable and readable by computers [12]. Finally, processed information units establish "entity-concept" associations with original data, enabling users to query original archives through any element clue in the event network. After passing authentication and assessment, archival information is classified and stored in databases, completing the full information processing workflow.

4.3 Resource Storage Layer

According to the Emergency Response Law of the People' s Republic of China, emergencies can be divided into four types: natural disasters, accidental disasters, public health events, and social security events. Based on this classification standard, the resource storage database of the information service platform can

be divided into four sub-databases: natural disaster sub-database, accidental disaster sub-database, public health event sub-database, and social security event sub-database. Each sub-database can be further divided into case basic information database, event evolution process database, countermeasure database, and prevention knowledge database according to different archival information content. The case basic information database primarily stores fundamental information for each public emergency, including time, location, and name. The event evolution process database stores data from different evolution stages of emergencies, presenting the entire process from emergence to conclusion from a temporal dimension. The countermeasure database stores policies, laws, regulations, and other emergency measures issued by relevant departments to address emergencies. The prevention knowledge database stores scientific knowledge related to emergencies released by authoritative departments, helping decision-making departments dispel rumors and strengthen disaster prevention and mitigation publicity to achieve preventive effects.

4.4 Resource Service Layer

The resource service layer is built upon the resource collection and storage layers, directly providing information services to users, including information retrieval services, information transmission and interaction services, and information recommendation services. Information retrieval and transmission interaction services are conventional service types common to traditional information systems. Information recommendation service is a distinctive feature of this platform, which predicts emergency trends and actual needs of decision-making departments through model building and provides corresponding support information. Decision-makers submit current situation descriptions of emergencies to the service platform, which performs natural language ontological processing and description before querying the case database. The platform calculates and ranks similarity matching results, selects the most similar emergency case, and searches for corresponding evolution process information, countermeasure information, and prevention information in that case's evolution database, countermeasure database, and prevention knowledge database. These information pieces are integrated into systematic response solutions and pushed to users. Through each associated element, users can query original archival data for reference, thereby fulfilling the platform' s function of improving decision-making efficiency.

5.1 Departmental Cooperation and Coordination Mechanism

The construction of a public emergency archives information service platform cannot achieve its goals by relying solely on archival departments; it requires multi-departmental and multi-stakeholder cooperation to establish a collaborative linkage mechanism promoting efficient platform operation. In this process, archival competent authorities possess professional technical advantages and should assume primary responsibility for platform construction and mainte-

nance. Additionally, a multi-party cooperation mechanism comprising archives, emergency event competent authorities, institutional archives, enterprises, and social organizations must be established. Within this cooperation framework, consensus should be reached through consultation to prompt various departments and organizations to open OA or ERP system interfaces, removing practical obstacles to archival data transfer. For organizations without OA or ERP systems, archival competent authorities can organize the signing of archival digital copy transfer agreements on a voluntary and equal basis. These organizations regularly transfer digital copies of archives to archival competent authorities according to unified formats, which are then manually imported into the service platform. Archival competent authorities should also open information service platform user permissions to archival data transfer institutions, enabling organizations to equally enjoy platform-provided information resources and services while fulfilling transfer obligations, thereby achieving cross-departmental and cross-regional sharing and utilization of archival information.

5.2 Regulatory Standards Support Mechanism

Article 26 of the Archives Law stipulates that "the national archival competent authorities shall establish and improve work mechanisms for collection, organization, protection, and utilization of archives related to emergency response activities," providing the highest-level normative document basis for establishing public emergency archives information service platforms. The 14th Five-Year Plan for National Archives Undertaking Development also points out the need to "coordinate the construction of thematic databases for major historical events, major activities, and emergency response activities," creating policy opportunities for platform construction. The National Archives Administration issued the Measures for the Management of Archives of Major Activities and Emergencies (Draft for Comments) in 2020, which provides macro-level and systematic regulations for emergency archives management but lacks specific implementation rules for collection, organization, preservation, and other work stages. Beyond national laws, regulations, and policies, local authorities should also respond promptly to the 2020 revision of the Archives Law by synchronously amending supporting local archival regulations and rules to provide regulatory support for platform construction. In addition to policies and regulations, unified standards must be established, including unified document format standards, metadata standards, transmission interface standards, and archival quality standards, to avoid situations where transferred data structures and formats are inconsistent, preventing heterogeneous archival information resources from being accurately recognized and read by the platform and improving platform data processing efficiency.

5.3 Technical Update Guarantee Mechanism

After the public emergency archives information service platform is put into operation, it will store large quantities of classified archives or archives involv-

ing sensitive content, imposing higher security requirements on the system. As the system may face various security risks during operation, including system crashes, hacker attacks, and internal personnel theft, comprehensive prediction and 梳理 ing of potential threats must be conducted with advance technical solutions. For example, firewalls and intrusion detection technologies can be employed to review system network communications; biometric authentication and other identity verification technologies can control access permissions; Hash algorithms and asymmetric encryption technologies can encrypt data content to prevent illegal theft during transmission. Additionally, in the information processing stage, methods such as ontological representation, object-oriented representation, and predicate logic can be comprehensively applied to accommodate different data structure types. During information service provision, timely response to technology upgrades and updates should be made to create better user experiences using cutting-edge technologies. For instance, semantic ontology technology can be used to construct emergency scenario elements, and semantic networks can build emergency knowledge networks to display case scenarios. Case reasoning, rule reasoning algorithms, and natural language processing algorithms in inference engines should also be continuously upgraded to enable the system to more accurately identify user needs expressed in natural language and provide more precise information content and solution recommendations, thereby improving supply-demand alignment.

The construction of an emergency archives information service platform is of great significance for enhancing emergency decision-making capabilities and improving the emergency management system. Based on existing research results, this paper proposes a construction framework for an information service platform from four aspects: requirements analysis, functional analysis, architecture design, and promotion mechanisms. However, what this paper presents is only a preliminary design concept that inevitably contains idealistic elements. Due to the diverse stakeholders and complex technologies involved in the system development process, the hierarchical architecture and functional modules must be dynamically adjusted according to actual conditions during development to ultimately meet the practical needs of archives management. The construction concept proposed in this paper offers considerable research space and requires continuous revision and improvement based on extensive empirical research in the future.

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Note: Figure translations are in progress. See original paper for figures.