Postprint: Analysis of Research Hotspots in Chinese Emergency Information Management Based on Bibliometrics and Co-word Analysis

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Abstract

[Purpose / Significance] Emergency information management is an interdisciplinary field between emergency management and information management. Systematically reviewing the current state of emergency information management research facilitates the effective utilization of information resources in emergency management research and provides references for the subsequent development and practical exploration of emergency information management research. [Method / Process] Using journal papers retrieved from the China National Knowledge Infrastructure (CNKI) database as the research data source, this study employs bibliometric analysis and co-word clustering analysis methods to analyze the current state of domestic emergency information management research. [Results / Conclusions] Disaster emergency information management, crisis information disclosure, emergency information management systems, emergency response to sudden incidents, and smart emergency management are the research hotspots in domestic emergency information management. In the future, China should strengthen basic theoretical research on emergency information management and construct a theoretical framework for emergency information management.

Full Text

Preamble

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Abstract

[**Purpose/Significance**] Emergency information management represents an interdisciplinary field bridging emergency management and information management. Systematically reviewing the research landscape in this domain can enhance the effective utilization of information resources in emergency management studies and provide valuable references for future theoretical development and practical exploration. [**Method/Process**] This study employs bibliometric analysis and co-word clustering methods to examine the current state of emergency information management research in China, using journal articles retrieved from the China National Knowledge Infrastructure (CNKI) database as the data source. [**Result/Conclusion**] The analysis identifies five major research hotspots: disaster emergency information management, crisis information disclosure, emergency information management systems, emergency response to incidents, and smart emergency management. Future research in China should strengthen foundational theoretical studies and construct a comprehensive theoretical framework for emergency information management.

Keywords: emergency information management, information system, information management, information disclosure, information communication

1 Introduction

Information plays an increasingly vital role in economic and social development, where mastering information equates to holding decision-making initiative. For emergency management, information and information management constitute the foundation and core, requiring corresponding information and management architecture support at every stage—including prevention, preparation, response, and recovery [1]. Emergency information management encompasses the entire process of information input, transformation, and output for emergency management based on the full lifecycle of incidents, utilizing relevant information technologies and methods to provide adequate information services for decision-making bodies [2]. With frequent occurrences of emergencies globally, emergency information management has become a prominent research topic attracting widespread attention from both academia and society. To comprehensively understand the research landscape in China's emergency information management field, this paper employs bibliometric methods to analyze the current state of research, aiming to reveal the achievements, characteristics, and progress over recent years and provide theoretical references for in-depth studies in this domain.

2.1 Data Sources

This study selected the China Academic Journal Network Publishing Database of CNKI (covering journals published from 1915 to present) as the data source. The search query was constructed as: ((SU='emergency management' AND TI='information') OR (SU='emergency management' AND TI='intelligence')

OR SU='emergency information management'), with publication years limited to 1995-2015, using "precise" matching. The retrieval was conducted on October 9, 2016, yielding 468 articles after removing duplicates and less relevant literature.

2.2 Research Methods and Tools

This study employs word frequency analysis to identify hotspot terms in emergency information management research and co-word clustering analysis to delineate research themes. Word frequency analysis is a bibliometric method that determines research hotspots and trends based on the frequency of keywords or subject terms that express core content in a field's literature [3]. Co-word clustering analysis, a common approach in co-word analysis, simplifies complex co-occurrence networks into a smaller number of clusters using statistical methods, visually representing relationships between them and revealing structural changes in disciplines and topics [4]. We utilized the SATI (Statistical Analysis Toolkit for Informetrics) software to extract keywords and generate frequency statistics, creating a co-word matrix of high-frequency keywords. This matrix was then imported into SPSS for cluster analysis to identify research themes.

3.1 Temporal Distribution of Publications

The temporal distribution of emergency information management research articles reflects development trends in China. Statistics on annual publication quantities are shown in Figure 1 [Figure 1: see original paper]. The data reveal a general upward trend from 1995-2015, which can be divided into three stages: (1) **Embryonic Stage (1995-2005)**: Characterized by slow growth with fewer than 10 articles annually, representing an exploratory phase. (2) **Development Stage (2006-2010)**: Marked by rapid growth and significantly expanded output, indicating a period of accelerated development. (3) **Mature Stage (2011-2015)**: Featuring stable annual output of approximately 60 articles, representing a relatively stable state. The following analysis focuses on data from this mature stage to examine disciplinary distribution, journal distribution, prolific authors, and high-frequency keywords.

3.2 Disciplinary Distribution

During 2011-2015, when emergency information management research entered a relatively stable development phase, disciplinary distribution analysis of core journal samples from CNKI reveals concentration in several fields, as shown in Figure 2 [Figure 2: see original paper]. The research demonstrates strong interdisciplinary characteristics, primarily spanning: (1) **Computer Science**, as emergency management research development relies heavily on information technology support, and utilizing modern IT for efficient information management represents a key focus. (2) **Management**, since the ultimate goal of emergency information management research is to provide strategic solutions for govern-

ment and disaster prevention departments, making management knowledge crucial. (3) **Safety Science**, which approaches research from disaster prevention and practical application perspectives, offering action-oriented solutions with practical operability. (4) **Journalism and Communication**, focusing on information dissemination and public opinion management during emergencies. (5) **Geography**, which emphasizes applied practice, particularly GIS-based emergency information management system design. (6) **Library and Information Science**, which, though relatively weaker compared to other disciplines, plays an important role through its specialized analytical methods for information management, with intelligent emergency management decision analysis representing a future development direction.

3.3 Journal Distribution

Statistics show that 200 journals published emergency information management research articles during 2011-2015, with 75% publishing only one article. Nineteen journals published two or more articles (see Table 1). The top 19 journals cover management, library and information science, computer science, safety science, surveying and mapping, and disaster studies—consistent with disciplinary distribution findings. The three most prolific journals were *China Emergency Management*, *Journal of Intelligence*, and *Modern Intelligence*, with the latter two being library and information science journals. Among the top 19 journals, library and information science titles accounted for 21%, demonstrating strong interest in this field. Emergency information management research is closely related to intelligence studies, as the emergency management process relies heavily on information science support.

3.4 Prolific Authors

Table 2 presents prolific authors in emergency information management research from 2011-2015. All prolific authors are affiliated with universities, with Wuhan University, University of Electronic Science and Technology of China (UESTC), and Hohai University representing three major research forces. Notable contributions include: Li Gang et al.'s analysis of multi-stage, multi-theme emergency intelligence needs in urban emergency management contexts [5] and exploration of "smart" emergency intelligence system construction from network perspectives [6]; Chen Hong et al.'s research on supply chain coordination under asymmetric information during emergencies [7]; Cheng Tiejun et al.'s proposal of interval multi-attribute emergency risk decision models based on cumulative prospect theory under incomplete information [8-9]; Yuan Weihai's detailed elaboration on China's emergency information systems and management architecture [10-11]; Xiang Liwen's summary of government emergency management information disclosure research [12]; Yao Leye's focus on intelligence work in emergency management [13-14]; Liu Chunnian's construction of emergency information resource classification directories [15]; Xia Zhijie's exploration of information sharing in emergency response [16-17]; and Xu Zhenyu's research on emergency manage-

ment information system evaluation [18-20]. These scholars remain active in the field.

3.5 High-Frequency Keyword Distribution

Analysis of recent five-year journal data using SATI software, after removing overly generalized terms (e.g., "problem," "information," "management") and merging synonyms (e.g., "geographic information system" and "GIS," "modern information technology" and "information technology"), identified 25 high-frequency keywords (frequency $\geq$ 5), as shown in Table 3 . The highest-frequency keywords—"emergency management," "emergency incidents," and "information system"—indicate that current research primarily focuses on emergency incidents and emergency information systems. These keywords can be categorized into four groups: (1) **Object**: Terms describing research targets, including emergency incidents, information security, and natural disasters. (2) **Purpose**: Terms revealing research objectives, such as supporting emergency decision-making and improving emergency management capabilities. (3) **Information Technology**: Terms identifying commonly used technologies, including management information systems, geographic information systems, and big data. (4) **Process**: Terms highlighting research emphasis on information disclosure, sharing, communication, and dissemination during emergency management processes.

4.1 Research Theme Analysis

High-frequency keyword sets typically capture major research themes with relatively few terms. Using 25 keywords with frequency $\geq$ 5 as the high-frequency set for 2011-2015, we processed co-occurrence patterns using SATI to generate a 25$×$25 co-word matrix. Importing this matrix into SPSS for cluster analysis produced the dendrogram shown in Figure 3 [Figure 3: see original paper]. The results reveal seven major research directions: (1) **Crisis Information Disclosure Research**, covering keywords "information disclosure," "public crisis," and "information dissemination," focusing on government emergency information disclosure status and problems. (2) **Emergency Decision-Making Research**, covering "emergency management," "emergency incidents," and "emergency decision-making," addressing methods, models, and systems for emergency decision-making. (3) **Emergency Management Evaluation Research**, covering "information system," "information security," "emergency management capability," "emergency management system," and "e-government," concentrating on capability/system evaluation and information system assessment. (4) **Information Technology Research**, covering "information sharing," "big data," and "information technology," exploring applications of advanced IT in emergency management. (5) **GIS-Based Emergency Information System Research**, covering "emergency management information system" and "geographic information system," focusing on system design and development. (6) **Emergency Information Management**

and Disposal, covering "emergency information," "emergency coordination," "emergency information management," and "emergency response," aiming to improve information processing accuracy and utility. (7) **Disaster Emergency Management Research**, covering "information communication," "disaster emergency management," and "natural disasters," concentrating on emergency management for sudden natural disasters.

4.2 Research Hotspot Analysis

To explore the evolution of emergency information management research over time, annual high-frequency keywords from 2006-2015 were compiled in Table 5 . The analysis reveals changing research themes over time. While "emergency management" consistently ranked first, other themes varied annually: (1) In 2006, research themes were relatively singular, focusing on "earthquake" and "emergency incidents." (2) During 2007-2008, the scope expanded to include "environmental pollution" and "public health," with research rapidly focusing on the "Wenchuan Earthquake" after 2008. (3) Post-2008, government information disclosure and release became hotspots, with keywords including "government information disclosure," "e-government," "information release," "release mechanism," and "information disclosure." (4) After 2009, information technology gained increasing attention, with keywords such as "data mining," "database," and "big data." (5) Since 2010, context-specific research emerged, with "online public opinion" gaining attention in 2010, "new media" becoming a hotspot in 2013, and "smart city"-related research appearing in 2015. These temporal changes demonstrate that emergency information management research closely follows societal development.

4.2.1 Disaster Emergency Information Management Research

Natural disaster emergency information management research examines information issues in managing earthquakes, floods, and other disasters, focusing on: (1) **Disaster Information Classification and Organization**, including disaster type classification, specific disaster information statistics, and standard development. For example, Xiang Zhengjun et al. discussed natural disaster emergency information statistics and standardization [21], while Peng Yao systematically reviewed domestic natural disaster information classification [22]. (2) **Information Communication in Disaster Emergency Management**, addressing coordination challenges among relevant organizations and proposing countermeasures. Cao Hailin et al. identified institutional barriers to citizens' right to know, obstructed media reporting channels, inadequate local government guidance, and lack of public initiative as major challenges, proposing strategies to strengthen information communication [23]. Zhang Liwen et al. elaborated on problems including asymmetric communication, lack of interactivity, information transmission delays, and insufficient information release [24].

4.2.2 Crisis Information Disclosure Research

Information disclosure serves as a crucial pathway for effective government-society communication during crises. Improving crisis management information disclosure mechanisms enhances government emergency management capabilities. Current research explores government emergency information disclosure systems and operational mechanisms, as well as stakeholder 博弈 among government, media, and public. Lin Rupeng et al. proposed information disclosure and communication strategies for emergency states [25], while Zhuge Fumin elaborated on attitude differences and 博弈 among government, media, and public regarding information disclosure [26].

4.2.3 Emergency Information Management System Research

Research hotspots include: (1) **GIS-Based Emergency Management Information Systems**, focusing on system construction and development for various environments, such as petrochemical enterprises [27] and urban rail transit [28]. (2) **Modern Information Technology Applications**, examining integration of big data, cloud computing, IoT, mobile internet, and remote sensing technologies in emergency management platforms. For instance, Zhang Ningxi proposed a government emergency information system architecture based on the Hadoop distributed computing framework for big data applications [29].

4.2.4 Emergency Response Research

Hotspots encompass: (1) **Network Public Opinion on Emergency Incidents**, studying characteristics, evolution patterns, guidance strategies, and classification methods for online public opinion information. (2) **Emergency Decision-Making Intelligence Systems**, with scholars exploring theoretical and practical issues of rapid-response intelligence systems for emergency decision-making [30-31]. Su Xinning et al. constructed emergency case knowledge bases based on stakeholder theory [32] and developed feature dictionaries for emergency intelligence collection and organization [33].

4.2.5 Smart Emergency Management

Smart emergency management—urban emergency intelligence—is a critical component of smart city development, employing intelligent technologies, thinking, and management methods. Research hotspots include: (1) **Smart City Emergency Management Systems**, examining key technologies, constraints, and architectural design [34-36]. (2) **Intelligence Systems for Smart City Emergency Decision-Making**, analyzing issues and constructing frameworks and operational models [37-39].

5.1 Conclusion

Based on CNKI-indexed emergency information management journal articles, this study employed bibliometric methods to analyze publication trends, disciplinary distribution, journal distribution, prolific authors, high-frequency keywords, and research hotspots. Findings indicate that China's emergency information management research developed through three stages: an embryonic period (1995-2005), development period (2006-2010), and mature period (2011-2015). Journal articles appear across diverse disciplinary journals in computer science, library and information science, surveying and mapping, and disaster studies, with library and information journals such as *Journal of Intelligence*, *Modern Intelligence*, *Library and Information Service*, and *Information Science* publishing numerous articles. Prolific authors from the past five years include Li Gang and Ye Guanghui from Wuhan University, Chen Hong and Wu Zhonghe from UESTC, and Cheng Tiejun and Wu Feng from Hohai University. High-frequency keywords fall into four categories: object, purpose, information technology, and process. The five major research hotspots are disaster emergency information management, crisis information disclosure, emergency information management systems, emergency response, and smart emergency management.

5.2 Research Limitations and Prospects

The aforementioned hotspots span multiple domains, confirming that emergency information management is an interdisciplinary field requiring integration of computer science, management, journalism and communication, and geography. However, current domestic research exhibits two main problems: (1) **Fragmented research content**—studies are scattered across different disciplines with varying focuses, lacking true interdisciplinary integration. (2) **Immature theoretical framework**—as an emerging interdisciplinary frontier, emergency information management lacks foundational theoretical research, with few studies addressing core issues and research scope, and no established theoretical framework.

Based on the current state, future research should: (1) **Strengthen foundational theoretical research**—despite the practical orientation of emergency information management, theoretical support is essential for development, making theoretical framework construction an urgent priority. (2) **Enhance think tank theory and construction**—as China actively builds new types of think tanks, emergency information management requires think tank support, necessitating both theoretical research and practical think tank development (e.g., disaster prevention, emergency response think tanks) to provide consultation for major national decisions. (3) **Promote collaboration among researchers, government, and industries**—emergency information management involves complex, cross-domain issues requiring cooperation among researchers with diverse backgrounds, as well as coordination with government departments and social sectors (e.g., environmental protection, disaster prevention) to comprehensively address challenges posed by emergencies.

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Author Contributions

Zou Qingyun: Conceptualization, data analysis, original draft writing and revision;
Gao Feng: Paper revision;
Xu Zhiyuan: Data processing.

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