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Exploring the Intellectual Structure and International Cooperation in Information Management:

A Bibliometric Overview Using 2-Tuple Linguistic Model

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ABSTRACT

To make a comprehensive literature review and identify the development trends, this study maps the intellectual structure of the research information management based on co-keyword analysis, the 2-tuple linguistic technique, and social network analysis. This study reveals the intellectual structure by analyzing the topological structure, conceptual structure, and strategic diagram. From the perspective of topological structure, the research of the information management field can be divided into three layers including the nucleus layer, middle layer, and marginal layer. In terms of the conceptual structure, the research of information management can be divided into four sub-fields including health information management, information systems, information technology, and information management application. The four subfields can be repartitioned into seven clusters by using a 2-tuple linguistic model, which means that the 2-tuple linguistic model can improve co-keyword analysis.

KEYWORDS

2-Tuple Linguistic Model, Co-Keyword Network Analysis, Global Information Management, Intellectual Structure, International Cooperation, Library and Information Management, Regional Analysis

1. INTRODUCTION

Traditionally, information management is defined as a process to assist decision-making promptly. With the development of information technologies, researchers from different disciplines contribute to the research of information management. The research of information management focuses on medical informatics (Angst *et al*., 2017; Kohli and Tan, 2016), agriculture (Wu *et al*., 2017), construction (Li *et al*., 2017; McMahon *et al*., 2004), organizational performance (Lal and Bharadwaj, 2020), and sociology (Srivastava *et al*., 2016). Owing to the growth and diversity of literature in information management, researchers start to define information management from a systems perspective. The research hotspots of information management change from information retrieval and information system in health care to the internet of things, e-health, and others. The development and changes

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in research hotspots motivate us to conduct a comprehensive literature review by showing a clear intellectual structure. This paper aims to explore the intellectual structure of research of information management by analyzing the topological structure and the conceptual structure using the bibliometric analysis method.

The intellectual structure refers to the knowledge fundament of the examined scientific domain, representing some attributes including its disciplinary composition, influence research topics, and the patterns of its interrelationships (Shafique, 2013). Based on the explanation of the collaboration pattern (Baker *et al*., 2020), international cooperation denotes the collaborations among different countries identified by analyzing the publications of different countries and the relationships among these publications in the domain of examined research in this paper.

Previous papers summarize the research status of information management in a specialized area (Hanafizadeh and Zareravasan, 2020; Niederman *et al.,* 2002; Taylor *et al*., 2010) or in a selected journal to show the research trends in that journal (Palvia *et al*., 2017; Yu *et al.*, 2017). However, some research gaps are overlooked. First, the existing literature reviews based on a particular journal offer an inner structure pattern of the journal but not the intellectual structure of the research of information management. By analyzing the intellectual structure, the researchers can point out the research hotspots and discipline connections in information management. Second, previous papers use conventional bibliometric methods to cluster research keywords inaccuracy, which might not completely distinguish the slight relations between keywords (Zupic and Cater; 2015). Using the 2-tuple linguistic technique, the researchers can cluster each keyword into a sub-network and show future research trends clearly.

To bridge these gaps, this paper shows the intellectual structure and international cooperation in the information management field by co-keyword analysis, social network analysis, and 2-tuple linguistic technique. Co-keyword analysis shows the connections among papers based on the quantitative aspects of keywords and papers' relevance. The 2-tuple linguistic technique is a linguistic, computational technique that can calculate and present the qualitative aspects of information (Herrera and Martinez, 2001, 2012). A bibliometric overview using the 2-tuple linguistic technique denotes that this paper reviews the research of information management using the 2-tuple linguistic technique. In this paper, the 2-tuple linguistic technique assists the authors to cluster the keywords based on the qualitative aspects of keywords and word similarity. By visualizing the result of co-keyword analysis and a 2-tuple linguistic model, social network analysis can show node properties and the nature of the network. Considering both the quantitative and qualitative aspects of keywords, the main research question of this paper is: How to effectively explore the intellectual structure of global information management by the 2-tuple linguistic technique and co-keyword analysis?

To answer the research question, we analyze 4,504 papers in the research of information management. Through co-keyword analysis and social network analysis (SNA), this study finds that the research of the information management field can be divided into three layers including the nucleus layer, middle layer, and marginal layer. The unbalanced distribution of the middle layer indicates the uneven development of disciplines. From the marginal layer, this paper finds that the cross-study of social commerce and open-source data processing, risk management and data-driven technology, and health care and data security are all interesting research trends. Using co-keywords analysis, the 2-tuple linguistic technique, and the social network analysis, this study reveals the research of information management can be divided into four main sub-fields including health information management, information systems, information technology, and information management application. The research relevance in the area of health information management is highest. The four main subfields can be further partitioned into seven clusters. As shown in the strategic diagram, the research of information technology has some new and emerging themes and the research of information systems is specialized in two themes including decision-making and information storage and retrieval. In addition, we find 16 countries and regions, accounting for 76% of publications about information management,

can be divided into three research groups. Most Japanese publications are finished by international cooperation and Japan has the highest preference for international cooperation.

The contributions of this paper can be summarized in two aspects. In the content aspect, this study scrutinizes all related publications in the Core Collection of Web of Science. This study analyzes the intellectual structure and international cooperation based on the papers from main journals relevant to information management. Different from other literature reviews, this study visualizes the ontological structure of the research of information management in the whole field but not in a subdivision field. In the technical aspect, the 2-tuple linguistic technique combined with social network analysis (SNA) is introduced into the bibliometric analysis. Different from other bibliometric research, this paper divides the whole network into smaller sub-fields using the 2-tuple linguistic technique, which provides an effective analytical method for evaluating keywords' importance.

2. LITERATURE REVIEW

Two streams of literature are related to this paper. One is the review paper about information management. The other is the literature about bibliometric methods.

2.1 Overview on the Research of Information Management

Some literature reviews the research of information management by focusing on a special area, including the review of information technology (Hanafizadeh *et al.*, 2020, Mannino *et al*., 2021; María *et al*., 2018; Matarneh *et al*., 2019; Pärn *et al*., 2017), the review of health information management (Georgiou *et al*., 2019; Khubone *et al*., 2020; Low *et al.*, 2019), the review of information security (Bongiovanni, 2019; Soomro *et al*., 2016), and others. Different from these papers, this study reviews all publications about information management.

While some papers adopt meta-analysis method to make a systematic review about information management (Ali and Warraich, 2021; Costa *et al.*, 2016), others use content analysis method to review the research of health information management (Yokota and Thompson, 2004). Only a few papers use the bibliometric analysis to overview the research of information management (Taylor *et al.*, 2017). Different from these papers, this study explores the intellectual structure by bibliometric analysis and 2-tuple linguistic technique, which can show disciplinary compositions and the linkages among different research sub-fields. To our best knowledge, there is little paper that summarizes all published papers of information management using the 2-tuple linguistic technique.

2.2 Bibliometric Methods

2.2.1 Co-Keyword Analysis

To display scientific literature objectively, bibliometrics researchers propose a wide array of quantitative measures to evaluate the contribution of authors, affiliations, and publications. The measures include citation analysis, co-citation analysis, co-author analysis, and co-keyword analysis (Shafique, 2013; Yu *et al*., 2017; Zupic and Cater, 2015). Co-keyword analysis selects frequent keywords in articles and constructs a co-occurrence keyword matrix for further discussion. Compared with citation analysis or co-citation analysis, co-keyword analysis can reveal the current situation of the research field and indicate future directions more clearly (Hu and Zhang, 2015), and can point out the connections with underlying topics. As keywords summarize the main research issues of the literature, the co-keyword matrix connects similar papers. This method has been widely used to detect intellectual structure for different fields (Feng *et al*., 2017; Ravikumar *et al*., 2015; Zhang *et al*., 2015).

However, there are some deficiencies of this method. When researchers map the structure using selected frequent keywords, they might omit some information since they delete intermediate frequency words. To solve these problems, this paper maps all keyword relationships and emphasizes the core layer.

2.2.2 The 2-Tuple Linguistic Model

The 2-tuple linguistic model is a linguistic, computational technique that can calculate and present the qualitative aspects of information (Herrera and Martinez, 2001, 2012). Different from ordinal linguistic computational models, which directly calculate based on terms' labels, the 2-tuple linguistic model adds a real number to present the deviation of symbolic translation, which can obtain the same or better results than the ordinal linguistic (Herrera and Martinez, 2000). Each keyword can be presented by a 2-tuple linguistic model. Traditional co-keyword analysis clusters adjacent nodes and grants each word a label depending on the sub-field to which it belongs. While the connections of some nodes are slight, these nodes could belong to several different parts simultaneously. The 2-tuple linguistic technique can settle this problem.

2.2.3 Social Network Analysis

Social network analysis was often used in bibliometrics research to identify and show the relationship among keywords (Chen and Xiao, 2016). The most common indicators are k-core and centrality including betweenness and degree. Betweenness centrality can evaluate the influence of actors and determine the center of the whole network (Otte and Rousseau, 2002). Betweenness centrality is the number of shortest routes passed by a given node. A higher value of betweenness centrality represents that the node is located in the center of the whole network and has a great power to affect the others' actions. Degree centrality refers to the number of linkages between two nodes (Otte and Rousseau, 2002). A higher value indicates that a node links with more nodes and has a more powerful effect on the network. A k -core of a graph G is a maximally connected sub-graph of G in which all vertices have a degree of at least k (Wasserman and Faust, 1994). Nodes with high degree and k -core value have more adjacent terms, which might reveal the sub-fields.

3. METHODOLOGY

In this section, this study describes the concrete data collection method and preliminary processing. The Web of Science Core Collection contains almost all influential papers. To obtain a reliable dataset, this study types "TS=(information management) and PY=1990-2016" in the expert search field and selects English articles in the core selection of WoS. Thus, the papers whose titles, abstracts, and keywords contain "information management" are chosen as basic data in case of the indexer effect (Zupic and Cater, 2015).

3.1 Data Collection and Screening

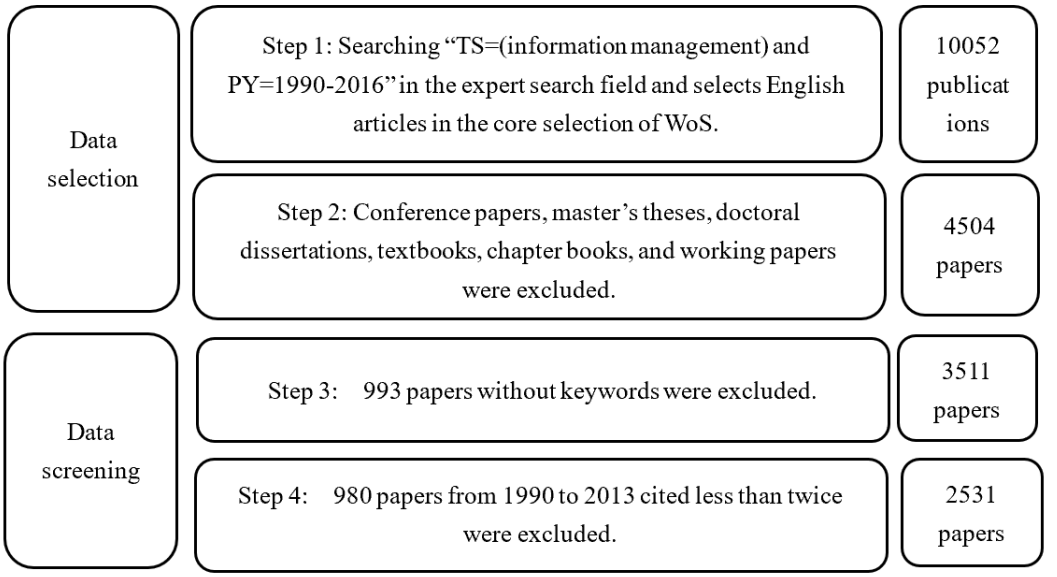
A total of 10,052 publications about "information management" from 1990 to 2016 is obtained. 4,504 articles are left after deleting 4,076 book sections and 1,472 other types of publications. The research domain is a sustainable development subject and the publications of information management increase rapidly after the year 2000 (seen in Figure A1). To make a co-keyword analysis, this study excludes 993 papers without keywords. Since citation rate can represent the quality of literature and poor-quality papers might affect the co-keyword analysis, this study removes 980 papers from 1990 to 2013 cited less than twice (Zhang *et al.*, 2015). Also, as newly published articles have a low reference rate, all papers with keywords over the past three years are preserved. Finally, this paper selects 2,531 papers. The whole process is shown in Figure 1.

3.2 Bibliometric Analysis Methodology

3.2.1 International Cooperation Analysis Process

Based on 2,531 papers, this study extracts address information in Bibexcel and then sorts descending the contributing countries and areas. After selecting the top 16 countries and contracting the co-occurrence countries matrix, this paper calculates the k-core, betweenness centrality, and degree

Figure 1. Database compilation process



centrality by social network analysis. According to these indicators and multidimensional scaling (MDS), this paper maps the network of international cooperation. The authors show the indicators of the international cooperation network in Table A1.

A higher degree value of European countries indicates that these countries have a powerful influence on the whole research area. The degree of the United States is the highest, which shows it has a significant influence in the information management field. Although the number of publications in China is higher than that of the United Kingdom, the academic impact of China is lower than the United Kingdom. Though the number of publications of Japan is almost the least in these countries and regions, the betweenness centrality of Japan is higher than that of all European countries except the United Kingdom, which means most Japanese publications are finished by international cooperation and Japan has the highest preference to international cooperation.

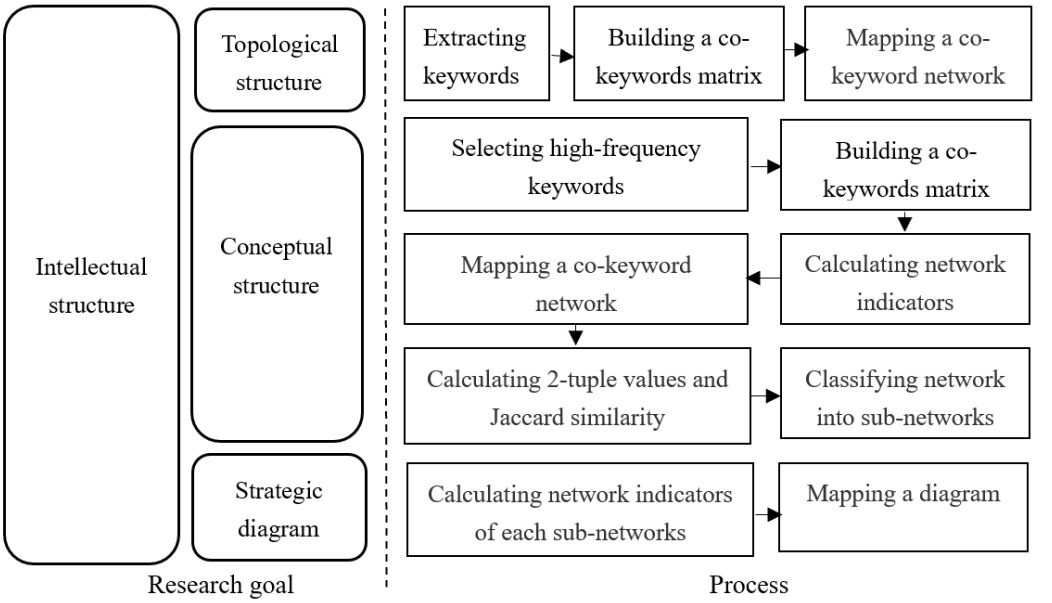
3.2.2 Intellectual Structure Analysis Process

As shown in Figure 2, the network indicators can show the linkages among subjects. After calculating the indicators, this paper calculates the 2-tuple values using the 2-tuple linguistic technique. Since each selected keyword is a linguistic term set $S = \left\{s_0, s_1, \ldots, s_g\right\}$, the keyword can be presented by a 2-tuple coordinate $\left(s_i, \alpha\right)$ where s_i is determined by k-core and α is determined by MDS. According to the 2-tuple coordinates, we get the Jaccard similarity among terms. Jaccard similarity is a statistical measure of similarity between sample sets (Niwattanakul *et al.,* 2013). Based on the Jaccard similarity, this paper can cluster highly similar keywords into a sub-field.

Based on the values of k-core, betweenness centrality, and degree centrality among keywords in Table A2, the authors find that "information system", "information retrieval", and "knowledge management" are the most popular terms. "Health care" and "medical informatics" are always a research hotspot and have become a strong branch through several decades of development. From 1990 to 1999, researchers focussed more on medical informatics, business, and engineering. From 2000 to 2004, the knowledge requirements of professional information management are diverse and interdisciplinary, including management, operation knowledge, and interpersonal skills. More

scholars began to focus on the special situation of "China" and other "developing countries" starting in 2010. Furthermore, "big data", "cloud computing", "internet of things" and "interoperability" are new research points in recent years.

Figure 2. the process of intellectual structure analysis

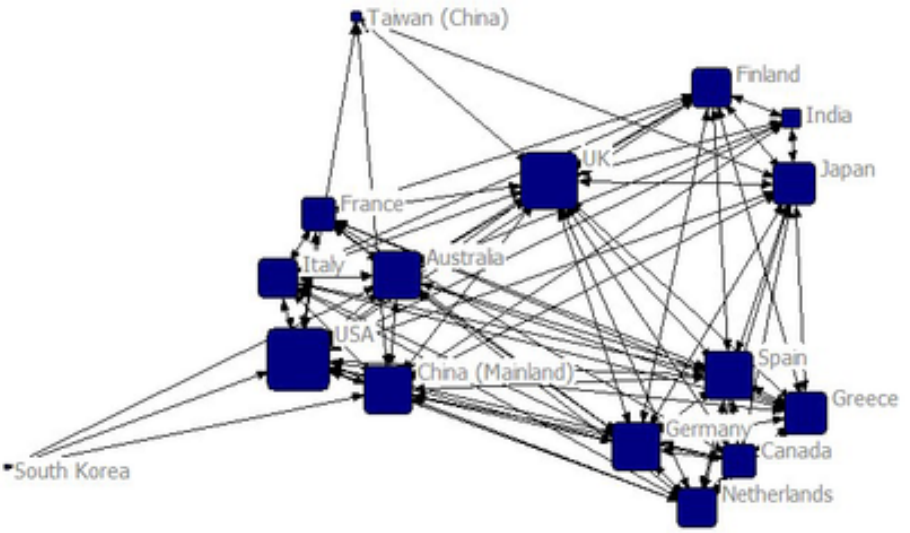


4. INTERNATIONAL COOPERATION ANALYSIS

In this section, this paper explores international cooperation in the field of information management by mapping the network among the top countries.

In Figure 3, this paper divides these countries and regions into three research groups: (1) the United States, China, Australia, France, and Italy. (2) Finland, India, and Japan. (3) Spain, Canada, Greece, Germany, and the Netherlands. The cooperation in the first group is most frequent and efficient. The United Kingdom has cooperation with all other countries except South Korea.

Figure 3. The cooperation among countries and regions in the information management field



Note: the area of the square represents the degree of nodes.

5. INTELLECTUAL STRUCTURE ANALYSIS

In this section, this paper analyzes the intellectual structure of the research of information management by mapping the keywords network and the strategic diagram using social network analysis.

5. 1 Topological Structure

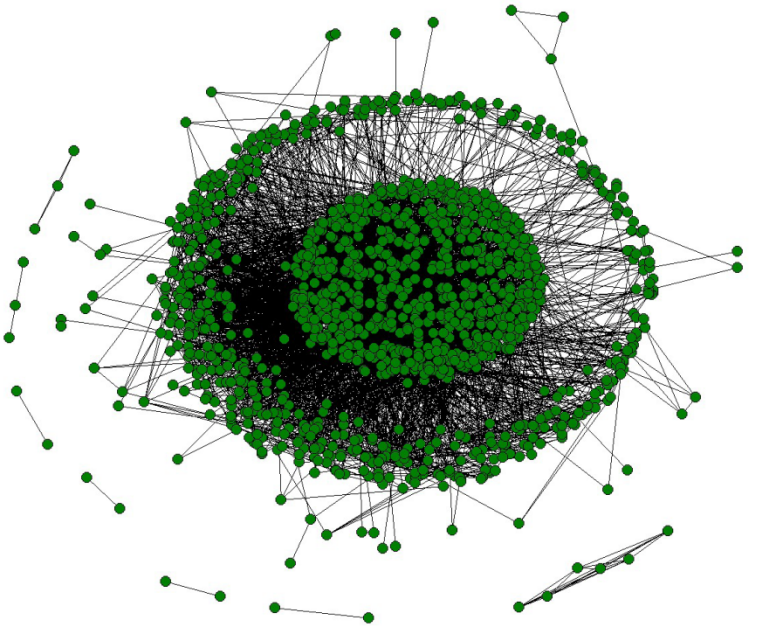
To detect the topological structure of information management, this study collects 602 keywords whose frequency is higher than two to construct a co-word matrix and process the matrix using the Ucinet software. Based on the research of Carmi *et al*. (2007), this study shows the topological structure of the information management field in Figure 4.

The inner layer, the nucleus, which contains the basic theories, has the most nodes distributed intensely. The unbalanced distribution of the middle layer indicates the uneven development of disciplines. The marginal layer distributed sparsely always dictates emerging research points. As the nodes in the nucleus have high degrees and close connections, Figure 4 shows the theoretical foundation of information management is mature and solid. Therefore, it is reasonable and necessary to explore the intellectual structure of this research domain.

5.2 Conceptual Structure

In this section, this study shows the conceptual structure by keyword network analysis. Deleting the search term and some general words like "implementation", this study selects 92 keywords, including high-frequency keywords whose frequency is higher than ten from 1990 to 2013 and new keywords from 2014 to 2016, and maps the intellectual structure. This paper divides the network into four sub-fields and separates the whole network into seven clusters using the 2-tuple linguistic technique. Each sub-field is shown in the following.

Figure 4. The topological structure of information management



5.2.1 Health Information Management

The core term in this sub-field is "health information management" (seen in Figure 5), which implies that information management affects the development of health care.

Since the same medical term might have a different meaning or the same situation might be expressed differently by machine-readable methods, it is vital to set up a database and unified language system, the Unified Medical Language System (UMLS). On the one hand, researchers from different medical areas can collect and understand the data effectively; on the other hand, UMLS stimulates knowledge sharing and information dissemination across disciplines to help residents make consensus recommendations (Kohil and Tan, 2016; Li *et al*., 2017). In addition, the research of health information management also focuses on the impact of combining medical informatics and anesthesia information on early intervention. Khubone *et al.* (2020) show that a unified dataset and health informatics allow for the implementation of evidence-based treatment and improve hospital quality.

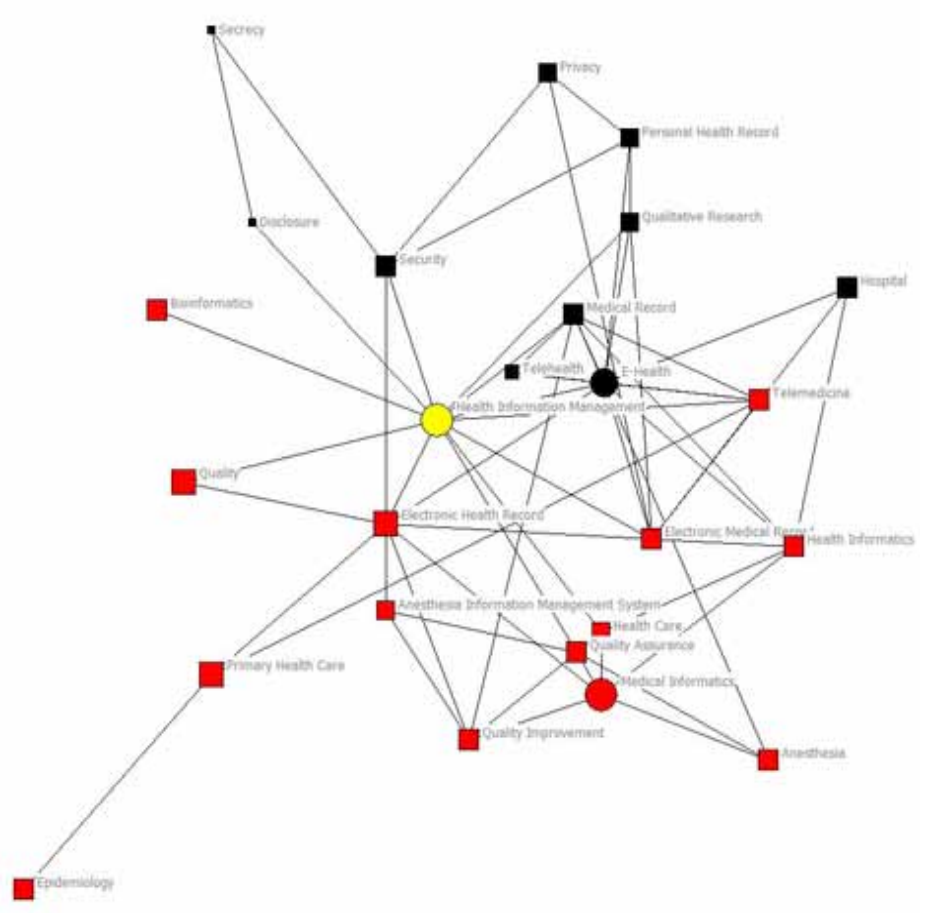
As shown in Figure 5, the research of health information management is repartitioned into two clusters: "personal e-health" (i.e Cluster 1) and "institutional medical informatics" (Cluster 2). The research of medical informatics includes health information systems, hospital information systems, and others. Whereas, the research of e-health focuses on the health of individuals in daily life and the protection of private information.

Note: The red color represents the Cluster 1, the black color represents the Cluster 2, and the yellow color represents the core node. The circle represents main nodes.

5.2.2 Information Systems

The second sub-field includes research on information systems. Information systems can accelerate data transmission to help firms to obtain a collaborative advantage. Improving individuals' information literacy can advance personal information management and knowledge sharing to inspire innovation (Anand *et al.*, 1998; Brancheau *et al*., 1996). Various information systems, including data processing

Figure 5. Repartition of health information management field

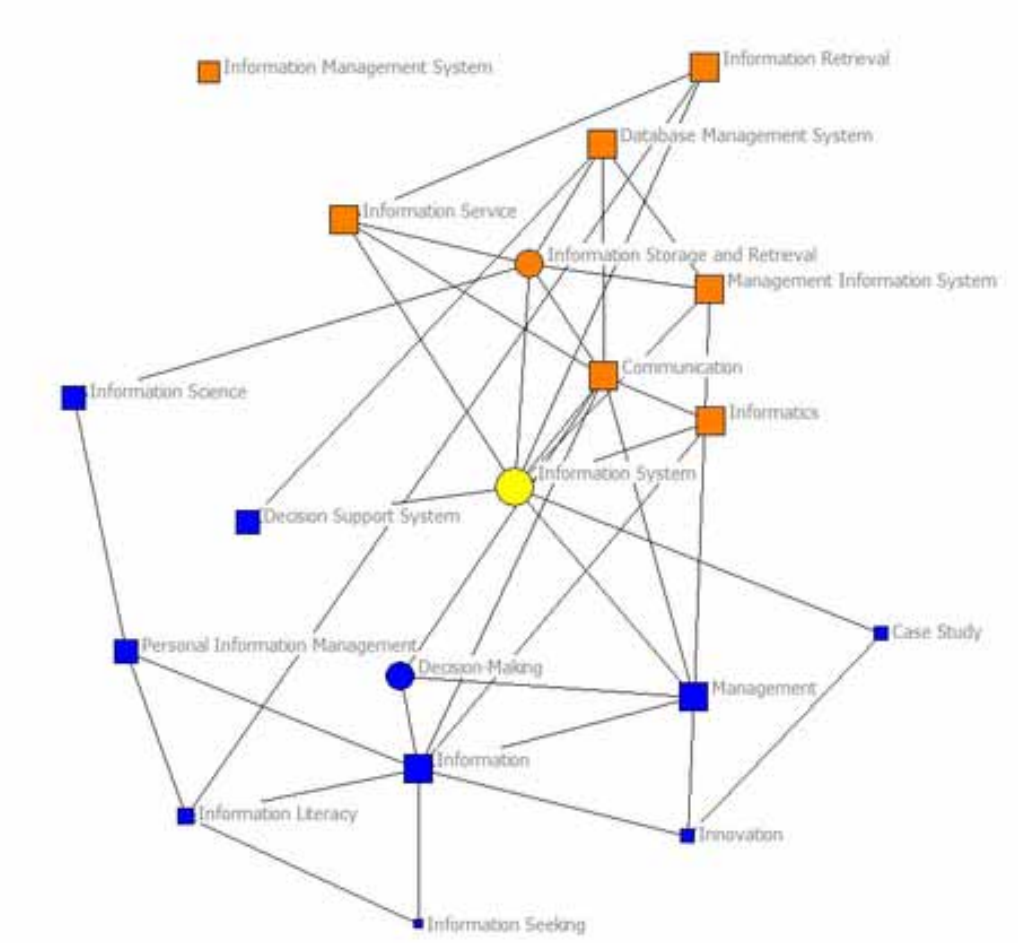


systems (DPS) and management information systems (MIS), advance management quality and innovation.

The ordinal operational data and personal knowledge are assembled to establish a decision support system (DSS), a software-based system to assist management decision-making (Chan *et al*., 2017; Peng *et al*., 2011). With the increasing amount of information overload, information retrieval is enhanced by new, advanced information retrieval agents and tools for intelligent data processing (Mannino and Mookerjee, 1999; Tu and Hsiang, 2000). As seen in Figure 6, DSS is one of the most influential nodes and the network can be repartitioned into two parts, represented by "information storage and retrieval" and "decision-making".

In Figure 6, the cluster, "information system application" (i.e. Cluster 3), is located next to the central node, "information system". Compared with the decision-making cluster, the cluster, "information system function" (i.e. Cluster 4), is more robust and intense. Figure 6 shows the network is relatively intense which means that information system is one of the major branches of information management.

Figure 6. Repartition of information system



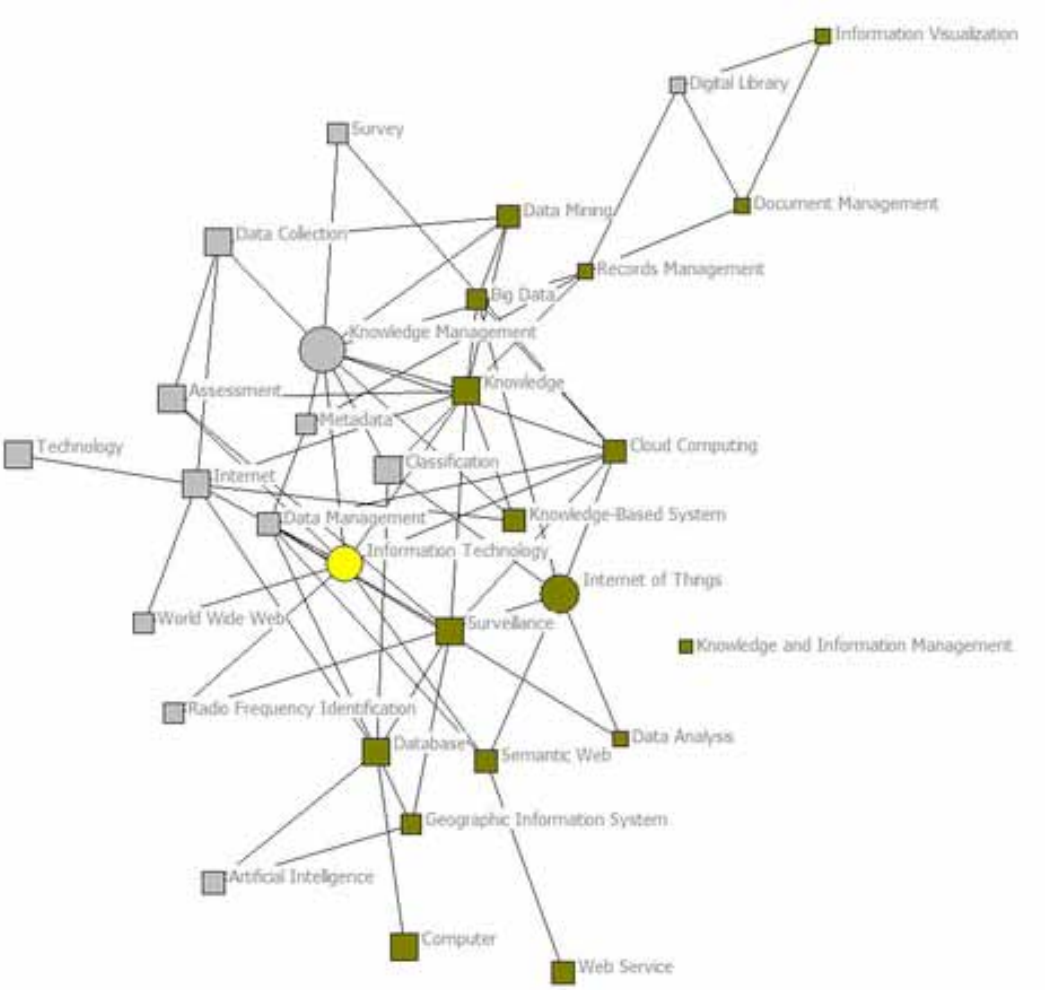
Note: The orange color represents the Cluster 3, the blue color represents the Cluster 4, and the yellow color represents the core nodes. The circle represents the main nodes.

5.2.3 Information Technology

The third sub-field, information technology, is the basis of information management. Various advanced technologies not only decrease data processing (Bai *et al*., 2012; Blanco *et al*., 2000; Ryu and Rhee, 2008) time but also impel information to translate into knowledge (Ma *et al*., 2017). With the advance of the internet and data collection technology, it is easier to acquire an array of data through surveillance and digital record, and ordinal operation record.

Figure 7 shows the various technologies are divided into two clusters, including the "knowledge management" (i.e. Cluster 5) and the "internet of things" (i.e. Cluster 6). In the knowledge management part, researchers prefer to collect data from an open-source such as survey data or the internet (Kim *et al.,* 2016). In the internet of things cluster, big data and cloud computing, arise. Combined with cloud computing, the internet of things can get real-time data and handle dramatic information (Jin *et al*., 2014). Figure 7 shows that deeper learning techniques including data mining and the semantic web are also used in the research of the internet of things.

Figure 7. Repartition of information technology



Note: The Gray color represents the Cluster 5, the green color represents the Cluster 6, and the yellow color represents the core nodes. The circle represents the main nodes.

In summary, the research of knowledge management focuses on traditional basic techniques, and the research of the internet of things concentrates on novel technologies in the information management field. Figure 7 shows that the two clusters have been inextricably connected and located closely compared with other parts.

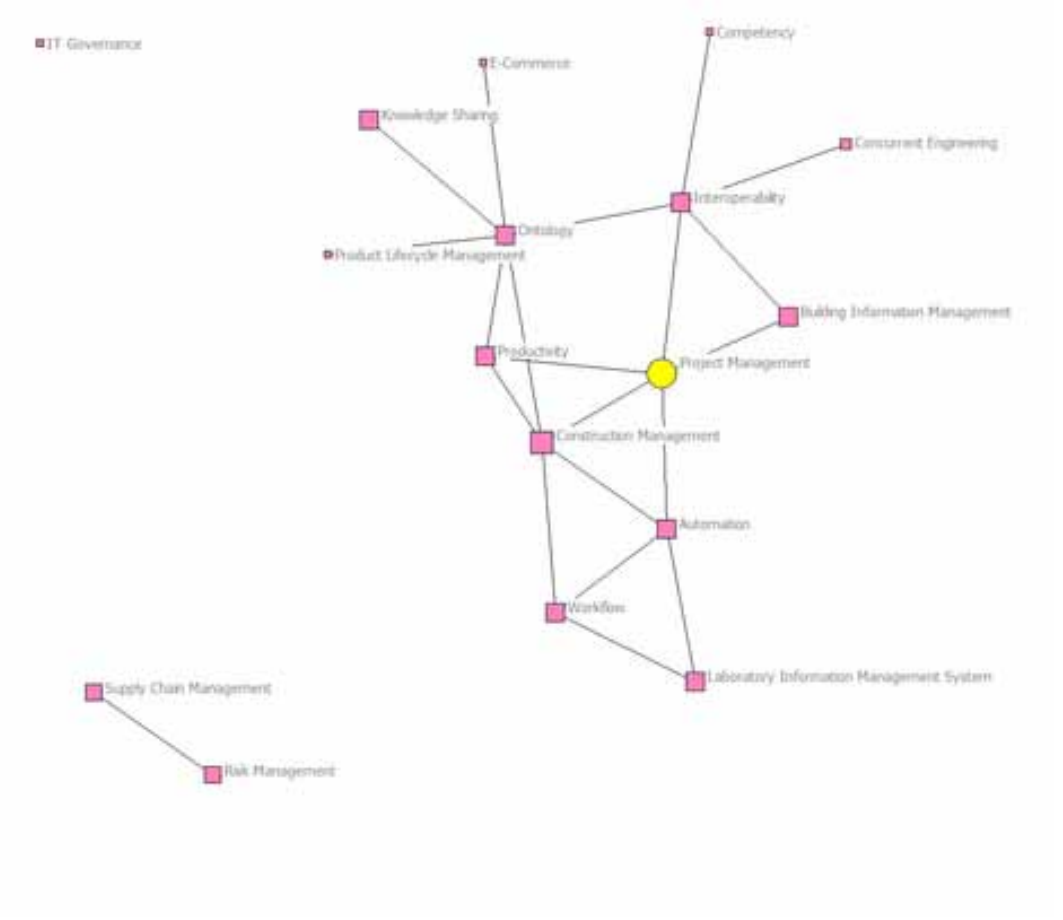
5.2.4 Information Management Applications

The information management application is the final cluster (i.e. Cluster 7). As shown in Figure 8, a typical research area is the construction industry, which recommends flexible data exchange and data interoperability to design better (McMahon *et al*., 2004). Scholars have established BIM to present the data of a building semantically and find BIM can stimulate communication during design and construction (Mannino *et al.,* 2021).

Another main area is the business and economic industry (Ben Liu and Karahanna, 2017; Lal and Bharadwaj, 2020; Luo *et al*., 2017; Rai *et al*., 2015; Zhang, 2017). The relevant research shows

that various ordinal business information systems can provide technical support for operations and information management can facilitate data transfer between manufacturers and retailers and inspire knowledge sharing within organizations. In conclusion, information management stimulates information dissemination and strengthens firms' competency.

Figure 8. Network of information management application



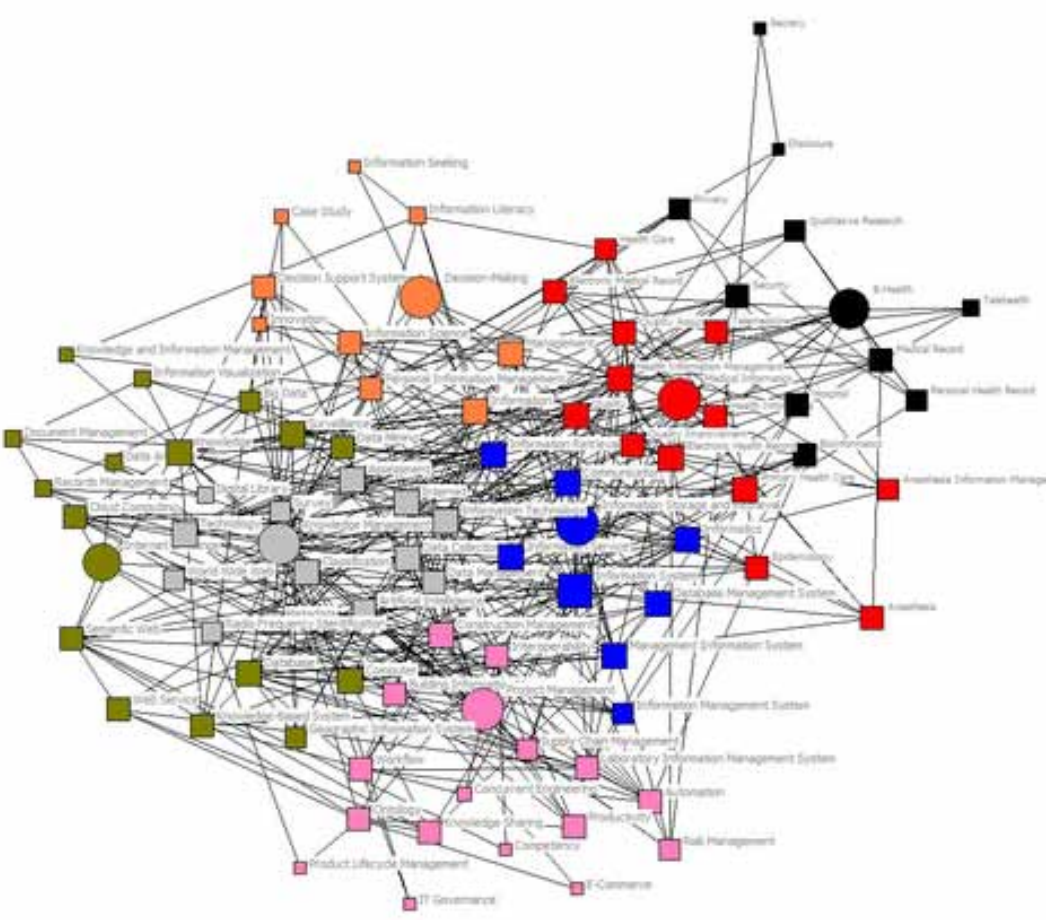
Note: The pink color represents the Cluster 7, yellow color represents the core nodes; circle represents the main nodes.

5.2.5 Aggregate Analysis

In Figure 9, the whole network can be summarized into two dimensions: technology integration and information management application. Technology integration can be divided into a lower level, where processing uses several limited techniques, and a higher level, where the system integrates various technologies including the internet of things. Information management is applied to the simple data environment first and then used to deal with complex situations with diverse data processing requirements.

The seven clusters are positioned intensely since these keywords are highly used. Information technology and information system are at the core, which suggests most researchers focus on the two main research fields. Health information management and information management application are located in the surroundings of the whole network. The two areas are developed from information technology and information systems. Otherwise, document management, e-commerce, and other small nodes indicate new research spots.

Figure 9. The whole network of information management



Note: The red color represents the Cluster 1, the black color represents the Cluster 2, the orange color represents the Cluster 3, the blue color represents the Cluster 4, the gray color represents the Cluster 5, the green color represents the Cluster 6, and the pink color represents the Cluster 7. The circle represents the main nodes.

5.3 Strategic Diagram

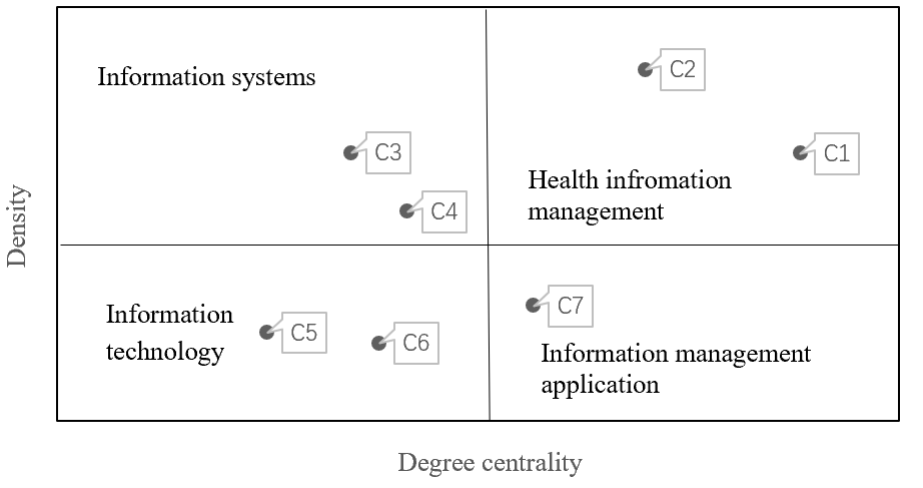
The authors get the degree centrality and the density of each cluster and classify these clusters into four quadrants based on these indicators (Seen in Table 1 and Figure 10). The research of healthcare information management has a high density and degree centrality, which means that Clusters 1 and 2

are close to each other in terms of keywords. The research of information systems has a high density which implies that Cluster 3 and Cluster 4 are close and a low degree centrality which implies Clusters 3 and 4 are specialized on one theme. The research of information technology has some emerging and new themes since its density and degree centrality is low. Finally, the research of information management application with low density focuses on various areas and can be further developed.

Table 1. Degree centrality and density of each cluster (C)

	C1	C2	C3	C4	C5	C6	C7
Density	0.582	0.764	0.583	0.455	0.192	0.169	0.25
Degree	106	84	42	50	30	46	68

Figure 10. The strategic diagram of clusters



Note: C1 represents the Cluster 1, C2 represents the Cluster 2, C3 represents the Cluster 3, C4 represents the Cluster 4, C5 represents the Cluster 5, C6 represents the Cluster 6, and C7 represents the Cluster 7.

6. LIMITATIONS

The article has several limitations that are typical of bibliometrics analysis. First, this paper sets a threshold of keywords and selects the top ten keywords to show the intellectual structure of information management. Although selected keywords contained the mainstream research, the loss of information is unavoidable. Otherwise, there is no consensus on the threshold of keyword selection in the co-keyword analysis. Researchers select various numbers of keywords for literature analysis (Feng *et al*., 2017; Ravikumar *et al*., 2015). Thus, researchers can create or introduce new techniques to develop the co-word analysis.

Second, this paper introduces the 2-tuple linguistic computational model to bibliometric analysis and calculates the Jaccard similarity between the terms. Although this study repartitions these terms into new clusters, the divided standard is not unified.

Third, since word similarity contains semantic distance and ontology distances (Ta *et al*., 2017), this paper does not consider the semantic similarity of keywords simultaneously. Scholars from different areas may use different words to express the same meaning, but these terms do not always have a higher connection with each other. Although ontological similarity is more important than semantic similarity, the research focus can be clearer after semantic similarity processing. Before keyword selection, this paper converts these terms into a standard form and recomputes their frequency. As this method is time-consuming and uneconomical, this study suggests researchers refer to the techniques of computer science and data mining.

Fourth, the results of the 2-tuple linguistic technique with bibliometric analysis need to be verified by peer-review in the future.

7. CONCLUSION AND FUTURE DIRECTIONS

This paper analyzes the intellectual structure and international cooperation of information management based on 2,531 papers. Combined with the 2-tuple linguistic technique and SNA, we get some findings in the following.

First, the research of the information management field can be divided into three layers including the nucleus layer, middle layer, and marginal layer.

Second, the research on information management can be divided into four main sub-fields: health information management, information systems, information technology, and information management application. Health information management is always a research hotspot and becomes a strong branch through several decades of development. In addition, different from that of other research sub-fields, the research relevance in health information management is highest.

Third, the four main subfields can be further partitioned into seven clusters: personal e-health, institutional medical informatics, information system application, information system function, knowledge management, internet of things, and information management application. All these clusters have linkages with each other and are distributed in different positions in the network. The research of the cluster of "information system application" mainly focuses on decision-making. Most research of the cluster of the "information system function" concentrates on information storage and retrieval. Different from the research of the cluster of "knowledge management" mostly adopted open-source data, the research of the cluster of the "internet of things" pays more attention to real-time data and dramatic information.

Fourth, the research of information management can be summarized into two dimensions: technology integration and information management application.

Fifth, the United States and the United Kingdom have a powerful effect in the information management field and cooperate with other countries intensely. Japan impels international cooperation because of the high betweenness. The research about information management concentrates on North America, East Asia, and Europe including 16 countries, which can be divided into three research groups.

The connections with different disciplines can reveal future research trends. Scholars can do further research by developing new technologies to deal with information overload or combine different disciplines to extend the application area. This paper lists several interesting research points as follows. First, under the environment of social commerce, researchers can develop the analysis of organization behaviors and customer interaction using open-source data to make optimal decisions (Iftikhar and Khan, 2020). Compared with traditional analysis methods, open-source data is larger and more inspiring than empirical analysis. Second, data-driven technology can support institutions in dealing with problems more effectively and agilely with responsive management. This technology

uses dynamic data and tactic data to reduce the community's vulnerability and risk and uses a nonlinear learning model for processing advanced datasets. In the future, data-driven technology needs to be completed to establish a sophisticated model and applied to more fields. Third, it is expected to establish an effective semantic analysis method to handle the experience-based information for deep learning. Experience-based information involving the experience and intuitive feelings of the decision-makers, which are different from the record or document data, is inaccurate but complementary for knowledge management. Hence, its development can impel semi-structured and subjective questions. Finally, data security is always a significant research spot in the case of information disclosure. While some literature points out technologies for defense, there is still a lack of an effective detector method to reduce the occurrence of security breaches. Inevitably, these interesting points will be considered in the future study.

The implications of this paper are shown in the following. First, it provides an approach for beginners to comprehend the development and the intellectual structure of the research of information management. Second, this paper gives a piece of advice for researchers to find new research hotspots by interdisciplinary collaboration. Third, this paper points out that international cooperation can be impelled by encouraging cooperation with influential countries.

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