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Co-citation and Visualized Analysis of Literatures in Library and Information Science Based on Web of Science and VOSviewer

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Abstract: *To analyze and summarize the changes in research themes and overall development trends in the field of Library and Information Science by using citation analysis methods to conduct statistical and visual analysis of the documents related to the field since 1900.Web of Science (WOS) database was selected to search the literature in the field of LIS from 1900 to 2022, and the literature was divided into four time periods. To draw the corresponding visualization maps, the visual software, VOSviewer, was used to mainly carry out co-citation in three parts, cited documents, cited author and cited source, and then conduct keyword co-occurrence and co-authorship which united by country in each time period.*

Keywords: *Information & Library Science; VOSviewer; web of science; co-citation*

1. Introduction

Co-citation analysis is a method for identifying and studying scientific communities, and it is suitable for paradigm and disciplinary development studies in established disciplines. Co-citation analysis is now used in bibliometric and disciplinary development studies in a variety of disciplines. 1980 Small pioneered the use of co-citation analysis in an attempt to explore the structure of information science research and its relationship to the social sciences, followed by dynamic co-citation analysis of 22 fields using ISI's Essential Science Indicators product[1] . White & McCain[2] usedcited author in co-citation analysis to divide research in intelligence science into two research areas, domain analysis and intelligence retrieval, and to explore the issue of topic shifting. The study identifies five research groups in the functionalist paradigm by identifying the main research areas, theories, and methods in the management discipline using co-citation analysis. Library and Information Science, as a long-developed discipline, has a more mature discipline and academic system, and the co-citation analysis of cited document, cited author, and cited source in LIS is helpful to better understand the development history and disciplinary paradigm of this field. The analysis of the co-citation of this three parts in LIS will help to better understand the development and disciplinary paradigm of LIS[3].

To comprehensively understand and summarize the theoretical and practical achievements in the field of LIS, and to better grasp the research themes and development directions in the field of LIS, this paper uses the VOSviewer knowledge mapping tool to analyze the papers on Library and Information Science in the SSCI Social Science Citation Index in the core collection of Web of Science database according to the 20th century, the first two decade of the 21st century, and first three years 20s. VOSviewer knowledge mapping tool is used in this paper to analyze the papers on LIS in SSCI(Social Science Citation Index) based on the core collection of Web of Science database. And analyze the co-citation in each time period.

2. Data source and research methods

2.1. Literature sources and search strategies

Web of Science database is the most authoritative citation-based database in the world today[4], with powerful indexing functions, including influential core academic journals in various fields, including Library and Information Science, and the related literature reflects a certain extent the most cutting-edge development in this discipline or field internationally [5]. Among them, the Social Science Citation Index (SSCI) in the Web of Science Core Collection (WoSCC) includes relevant papers in the field of Library and Information Science.

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In this research project, the SSCI index in the Web of Science Core Collection database used "Information Science" and "Library Science" as subject terms, and the search content included title, abstract, authors and keywords, and the type of literature was limited to "Article", the language was limited to English, and the time limit was no more than 2022, i.e., the search formula is as follow, (WC=(Information Science & Library Science)) was constructed AND ((DT==("ARTICLE") AND LA==("ENGLISH")) NOT (PY==("2023"))), a total of 138,762 research-related documents in the field of Library and Information Science were obtained, and the data were exported and saved for subsequent analysis by selecting "Full record and cited documents". The data were exported and saved for following analysis,and so on.

2.2. Co-citation and visualization research methods

This study focuses on co-citation and visualization analysis using VOSviewer, a bibliometric analysis software developed by Nees Jan van Eck and Ludo Waltman of Leiden University, The Netherlands, in 2009 to map scientific knowledge in various fields [6]. The main analysis fields of VOSviewer are country co-occurrence, institutional co-occurrence, author co-occurrence,cited author in co-citation, and cited document in co-citation.

In this study, the VOSviewer keyword co-occurrence and country co-authorship functions were firstly used for the initial analysis of the collected literature, and then used the VOSviewer cited document in co-citation, cited author and cited source in co-citation functions for the main co-citation analysis, and used the cluster density view for a more intuitive visual analysis. The cluster density view was used to visualize the analysis results.

After determining the use of VOSviewer for the analysis, the data collected in this study were again classified and integrated, and the literature was divided into four time periods: 1900-1999, 2000-2009, 2010-2019, and 2020-2022, and imported into VOSviewer for keyword co-citation, country co-authorship, and for each time period. The analysis was performed for keyword co-citation, cited document, cited author and cited journal in co-citation for each time period. Such time division criteria can make the analysis results more intuitive to reflect the research hotspots and changes in the field of Library and Information Science in the 20th century, the early 21st century, the 21c10s and the 21c20s, and help to grasp the research trends in the field of Library and Information Science more carefully.

3. Results and analysis

In this section, by organizing and summarizing the collected data, all of them were divided into four time periods: 1900-1999, 2000-2009, 2010-2019, and 2020-2022. First, a general analysis of the co-citation situation of each time period was visualized and analyzed from three aspects: co-citation in cited documents, co-citation in cited authors, and co-citation in cited journals, and then the co-occurrence of keyword and co-authorship united by country publication volume in each period was conducted using VOSviewer, and the conclusion was obtained as shown in the following five parts.

3.1. Statistics on the number of literatures

Before analyzing the document co-citations, journal co-citations, and author co-citations in each time period, this study first counted the number of literatures in the field of LIS in four time periods: 1900-1999, 2000-2009, 2010-2019, and 2020-2022, in order to firstly identify the trend of research related to the field of LIS through the number of literatures in different time periods. A total of 62,998 papers were published from 1900 to 1999, 24,497 papers from 2000 to 2009, 36,803 papers from 2010 to 2019, and 14,464 papers from 2020 to 2022. From the data, it can be obtained that there are 62998 literatures in the field of LIS in the 20th century, while there are 75764 literatures in the field of LIS in the 21st century after 22 years of development. The development of the number of publications in the field of LIS from the 20th century to the 21st century reflects the development of the discipline to a certain extent. At the same time, focusing on different eras of the 21st century, we can find that the number of articles published in the 2010s has increased significantly compared with the beginning of the 21st century, which also reflects the development of the LIS field research in the 2010s to a certain extent. Finally, the number of literature in different time periods also affects the citation frequency of documents, journals, and authors in different time periods, which is directly related to the subsequent co-citation statistics.

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3.2. Document co-citation analysis

The co-citation data of documents in four major time periods 1900-1999, 2000-2009, 2010-2019, and 2020-2022 were counted by VOSviewer, and the statistical tables of TOP10 highly cited literature in the field of Library and Information Science in each time period are shown in Table 1, as well as the co-citation network diagram of literature in the field of Library and Information Science in each time period as shown in Figure 1, and the data table and network diagram are compared and analyzed for each time period.

The citation frequency of the top 10 most cited literature has increased significantly since 2010, and the increase in citation frequency is related to the increase in the number of articles published in the field, as well as the increase in the standard of literature writing in the field. This also triggers us to think whether the field of Library and Information Science has been greatly developed in the 2010s. The comparison of the network diagrams over the four time periods shows that, firstly, the major clusters in the network diagrams are increasingly connected, which reflects the trend of gradual convergence of research themes within the Library and Information Science field. In addition, the clusters have increased over time, and two new clusters, cyan and orange, were created in the past three years, which may represent new research hotspots in the field of Library and Information Science. By reviewing the cyan clustering literature on the Web of science, we found that the overall research of this cluster is related to information security[7] research, while the orange cluster is related to information systems research , and the importance of these two research topics has increased in recent years compared to the previous ones.

The top three highly cited literature from 1900-1999 are Salton G (1983), Vanrijsbergen C (1979), and Price Dids (1963), and the contents of the literature are mainly related to the topic of information retrieval[8] . The top three highly cited papers from 2000-2009 were Davis FD (1989), Fornell C (1981), and Davis FD (1989), with the main topics being information technology and information systems. 2010-2019, the top three highly cited papers were Fornell C (1981), Davis FD (1989), and Podsakoff PM (2003). 2020-2022, the top three highly cited documents are Fornell C (1981), Podsakoff PM (2003), and Venkatesh V (2003). 2010- 2019 and 2020-2022, the top three highly cited documents are Fornell C (1981), Podsakoff PM (2003), and Venkatesh V (2003). 2019 and 2020-2022 are two time periods in which the main research content is related to information technology and information systems, which is more similar to 2000-2009. One of the major changes in research hotspots from 1900-1999 to 2000-2022 is the change from information retrieval to information technology and information systems, which is an important message from the Top 10 highly cited literature statistics table.

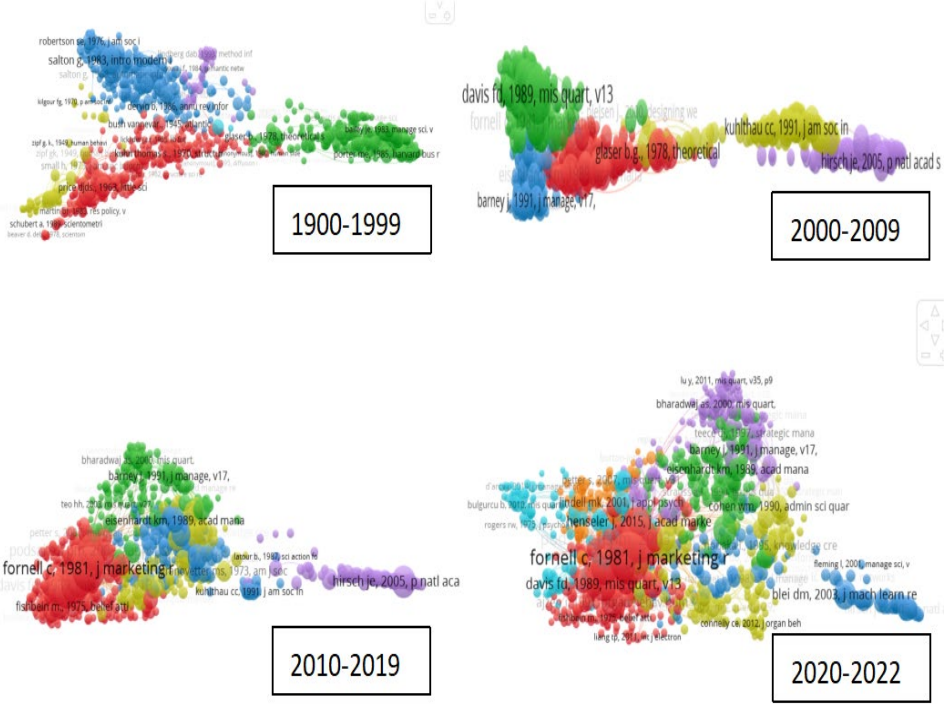

Figure 1: Co-citation network of cited doucuments in LIS

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Table 1: Top 10 Highly Cited Documents

Year period	Rank	Author	Year published	Journal	Frequency
1900-1999	1	Salton G	1983	Intro modern inform	306
	2	Vanrijsbergen C	1979	Information retrieva	213
	3	Price Djd	1963	Little sci big sci	171
	4	Garfield E	1979	Citation indexing	158
	5	Garfield E	1972	Science	155
	6	Price Djd	1965	Science	144
	7	Kuhn Thomas S	1970	Structure sci revolu	143
	8	Glaser B	1978	Theoretical sensitiv	142
	9	Salton G	1968	Automatic informatio	142
	10	Salton G	1989	Automatic text proce	141
2000-2009	1	Davis FD	1989	Mis quart	357
	2	Fornell C	1981	J marketing res	250
	3	Davis FD	1989	Manage sci	230
	4	Glaser B	1978	Theoretical sensitiv	206
	5	Delone WH,	1992	Inform syst res	186
	6	Eisenhardt KM	1989	Acad manage rev	178
	7	Kuhlthau CC	1991	J am soc inform sc	167
	8	Venkatesh V	2003	Mis quart	162
	9	Venkatesh V	2000	Manage sci	161
	10	Hirsch JE	2005	P natl acad sci usa	161
2010-2019	1	Fornell C	1981	J marketing res	1638
	2	Davis FD	1989	Mis quart	1114
	3	Podsakoff PM	2003	J appl psychol	1054
	4	Venkatesh V	2003	Mis quart	959
	5	Hirsch JE	2005	P natl acad sci usa	887
	6	Ajzen I	1991	Organ behav hum dec	639
	7	Chin WW	1998	Quant meth ser	635
	8	Glaser B	1978	Theoretical sensitiv	558
	9	Eisenhardt KM	1989	Acad manage rev	554
	10	Nonaka I	1995	Knowledge creating c	546
2020-2022	1	Fornell C	1981	J marketing res	941
	2	Podsakoff PM	2003	J appl psychol	741
	3	Venkatesh V	2003	Mis quart	425
	4	Davis FD	1989		411
	5	Braun V	2008	Qualitative res psyc	322
	6	Ajzen I	1991	Organ behav hum dec	308
	7	Blei DM	2003	I mach learn res	294
	8	Henseler J	2015	J acad market sci	288
	9	Hu IT	1999	Struct equ modeling	242
	10	Chin WW	1998	Quant meth ser	231

3.3. Journal co-citation analysis

Analyzing cited source in co-citations is a way to further analyze the core journals that have a significant impact on the field of study through the frequency of co-citations, for example, as a way to determine the main positions of research in the field of library and intelligence, etc. According to the main requirements and directions of journals, co-citation analysis can better reflect the research directions and cross-development of academia, and thus draw a complete academic knowledge network and have a deeper understanding of the field.

From table 2, there are many journals that are ranked in the top 10 more than once. J am soc inform sci,which is also known as the Journal of the American society for information science,contains two subject classifications:sci-computer science & information systems and ssci-information science & library science.The journal Information processing & management is also divided into these two sections;

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Scientometrics is a scientific bibliometric journal, which is included in both SSCI and SCI and is more comprehensive. The journal aims to publish the best research in the information systems discipline. Its mission is to promote the effective and efficient use of information technology knowledge by individuals, groups, organizations, societies, and nations to improve economic and social welfare. The American journal manage sci (Management science series a-theory) is classified into two sections: Sci- operations research & management science and Ssci- management. In addition, there are Information processing & management, Coll res libr (College & research libraries), J doc (Journal of documentation), and Libr j (Library journal). Commun acm(Communications of the acm) and J am soc inf sci tec (Journal of the american society for information science and technology) have more co-citations in each phase of the literature. Except Journal of scientometrics belongs to Hungary, and Journal of documentation, information processing & management belongs to the UK,the rest of the journals are American journals.it can reflect that American journals are the main position of research in the field of library and intelligence. The rest of the journals are American journals[9].

It can be seen in table 2 that an American journal Inform process manag(Information processing & management), in the field of management research and information management, has a high degree of co-citation throughout the 20th century and the first decade of the 21st century. In addition, another Dutch journal RRes policy(Research policy) appears in the table as well, the journal categorizes topics into ssci-management and ssci- planning & development, which shows that the research content of library intelligence is more concerned with the integration of management at this stage[10].

In recent years, the journal Computers in human behavior has emerged as a scholarly journal dedicated to the study of computer use from a psychological perspective. It publishes original theoretical works, research reports, literature reviews, software reviews, book reviews, and announcements. The journal discusses both the use of computers in psychology, psychiatry, and related disciplines, and the psychological impact of computer use on individuals, groups, and society[11]. The former includes articles exploring the use of computers in professional practice, training, research, and theory development. The latter category includes articles dealing with the psychological impact of computers on phenomena such as human development, learning, cognition, personality, and social interaction. The journal discusses human-computer interactions rather than computers themselves. Computers are discussed only as a medium for shaping and expressing human behavior. The main message of most articles concerns information about human behavior. Thus, professionals who are interested in the psychological aspects of computer use but have limited knowledge of computers will find this journal of interest, indicating that research in the field of library and intelligence has focused more on the analysis of information behavior while using systems, information, etc. as the object of study, emphasizing the role of humans in the development of the discipline, which also coincides with the results of keyword analysis.

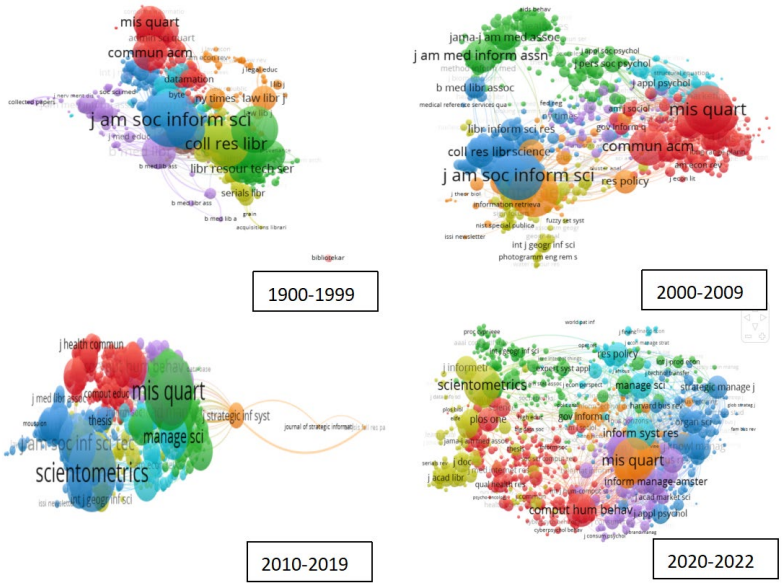

Figure 2: Co-citation network of cited journals in LIS

By visualizing the data at each stage using the VOSviewer, the cited document in co-citation network visualization was obtained as shown in Figure 2, with the change of years, the nodes of the network graph kept increasing, which indicated that the sources of journal citations kept increasing as the research in

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the field of library intelligence continued to deepen. In addition, the increasing number of connections within and between clusters indicates increased communication and integration between disciplines, deepening disciplinary crossover, and deeper communication between library intelligence research and computer science and technology, information technology, network technology, management, bibliometrics, and even psychology.

Table 2: Top 10 highly cited journals

Year period	Rank	Journal	Frequency
1900-1999	1	J am soc inform sci	9646
	2	Communication	6981
	3	Coll res libr	6729
	4	J doc	4859
	5	Libr j	4609
	6	Commun acm	3865
	7	B med libr assoc	3730
	8	Scientometrics	3657
	9	Mis quart	3575
	10	Inform process manag	3194
2000-2009	1	J am soc inform sci	8381
	2	Mis quart	8312
	3	Scientometrics	8180
	4	Commun acm	5108
	5	J am soc inf sci tec	4826
	6	Inform process manag	4517
	7	Inform syst res	4299
	8	J doc	4120
	9	Manage sci	3982
	10	J am med inform assn	3805
2010-2019	1	Mis quart	32296
	2	Scientometrics	31600
	3	J am soc inf sci tec	19300
	4	Inform syst res	16506
	5	Manage sci	11287
	6	Organ sci	10034
	7	J manage inform syst	9593
	8	Comput hum behav	9373
	9	RRes policy	8960
	10	J informetr	8651
2020-2022	1	Mis quart	16534
	2	Scientometrics	13259
	3	Comput hum behav	8934
	4	Inform syst res	8507
	5	J inform manage	7053
	6	Jnform manage-amster	5296
	7	Manage sci	5079
	8	J manage inform syst	5038
	9	J bus res	4777
	10	J knowl manag	4754

3.4. Author co-citation analysis

The VOSviewer was used to count the co-citation data of authors in four major time periods, 1900-1999, 2000-2009, 2010-2019, and 2020-2022, respectively, to derive the data tables of TOP 10 highly cited authors in the field of Library and Information Science for each time period, as shown in Table 3 and the network diagram of co-citation of authors in the field of Library and Information Science for each time period, as shown in Figure 3.The data tables and network diagrams of each time period are compared and analyzed.

From the data table3, the top three highly cited authors from 1900-1999 are Salton G

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(Frequency=1998), Garfield E (Frequency=1576), and Lancaster FW (Frequency=1157). the top three highly cited authors from 2000-2009 are Garfield E (Frequency=1576) and Lancaster FW (Frequency=1157). The top three highly cited authors in 2000-2009 were Garfield E (Frequency=1254), Spink A (Frequency=958), and Egghe I (Frequency=911). 2010-2019, the top three highly cited authors were Venkatesh V (Frequency=3353), Ieydesdorff I (Frequency=3353), and Ieydesdorff I (Frequency=3353), The top three highly cited authors for 2020-2022 are Venkatesh V (Frequency=1623), Hair JF (Frequency=1543), and Podsakoff PM (Frequency=1074). The change in the top three highly cited authors over the four time periods reflects the change in research hotspots over time. Meanwhile, two authors, Garfield E (ranked second in 1900-1999 and first in 2000-2009) and Venkatesh V (ranked first in 2010-2022), appear twice in the top three highly cited authors, with Garfield E mainly engaged in citation indexing research[12] and Venkatesh V's research. The focus is on user applications of computer and information technology[13], which reflects the importance given to citation indexing research and computer and information technology application research in the field of Library and Information Science.

Expanding the view to the TOP 10 highly cited authors in the field of Library and Information Science for each time period, we can find that in addition to Garfield E and Venkatesh V, six authors, Salton G, Davis FD, Bornmann L, Gefen D, Thelwall M, Chin WW, also appear in different time periods, which reflects their related research themes i.e. automated text[14], IT applications[15] , bibliometrics [16][17], e-commerce [18], information systems research[19]. The attention in the field of Library and Information Science is quite high. In addition, we can find that the similarity between the top 10 highly cited authors from 2010-2019 and 2020-2022 is relatively high, which may reflect the similarity of research hotspots between these two time periods. However, there are significant differences between these two time periods and the other two time periods of the top 10 highly cited authors. We can consider that the research hotspots in Library and Information Science may have changed more obviously after 2010.

From the co-citation network diagram of authors in the field of Library and Information Science for each time period, we can find that the different color clusters show a progressively more connected trend over time. This reflects that the correlation between the cited authors has gradually increased, reflecting certain research themes in the field of Library and Information Science and the trend of integration of Library and Information Science with other disciplines. In addition, we can also find an interesting point from the network diagram, that is, the purple clusters represented by Garfield E have experienced the emergence of the time period of 1900-1999, to the development and growth of 2000-2009 to the peak, and then to the development of the post-2019 clusters accounted for a smaller share of the development of this cluster, which to a certain extent can reflect the citation index-related research in the changing importance of the Library and Information Science field.

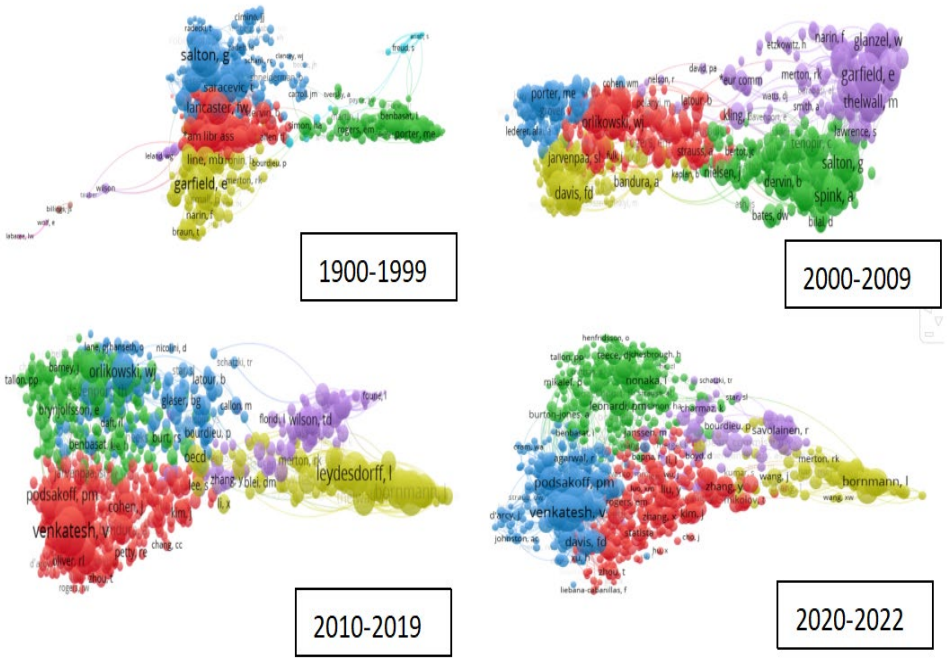

Figure 3: Co-citation network of cited authors in LIS

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Table 3: Top 10 highly cited authors

Year period	Rank	Author	Frequency
1900-1999	1	Salton G	1998
	2	Garfield E	1576
	3	Lancaster FW	1157
	4	Saracevic T	875
	5	Line MB	800
	6	*am libr ass	722
	7	Belkin NJ	718
	8	*unesco	671
	9	*us bur cens	659
	10	Brookes BE	615
2000-2009	1	Garfield E	1254
	2	Spink A	958
	3	Egghe L	911
	4	Thelwall M	906
	5	Salton G	861
	6	Glanzel W	792
	7	Orlikowski WI	767
	8	Davis FD	751
	9	VenkateshV	715
	10	Leydesdorff L	710
2010-2019	1	Venkatesh V	3353
	2	Leydesdorff L	2768
	3	Bornmann L	2716
	4	Glanzel W	2133
	5	Garfield E	2115
	6	Davis FD	2077
	7	Gefen D	2020
	8	Fornell C	1978
	9	Chin WW	1960
	10	Orlikowski WJ	1804
2020-2022	1	Venkatesh V	1623
	2	Hair JF	1543
	3	Podsakoff PM	1074
	4	Fornell C	1035
	5	Bornmann L	962
	6	Davis FD	711
	7	Chin WW	705
	8	Thelwall M	705
	9	Henseler I	703
	10	Gefen D	657

3.5. Keyword and country distribution

It can be illustrated by table 4 that in the 20th century, the main keywords in the field of library and information science are system, information, science, technology, retrieval and library. It can be seen that in this period, the researchers' research on the related field was more superficial in the understanding that "Library and Information Science is the technology and systematization of library construction".

In the 21st century, with the continuous development and popularity of the Internet, "Internet" has become the first hot keyword in the field of library intelligence science research, the concept of "model" has been strengthened, and "impact" has also appeared among the hot keywords. impact" also appeared in the hot keywords. Compared with the 20th century, the field of Library and Information Science at this stage paid more attention to networking, the performance of models and the impact of the area. Although the pursuit of technology was still maintained, the research content was richer.

In the 21st century, the status of "impact" and "management" was strengthened, and a new hot concept: knowledge emerged. In the DIKW model, knowledge is a higher-level concept than information, which

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shows that the research in the field has been deepening, not only focusing on the integration with technology and network but also expanding outward and digging inward at the same time.

In recent years, "social media" and "innovation" appear in the top ten of the keywords, which indicates that researchers pay more attention to innovation in research and to the role of human communication and interaction in social networking in the development of graphical intelligence. The role of human communication and interaction in the Library and Information Science research field is paid more attention to by people. At the same time, there has been an increase in research on the era and environment in which the research is conducted.

Table 4: Top 10 keywords in the field of LIS

Year period	Rank	Keyword	Frequency
1900-1999	1	systems	334
	2	information	321
	3	science	279
	4	technology	252
	5	model	231
	6	design	220
	7	library	183
	8	management	176
	9	retrieval	175
	10	system	168
2000-2009	1	internet	1082
	2	information	913
	3	model	736
	4	technology	699
	5	impact	663
	6	science	656
	7	systems	614
	8	management	545
	9	communication	471
	10	performance	466
2010-2019	1	impact	2887
	2	model	2341
	3	information	2112
	4	science	1894
	5	performance	1851
	6	management	1825
	7	internet	1734
	8	knowledge	1481
	9	systems	1444
	10	communication	1393
2020-2022	1	impact	1513
	2	information	1019
	3	model	1008
	4	social media	915
	5	performance	903
	6	technology	812
	7	management	733
	8	innovation	705
	9	science	683
	10	knowledge	627

It can be illustrated by table5 that since 1900, USA, England, Canada and Australia have been in the top 5 in terms of the number of publications, and the USA has been at the top of the list of national publications, pulling away from the second place by a large margin. In the 20th century, China was limited by the war and the level of national development and published fewer articles in the field of library and intelligence, but in the 21st century, as the country and scholars' attention to the field deepened, China's related research increased rapidly, and after entering the decade, China was the second country in terms of the number of articles published. Considering the population and research strength of each

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country, the research in the field of library and intelligence in each country has gradually broken the dominant situation of the United States in recent years, showing a balanced trend[20].

Table 5: Top 10 Country in the field of LIS

Year period	Rank	Country	Frequency
1900-1999	1	USA	13869
	2	England	1592
	3	Canada	1115
	4	France	313
	5	Australia	234
	6	Netherlands	230
	7	Germany	192
	8	India	177
	9	Scotland	145
	10	Belgium	144
2000-2009	1	USA	11159
	2	England	2236
	3	Canada	1223
	4	Australia	712
	5	China	659
	6	Netherlands	575
	7	Spain	497
	8	Germany	440
	9	South Korea	332
	10	Germany	310
2010-2019	1	impact	14331
	2	model	3654
	3	information	2922
	4	science	2057
	5	performance	1926
	6	management	1716
	7	internet	1335
	8	knowledge	1317
	9	systems	1168
	10	communication	798
2020-2022	1	USA	4782
	2	China	3010
	3	England	1075
	4	Australia	864
	5	Canada	684
	6	Spain	640
	7	Germany	634
	8	India	604
	9	South Korea	493
	10	Netherlands	391

4. Conclusion

The VOSviewer analysis of co-citation of documents, authors, and journals in the LIS field literature for different time periods leads to the following conclusions. From focusing on the development and progress of technology in the 20th century, to focusing on network, model performance, and domain impact in the early 21st century, and then to focusing on the integration of technology and humans after the 2010s, research in the field of LIS has gone through three main stages of development. In the 2010s, research in the field of LIS may have been greatly developed. Both the number of literature and the frequency of highly cited documents, authors, and journals have increased dramatically in this period, and the nodes and clusters of co-citation networks of documents, authors, and journals have increased after the decade, and the nodes are more densely connected, which reflects the increase of scientific communities in the field and the emergence of a hundred developmental trends. After the year 2020, two

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major research themes about information security and information systems and human interaction research increased more attention and become one of the hot spots of disciplinary research, which may be closely related to the changing international situation. Garfield E, Venkatesh V, Salton G, Davis FD, Bornmann L, Gefen D, Thelwall M, Chin WW and other scholars have made outstanding theoretical contributions to research on bibliometrics, citation indexing, information systems, and computer and information technology applications in the field of LIS, and are essential figures in the formation of the disciplinary system and research paradigm. They are indispensable figures in the formation of the discipline and research paradigm. *The journal of the American society for information science*, *Mis quarterly*, and *Scientometrics* are the most important journals in the field of LIS, and are very important for theoretical and practical research in the field of LIS. In recent years, *Mis quarterly* has gradually surpassed The journal of the American society for information science in terms of importance in the field of LIS, and its importance in the field has been highlighted. In recent years, the trend of integration of various research topics in the field of LIS is obvious, and the trend of cross-fertilization research between the field of LIS and other fields has also been highlighted, and cross-fertilization research has become a major trend in the field of LIS. In addition, according to the country co-authorship, we can know that the United States has been in a dominant position in the field of LIS research, and has a solid theoretical and practical foundation in the field of LIS research. However, nowadays, China and other countries are rapidly increasing their research in the field of LIS, and in recent years, the research in the field of library intelligence is gradually breaking the dominant situation of the United States.

The understanding of the important theoretical foundations of the field and the generation and changes of the scientific research community in the field can be easily reached by using VOSviewer to analyze the co-citation and visualization of research related to the field of LIS, so that we can better grasp the overall research system and development trend of the discipline, which is necessary for the development of the field of LIS.However, this study has limitations to some extent, for example, the criteria of the literature included in the study are limited to the English SSCI documents, while the literature in other languages in the WOS database is not included in the statistics. In addition, because the third decade in the 21th century is counted until 2022, so the criteria for comparing the literature of this period with the literature of other time periods cannot be unified. Last but not least, the results of this analysis are time-sensitive on some level because the database is dynamically updated online.

In summary, the co-citation and visualization analysis of LIS research documents since 1900 using VOSviewer can provide a more intuitive and comprehensive picture of the research hotspots and development trends in the future, which is expected to be useful for theoretical and practical research in LIS.

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