Visual analysis of domestic and foreign Omni-channel retail research based on knowledge graph

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Abstract. With the prevalence of e-commerce and the decline of traditional retail channels, the retail and manufacturing industries have expanded their sales channels. Omni-channel retail has become a "new star" in the retail industry and a research focus. Because the literature research content of omni-channel retail is complicated and large, in order to sort out the research results in this field, it is convenient for future scholars to study omni-channel retail. This paper uses Citespace software to conduct quantitative and visual analysis of "CNKI" and "Omni-Channel" research literature in WOS (web of science) from 2009 to 2019. Research findings: First, with the constant changes in research hotspots in the retail field, omni-channel retail has also continued to develop. Second, the "omni-channel" research method focuses on qualitative research, and quantitative research focuses on specific issues such as "consumer purchasing behavior" and specific issues such as procurement pricing. Third, with the further development of omni-channel retail, consumer purchasing behavior research, retail marketing system construction research, integration of warehouse operations and design suitable for omni-channel operation, and omni-channel e-logistics and distribution will become omni-channel research. The direction is worthy of attention.

1. Introduction
The "China Online Trading Market Governance Report (2019)" stated that by the end of 2019, the number of people doing online shopping through online channels in my country has reached 610 million. This indicator accounts for about 38.1% of the world's online shoppers, and its transaction volume ranks first in the world. One. The number of people who use the Internet as a shopping channel is gradually increasing. The rapid increase of online retailers has greatly impacted traditional retailers that have long relied on offline physical stores. In order to maximize the advantages of Internet traffic, more experts, scholars and retailers have gradually improved the development of the retail industry. Research on the situation and research on how to use online channels for business development, hoping to adopt relevant measures to promote the coordinated development of online and offline channels. It’s a view to combining the network with physical resources and achieving complementary advantages. Under the background of omni-channel, how companies should adjust their own operating strategies to adapt to the trend of omni-channel has become a major problem – companies are facing.
In recent years, the concept of omni-channel retail has been increasing day by day in the research of my country's retail industry. My country's retail industry has evolved from traditional single-channel retail to multi-channel retail where traditional offline physical stores and online online stores coexist, and finally developed to a state where online - stores and offline physical stores are now combined. The advent of the big data era presents the characteristics of data-driven retail more prominently, and omni-channel retail uses retail big data as a tool to further integrate online and offline. Li Fei [1] from the perspective of the cause of omni-channel, gave the concept of omni-channel retail as follows: omni-channel retail refers to retailers who innovate channel collaboration methods with other stakeholders and provide as many types of channels as possible to target customers, So that customers' individual preferences for channels are satisfied, and ultimately customer value and retail business goals are achieved. Saghiri, S et al. [2] refined the related concepts of omni-channel retail, and specifically summarized it as a three-dimensional framework, namely the purchase process, channel agents and channel types. Melacini, M et al. [3] conducted a specific research on the marketing strategy of omni-channel retail, including the following three aspects: distribution network design, inventory and capacity management, delivery planning and execution. From these three aspects, it points out that the omni-channel retail model is the future business logistics model. Qi Yongzhi [4] discussed the evolution path of retail channels through single-channel, multi-channel, cross-channel and omni-channel development from the aspect of omni-channel implementation strategy. From the existing research content, to a certain extent, scholars have conducted a preliminary analysis on the concept of omni-channel retail, but there is no uniformly recognized concept in the academic circle. Due to the large amount of existing literature, the research content is too complex, and it is impossible to clearly display the crossover and research hotspots of the omni-channel retail field, making it difficult for subsequent researchers to fully grasp the main points of the omni-channel retail literature. At the same time, the development of the big data era makes the research perspective of omni-channel retail different from that in the past. Therefore, understanding and grasping the evolution law of omni-channel retailing has important theoretical and practical significance for the future development of my country's retail industry.

In view of the above reasons, this article adopts bibliometric research methods and uses CiteSpace visualization software to focus on the omni-channel retail research based on the core of the Chinese literature database of "CNKI" and the English literature database of WOS (Web Of Science) from 2009 to 2019. As the data source, we conduct bibliometric and visual analysis to show readers the distribution of omni-channel retail research topics and research hotspots, and conduct a detailed exploration of the future development trend of omni-channel retail research. Through the retrieval and sorting of relevant documents in the omni-channel field at home and abroad, it provides a certain reference and guidance for the research in the omni-channel retail field in China, and promotes the development of my country's retail industry.

2. Research methods and data collection

2.1. Research method
The research method used in this paper is the visual analysis of knowledge graphs, and the Cite-space software is selected as a tool for the research of visual analysis of omni-channel retail at home and abroad. Citespace software uses the knowledge domain as a tool to automatically generate a visual knowledge graph, which can show complex related content such as the composition, evolution and source of knowledge units and knowledge networks, and present scientific knowledge in graphical and serialized methods [5]. Cite-space software uses Burt's structural hole theory, Kuhn's paradigm transformation theory, and Pirolli's optimal information foraging theory as its theoretical basis, and uses minimum spanning tree and maximum expected value clustering algorithms and key Path and other methods [6-7] visually display the content of the author's cooperation network and keyword network of the literature, which are applied to the content of bibliometric analysis in many fields.
2.2. Data collection
In order to fully present the omni-channel research and development process, this article selects the documents collected in the 2009-2019 "CNKI" Chinese literature database and the core collection of the WOS (Web Of Science) database as the data source. Among them, considering the relatively large number of journals included in the "CNKI" database, this article restricts the source of the "CNKI" to the Core journal of Peking University (PKU), Chinese social science citation index journals (Chinese Social Sciences Citation Index (CSSCI), Scientific Citation Index (SCI), and Engineering Index (The Engineering Index, EI), the subject term of which is "omnichannel", and the search results obtained 191 data, all It is a Chinese article, no SCI indexed paper; the document type source of the core set of the WOS (Web Of Science) database is limited to journal articles (Article), the language is English, and the search topic is "Omni-Channel" (all channels). The search results are totally 160 pieces of data obtained, including 5 highly cited papers and 9 review articles. Figure 1 shows the publication of omni-channel research papers on CNKI and the core set of the WOS database in 2009.

Figure 1. 2009-2019"CNKI" and WOS database channel research papers published.

3. Visual analysis of omni-channel retail research at home and abroad
Based on the 191 SCI, EI, PKU, CSSCI journal papers retrieved and published on the "CNKI" from 2009 to 2019, and 160 SCI journal papers retrieved and published in the WOS database core collection, using Citespase software and knowledge Tupu and other related theories, combing and researching and analyzing related literature in six aspects: the number of published articles, highly cited papers, author collaboration networks, keyword networks, keyword clustering, and co-cited documents.

3.1. Comparative analysis of the number of international and domestic annual publications
Refer to Figure 1 for the publication of related papers on two database channels in 2009. The first domestic research paper on omni-channels was the article "Convergys Helps Operators Provide Unified Customer Experience with Omni-channels" published in "Communication World" by Sha Ye, general manager of China, in 2009. The article introduced Convergys' assistance in operations in the 3G era an introduction to the experience of providing omni-channel services [8]. A considerable number of scholars believe that the first omni-channel research article was published in 2013 by Darrell K. Rigby in The future of shopping in Harvard business review [9]. It can be seen that omni-channel services and original articles are all from China. Since no papers appeared in 2009-2013, the
data in Figure 1 started in 2012. This is also an example of my country's e-commerce service leading the world.

In addition, from 2009 to 2019, domestic and international attention to the content of omni-channel retail research has increased significantly, and the number of domestic and foreign channel research papers has increased significantly. The reason is that the three major e-commerce giants in China have developed rapidly, subverting traditional sales channels. E-commerce activities under the sharing economy have become the main new force driving global economic growth. The rapid development of e-commerce under the sharing economy thinking has also brought risks for enterprise development. And new issues require domestic and foreign scholars to carry out relevant research on omni-channel retail.

3.2. Analysis of Highly-Cited papers

To a certain extent, the analysis of highly-cited papers can reflect the academic hotspots and trends in this research field, and it is also the reference point and reference object for academic researchers for literature research. As of December 31, 2019, the contents of the top ten related papers in the omni-channel retail research literature retrieved from the CNKI database are shown in Table 1. It can be found from Table 1 that the concept and evolution process of omni-channel retail and new retail, which are based on qualitative research methods such as empirical research, accounting for the vast majority, and this is even true for the papers whose scope is extended to the top 30 citations. This shows that, in the context of the rapid development of e-commerce, under the combined effect of technology-driven and demand-driven, my country's retail industry is undergoing a transition from traditional channels to omni-channel retail.

| Serial number | Article title                                                                 | First author     | Journal Title                                      | Year of publication | Number of citations/time |
|---------------|-------------------------------------------------------------------------------|------------------|---------------------------------------------------|---------------------|----------------------------|
| 1             | The meaning, model and development path of "new retail"                       | Zhao Shumei[10]  | Chinese circulation economy                       | 2017                | 337                        |
| 2             | New Retail: Connotation, Development Motivation and Key Issues                | Du Ruiyun[11]   | Price theory and practice                         | 2017                | 270                        |
| 3             | The meaning, causes and countermeasures of omni-channel retailing —— Revisiting to meet the revolutionary storm of multi-channel retailing | Li Fei[12]      | Technology and Business University (Social Science Edition) | 2013                | 257                        |
| 4             | Omni-channel marketing theory-three points to meet the storm of China's multi-channel retail revolution | Li Fei[13]      | Technology and Business University (Social Science Edition) | 2014                | 140                        |
| 5             | A New Theory of Working Capital Management from the Perspective of "All Channels" and Research Paradigm of "New Retail" | Cao Yushan[14]  | Friends of Accounting                             | 2015                | 134                        |
| 6             |                                                                           | Wang Kun[15]     | Chinese circulation economy                       | 2018                | 120                        |
| 7             | Omni-channel business model selection under mobile retail                     | Liu Xiangdong[16]| Journal of Beijing                                 | 2014                | 89                         |
However, as of December 31, 2019, the top ten omni-channel research literature citations in the WOS database core set from 2009 to 2019 showed different characteristics in research content and research methods (see Table 2). The empirical research focusing on the transition from traditional retail channels to omni-channel retail and the structure of omni-channel retail, and the quantitative research focusing on the optimization of omni-channel logistics processes, have the same number in the top ten cited articles.

Table 2. The top ten papers cited in the core set of the WOS database in 2009—2019.

| Serial number | Article title                                                                 | First author          | Journal Title                                           | Year of publication | Number of citations/times |
|---------------|-------------------------------------------------------------------------------|-----------------------|---------------------------------------------------------|---------------------|--------------------------|
| 1             | From Multi-Channel Retailing to Omni-Channel Retailing: Introduction to the Special Issue on Multi-Channel Retailing | Verhoef, P, C[19]    | Journal of retailing                                   | 2015                | 358                      |
| 2             | Categorization of multiple channel retailing in Multi-, Cross-, and Omni-Channel Retailing for retailers and retailing | Beck, N[20]           | Journal of retailing and consumer services             | 2015                | 93                       |
| 3             | Last mile fulfillment and distribution in omni-channel grocery retailing: A strategic planning framework | Huebner, A[21]       | International journal of retail & distribution management | 2016                | 71                       |
| 4             | Digital marketing: A framework, review and research agenda                    | Kannan, P, K[22]     | International journal of research in marketing         | 2017                | 70                       |
| 5             | Retail logistics in the transition from multi-channel to omni-channel         | Huebner, A[23]       | International journal of physical distribution & logistics management | 2016                | 70                       |
| 6             | Managing Multi- and Omni-Channel Distribution: Metrics and                    | Ailawadi, K, L[24]   | Journal of retailing                                   | 2017                | 61                       |
### Research Directions

| No. | Title                                                                 | Author(s)       | Journal                                           | Year | Page |
|-----|------------------------------------------------------------------------|-----------------|---------------------------------------------------|------|------|
| 7   | Realignment of the physical distribution process in omni-channel fulfillment | Ishfaq, R[25]  | International journal of physical distribution & logistics management & management | 2016 | 53   |
| 8   | Online retail returns management Integration within an omni-channel distribution context | Bernon, M[26]  | International journal of physical distribution & logistics management & management | 2016 | 38   |
| 9   | Toward a three-dimensional framework for omni-channel Channel design to enrich customers' shopping experiences Synchronizing clicks with bricks in an omni-channel perspective - the Direct Optic case | Saghiri, S[2]  | Journal of business research                      | 2017 | 37   |
| 10  |                                                                        | Picot-Coupey, K[27] | International journal of retail & distribution management | 2016 | 35   |

#### 3.3. Author cooperative network analysis

The Citespace software automatically presents the author's cooperation network based on the relevant information of the authors in 2009. As shown in Figure 2 and Figure 3, the top 50 articles cited in the omni-channel research in the core of the "CNKI" database and the WOS database are used as the research objects. Before running, set the minimum number of cooperation threshold to 1. After running, the displayed connecting lines of different thicknesses between nodes in the author cooperation network represent the number of papers published by different authors. Among them, the author cooperation network in the "CNKI" database includes 19 nodes and 8 connections; the author cooperation network in the core of the WOS database includes 28 nodes and 22 connections. (As shown in Figure 2 and Figure 3), it can be seen that the cooperation network structure of related research scholars in the domestic omni-channel field has formed a relatively stable situation. For example, the cooperation network structure with Professor Zhang Mengxia of Capital University of Economics and Business, Professor Sun Yongbo of Beijing Technology and Business University, and Professor Shen Pengyi of East China Jiaotong University as the core nodes, the node centrality index is all greater than 0.01, and the cooperation frequency is more than 1 time, which fully shows that Nodes have an important position in the entire omni-channel researcher cooperation network. However, the cooperation network structure between authors in the core of the WOS database is relatively loose, the number of cooperation between authors is less, the centrality index of the nodes is 0, and there are no more prominent and prominent core nodes. In these network structures, there are also sub-networks with a slightly higher frequency of cooperation, such as the Alexander Hübner team of Catholic University, the Marco Melacini team of the Politecnico di Milano, and the Johannes Wollenburg team of Nottingham University. The number of cooperation is more than 3 times. The node center Sex refers to 0. This also shows to a certain extent that the network structure of cooperation among authors in the core of the WOS database is not stable. There are more temporary cooperation and loose cooperation relations. The Omni-channel research cooperation network structure represented by a few scholars is still evolving. In the process.

Through the Citespace software, the relevant analysis is carried out with the cooperation of countries and regions as the content, and the statistics are carried out according to the country and region of the issuing organization. The content is shown in Figure 4. The core of WOS database is concentrated on omni-channel research. According to the node centrality index and the number of cooperation between authors, the cooperation network structure is further analyzed. The specific content is shown in Figure 5.
postings, the United States and China are ranked first and second respectively. The reason is that according to the survey report, in the global retail sales ranking in 2018, the total retail sales of China and the United States reached 5.76 trillion US dollars and 6 trillion US dollars respectively [28]. In addition, two well-known advanced e-commerce companies in two countries (such as Wal-Mart, JD, etc.) also occupy an important position in the global online retail market.

![Network diagram of authors' cooperation in the "CNKI" database from 2009 to 2019.](image1)

![Network diagram of authors' cooperation in the core of the WOS database in 2009.](image2)

![Network map of countries and regions with the core concentration of the WOS database in 2009.](image3)

3.4. **Keyword network analysis**

Keywords are an important characterization of the thesis research topic. The focus and evolution of research hotspots in a certain field are the results of the analysis of the frequency and change trend of keywords. First, the time period of this article is selected as an annual unit, and the keywords are selected from the top 50 content in each time period. The keyword network structure presented after the program runs is refined and trimmed using path search algorithms [29]. As shown in Figure 5 and Figure 6, during 2009-2019, the keyword network of papers in the CNKI database included 39 network nodes, 72 network connections, and a network density of 0.0972; the core centralized paper keyword network of the WOS database included 126 network nodes, 433 network connections, and a network density of 0.055. It is not difficult to see from the literature keyword network structure in the "CNKI" database that the number of occurrences and node centrality indicators of business model innovation, supply chain integration, supply chain, traditional retail enterprises and other keywords show a high level; In the keyword network concentrated in the core of the WOS database, brand management (Brand management), multi-channel (Multi-channel), consumer-led (Customer loyalty), omni-channel services (Omni-channel services), adaptive sales (Adaptive selling ) And innovation (Involvement) and other keyword content and node centrality indicators show a high level.
Table 3. Keyword clustering results.

| Database category | Research areas                               | Keywords and cluster categories                                      |
|-------------------|----------------------------------------------|-----------------------------------------------------------------------|
| CNKI              | Retail industry sector                        | Omni-channel retail(Cluster 0)                                        |
|                   |                                              | Traditional retail company(Cluster 4)                                 |
|                   | Omni-channel retail decision optimization     | Business model innovation(Cluster 1)                                  |
|                   |                                              | Supply chain integration(Cluster 2)                                   |
|                   | Other                                        | Brand management(Cluster 0)                                           |
|                   | Omni-channel retail decision optimization     | Customer loyalty(Cluster 3)                                           |
|                   |                                              | Adaptive selling(Cluster 6)                                           |
| WOS               | Research method                              | heuristics(Cluster 1)                                                |
|                   |                                              | content-analysis based literature review(Cluster 4)                  |
|                   |                                              | Multi-channel(Cluster 2)                                              |
|                   | Other                                        | Omni-channel services(Cluster 5)                                      |
|                   |                                              | Involvement(Cluster 7)                                               |

3.5. *Keyword cluster analysis*

Using Cite-space software to perform K-means clustering analysis on the presented keyword network structure can identify the field type of the research content, as shown in Figure 5 and Figure 6, the paper keyword clustering process in the "CNKI" database. After the path search algorithm is pruned, 5 clusters are obtained. The modularity of the clustering index (Modularity) is 0.4364, and the mean silhouette coefficient of the cluster homogeneity index is 0.723, indicating that the clustering results are obvious and have relatively high - confidence level; 8 clusters are obtained in the keyword clustering results of papers in the core set of the WOS database, with a modularity of 0.4732 and an average profile coefficient of 0.4375. The clustering results are more appropriate. After removing the smaller clusters, better clustering results can be obtained, see Table 3 for details. The research fields formed by the paper clustering in the two types of databases are relatively consistent. The research fields displayed by the keyword clustering results of the papers in the "CNKI" database are more concentrated than the core centralized papers of the WOS database.
3.6. Co-cited literature analysis
The dynamic evolution process of omni-channel research theory development can be analyzed through the links between co-cited documents. There is no data related to co-cited documents in the CNKI database, so only the content of co-cited documents from 2009 to 2019 in the core set of the WOS database is analyzed here. As shown in Figure 7 and Figure 8, the number of papers citing 171 omni-channel research literature reached 6,178. Combining the number of documents and taking the average of each year as a time period, the threshold of document extraction is set as the minimum number of citations C=2 and the minimum number of co-citations CC=4. After pruning according to the path search algorithm, the final result is a co-cited document structure composed of 181 nodes and 526 connecting lines, and the structure density is 0.0323. By using the K-means algorithm to perform clustering, the modularity of the clustering modularity parameter is 0.5732 and the average contour coefficient of the clustering homogeneity parameter is 0.2461. It can be seen that the clustering hierarchy is significant and has high reliability. The content of omni-channel research is divided into two aspects: first, omni-channel retail decision-making optimization, including brand management (cluster 0), consumer-led (cluster 3) and adaptive sales (cluster 6); Second, the whole channel retail research method, including heuristics (cluster 1) and literature review based on content analysis (cluster 4). Other clustering results include multi-channel (cluster 2), omni-channel service (cluster 5) and innovation (cluster 7).

4. Conclusions and prospects
Based on the Cite-Space software, this paper uses bibliometrics and knowledge graph research methods to visually analyze the 1890 documents included in the core collection of the WOS database with the theme of business model innovation. The study found that the total number of publications in the omni-channel retail sector is increasing year by year; China’s publication in the omni-channel retail sector is second only to the United States; domestic academic core groups in this field include: Capital University of Economics and Business-Beijing Technology and Business University-East China Jiaotong University, The core academic groups abroad include Catholic University-Politecnico di Milano-University of Nottingham. Although there are a lot of foreign postings, the root cause is that the earliest omni-channel retail is proposed as "Convergys Helps Operators Provide Omni-channel Unified Customer Experience" published in 2009 by Sha Ye, general manager of China. One article. Research hotspots in this field include: business model innovation, supply chain integration, brand management, consumer leadership, and specific content of adaptive sales. The omni-channel retail field will conduct further research from the omni-channel consumer behavior perspective, the omni-channel marketing system perspective, the omni-channel electronic logistics integration distribution
optimization perspective, and the omni-channel procurement and pricing perspective. In the past few years, although the use of qualitative methods to study omni-channel retail has achieved significant results, there is still a lack of systematic theoretical support based on quantitative research methods, so that the existing research methods are tightly applicable to a small number of retail companies. The practice guidance of retail companies is poor. Therefore, in the field of omni-channel retail, more in-depth research is needed for quantitative research with better practical guidance.

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