Visual Analysis on Foreign Studies of Intelligent Logistics - Core Literature, Frontier and Study Trend

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Abstract

Using web of science citation database as retrieving object and intelligent logistics as key word, the author retrieved related literature on this topic from year 2006-2016. Using visualized technique in mapping of science, this author analyzed distribution of the age, authors, key words and institutions, thus mapping a brand-new knowledge map about development trend of intelligent logistics and displaying its core literature, frontier and study trend over the past 11 years, which provides reference for researchers in this field.

Keywords: Intelligent Logistics, Visualization, Core Documents, Research Frontiers.

1.INTRODUCTION

Intelligent logistics means the use of advanced IOT technology such as bar code, sensors, automatic recognition, GPS and GIS, etc. in basic functions, such as transportation, stock, delivery, packaging, loading and unloading, of the logistics via information processing and web communication technology platform with the aim of realizing automatic operation and high-efficiency optimized management during goods transportation, improving service quality, lowering logistical costs as well as natural and social resource consumption (Bauin et al., 2011). The main technologies include: auto recognition technology, which has developed into polytechnic composed of bar-code recognition, smart card identification, optical character recognition, radio frequency identification and biological identification, etc. and has been developing toward the direction of integrated application, data mining and artificial intelligence technologies. Its future trend will feature mainly 4 characteristics: intelligence, integration, hierarchy, flexibility and socialization. In recent 30 years, research on intelligent logistics has been developing fast both at home and abroad, but there hasn't been mentioned the visual analysis on foreign studies of its core literature, frontier and trend. Therefore, based on analysis of intelligent logistics, this paper uses mapping of science technique to retrieve relevant literature on this topic between year 2006-2016 from web of science citing database with intelligent logistics as key word, thus forming a brand new knowledge map about trend of intelligent logistics which displays the core literature, frontier and study trend of intelligent logistics over the past 11 years in the hope of providing reference to researchers both at home and abroad in terms of logistics-related research and development (Chen et al., 2012).

2. DATA SOURCE AND STUDY METHODS

2.1 Data source

Through key word retrieving, all data was obtained from the web of science citing database, mainly including age, author, key words and institution of literature.

2.2 Retrieving method

Using intelligent logistics related key words, 514 pieces of articles were obtained from web of science database with time range set between 2006-2016, displaying representative literature on intelligent logistics and its research status as well as discipline, thus being recognized the gap of research on intelligent logistics around the globe, which is of great benefit to research in this field (Qiu and Li, 2013).

2.3 Research tool

Using the CiteSpace II visualization software developed by Professor Chen Chaomei (Drexel University of America), the author drew the mapping of science on intelligent logistics studies based on data obtained from web of science database, thus displaying research stream of this field in a visualized way.

3. CORE LITERATURE ANALYSIS OF INTELLIGENT LOGISTICS STUDIES

3.1 Visualization of Core Literature on Intelligent Logistics

After introducing obtained 514 pieces of literature into the CiteSpace II software with network node being expressed as cited reference, selecting adequate threshold value and the pathfinder route, then running the CiteSpace II software, we got the times series chart of representative figures and works about intelligent logistics as shown in Figure 1, which contains totally 51 nodes and 61 connecting lines.

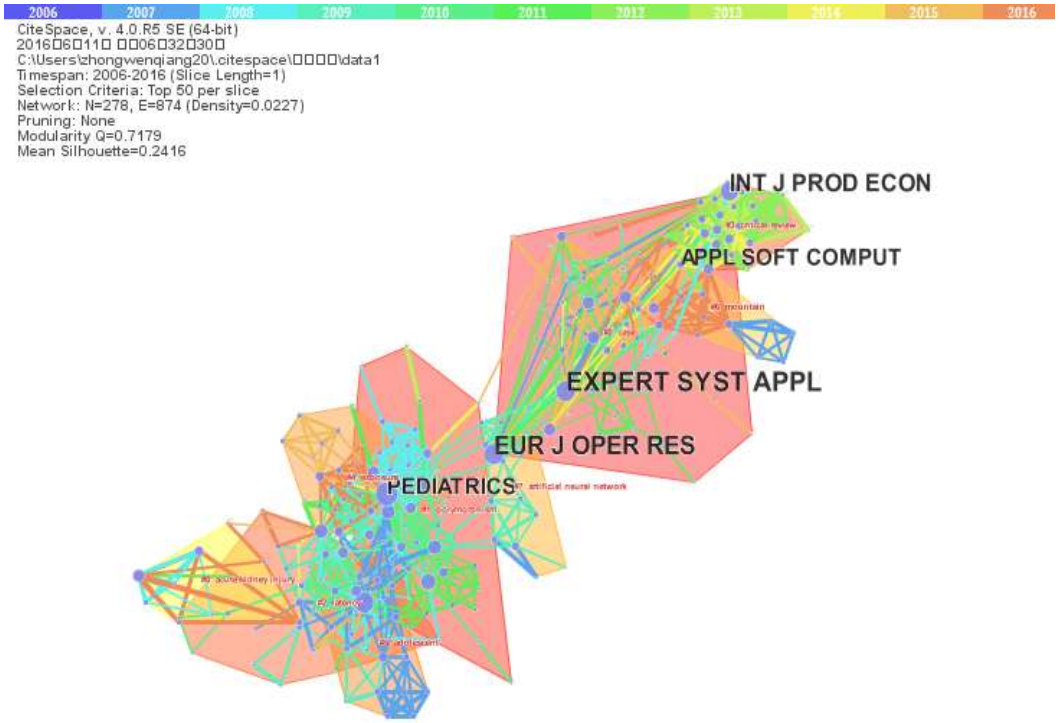

Figure 1. The distribution of the core literature in 2006-2016

Every node in this graph represents one piece of article, and the size of node shows the frequency the piece has been cited. The larger the node is, the more this piece has been quoted, and vice versa. The connecting line between 2 nodes stands for cross reference relationship between 2 pieces. The heavier the line is, the more cross-reference there have been (Hsu and Huang, 2011).

3.2 Detailed Analysis of Core Literature on Intelligent Logistics

Literature of high citation and that on fundamental knowledge are categorized as core literature, and in this paper core literature means highly cited literature only (Cao, 2012). By use of the CiteSpace II software and with related parameters being set, co-occurrence distribution graph of highly cited literature was obtained as in Figure 1. Here we will analyze the first 20 pieces of core literature and first 5 clusters as shown in Figure 1 and Table 1 (Ordering according to number of cluster members)

Through comprehensive analysis of data in Figure 1 and Table 1, below conclusions can be drawn:

(1) From Figure 1 it's not hard to see that, current research of intelligent logistics mainly focuses on 5 aspects: fundamental theory, application program, system application, application of computer software and intelligent system planning.

(2) From Table 1 it can be clearly seen that, the key word, USA, appears the most often for 117 times, indicating intelligent logistics research in the US has won the admiration of most people. Meanwhile, high-frequency key words show that the major countries involved in study of this field include China, Taiwan, England, Spain, Germany, South Korea, and Brazil, etc.

Table 1 2006-2016 core literature details

Nouns	Year	Freq	Author
1	2007	117	USA
2	2008	64	PEOPLES R CHINA
3	2007	57	TAIWAN
4	2007	41	ENGLAND
5	2009	28	SPAIN
6	2008	26	GERMANY
7	2010	22	SOUTH KOREA
8	2008	16	BRAZIL
9	2009	16	JAPAN
10	2010	15	INDIA
11	2008	15	Hong Kong Polytech Univ
12	2007	15	ITALY
13	2010	15	NETHERLANDS
14	2007	14	TURKEY
15	2012	11	Chen CY
16	2012	10	Natl Pingtung Univ Educ
17	2013	8	FRANCE
18	2008	8	AUSTRALIA
19	2013	8	SWITZERLAND

4. DETAILED ANALYSIS OF CORE LITERATURE

4.1 Author Analysis

In co-cited network of articles, different clusters are connected by key nodes. According to definition by Doctor Chen Chaomei, key node in graph of co-cited network is the node, connecting two or more clusters, owns relative centrality and high citation. These nodes may probably be the key points in transition from one time phase to another in the network (Cobo et al., 2011). Therefore, it is the key link in quantitative analysis to define the key points in the research field. Assume &1 and &2 are respectively article a and article b appearing at time t and t+t with research frontier marked and two co-citation literature clusters forms with article a and b as the center of each. If articles on the path linking these 2 clusters describe the pattern of transformation between these 2 articles, we define such nodes as key nodes. Through analysis of key node literature in Figure 2 we can know that, co-citation knowledge map for above social network analysis of literature includes in total 477 nodes, of which 16 are key nodes (as shown in Table 2). It can be analyzed in details as following:

Through comprehensive analysis of Figure 2 and Table 2, we can draw below conclusions:

Cited half-life, cited frequency and centrality of articles published between 2006-2016 by node authors is 5.02 for Doctor Chen CY from Drexel University of America, and the first 3 are respectively Chen CY, Chen CW and Choy KL. Meanwhile, papers published by Doctor Chen CY in 2012 has been cited 11 times, those published by Chen CW in 2012 has been quoted 7 times and the articles published by Choy KL in 2007 has been cited 7 times (Qin et al., 2011). Hence it can be seen that, the more one paper is cited, the more representative that paper is and the more research value that paper is of. However, much research shows that there is no obvious relevance between the reference and the number of citations and that the reference can be

used as an article evaluation indicator independent from the cited frequency. Therefore, cited frequency can only be used as reference.

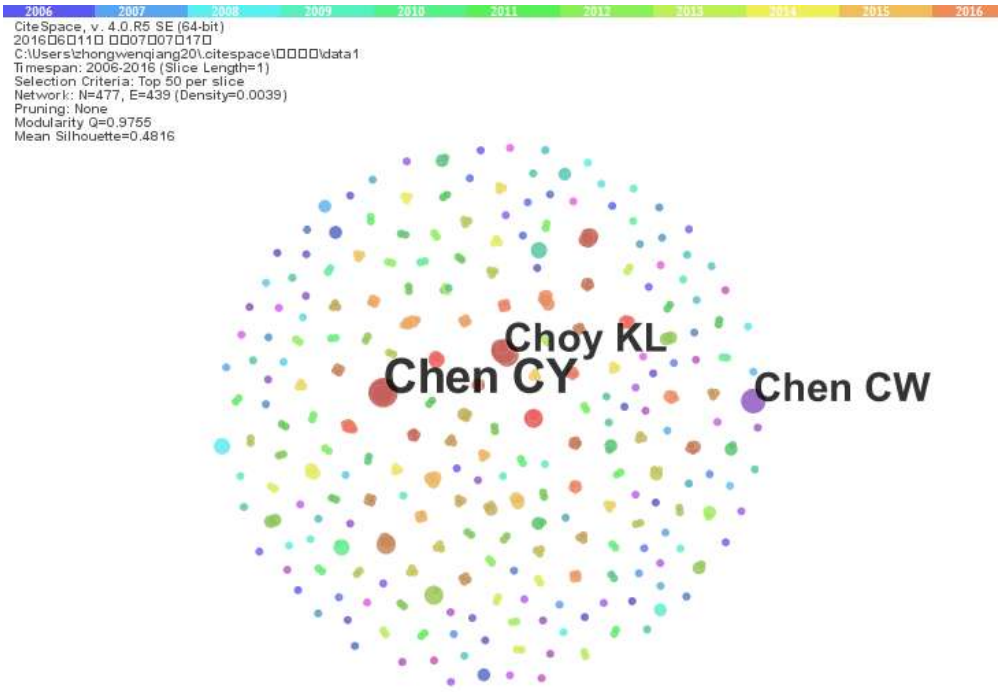

Figure 2. Co-citation map of key nodes of the network information

Table2 Co-citation map of key nodes of the network information

Nouns	Year	Burst	Center	Author
1	2012	11	5.02	Chen CY
2	2012	7		Chen CW
3	2007	7		Choy KL
4	2012	6		Ho GTS
5	2012	6	2.7	Shih BY
6	2012	5		Chen YH
7	2014	4		Celi LA
8	2012	4		Chang CJ
9	2014	4		Gunasekaran A
10	2012	3		Chang H
11	2011	3		Chen MY
12	2009	3		Bose I
13	2015	3		Lee CKM
14	2015	3		Ngai EWT
15	2013	3		Shankaran S
16	2008	3		Chan CK

4.2 Key Word Analysis

The timeline option refers to division of the whole network into several clusters and arrangement of articles in clusters chronologically with the aim of examining the relationship between those articles. Options under this status display mainly characteristics of. As shown in Figure 3 and Table 3, the largest research cluster (#0) owns 67 members and a silhouette value of 0.682, indicating that delivery center is one of the main topic in intelligent

logistic studies. The 2nd largest cluster (#1) owns 53 members and a silhouette value of 0.608, centering mainly on LLR and TFIDF algorithm. Core of intelligent logistic studies focus on 3 directions: regression analysis of logistics, intelligence and research on intelligent model (Li and Hou, 2017).

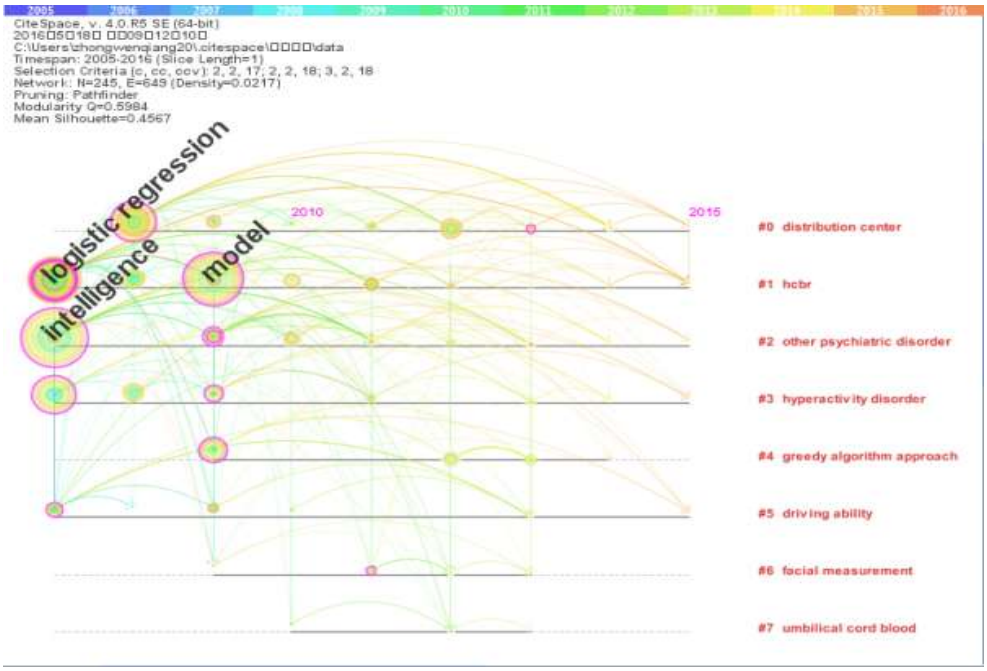

Figure 3. 2006-2016 years of intelligent logistics Atlas of keyword research

Table 3 2006-2016 years of intelligent logistics Atlas of keyword research

ClusterID	Size	Silhouette
0	67	0.682
1	53	0.608
2	32	0.679

4.3 Institution Analysis

Ranking of research institutions is decided by their number of citations. From Figure 4 one can clearly see the general time of intelligent logistical research by institutions. From it one can also see that the first 6 research groups, such as Hong Kong Polytech Univ, studied this field around 2007. In combination of Table 4 and Figure 4, it can be known that Hong Kong Polytech Univ (2007) has been quoted 15 times. Similary, ranking the 2nd is Natl Pingtung Univ Educ (2012) that has been quoted 10 times. And ranking the 3rd is Natl Cheng Kung Univ (2011) that has been cited 8 times. From the ranking we can know that universities in Hong Kong plays a leading role in research of intelligent logistics.

Table 4 2006-2016 years of intelligent research map

Nouns	Freq	Burst
1	15	Hong Kong Polytech Univ
2	10	Natl Pingtung Univ Educ
3	8	Natl Cheng Kung Univ
4	7	Natl Kaohsiung Marine Univ
5	7	Harvard Univ
6	7	Univ Bremen
7	5	Univ Hong Kong
8	5	Univ Nottingham
9	4	Chinese Acad Sci

10	4	Shanghai Jiao Tong Univ
11	4	Univ Edinburgh
12	4	Beth Israel Deaconess Med Ctr

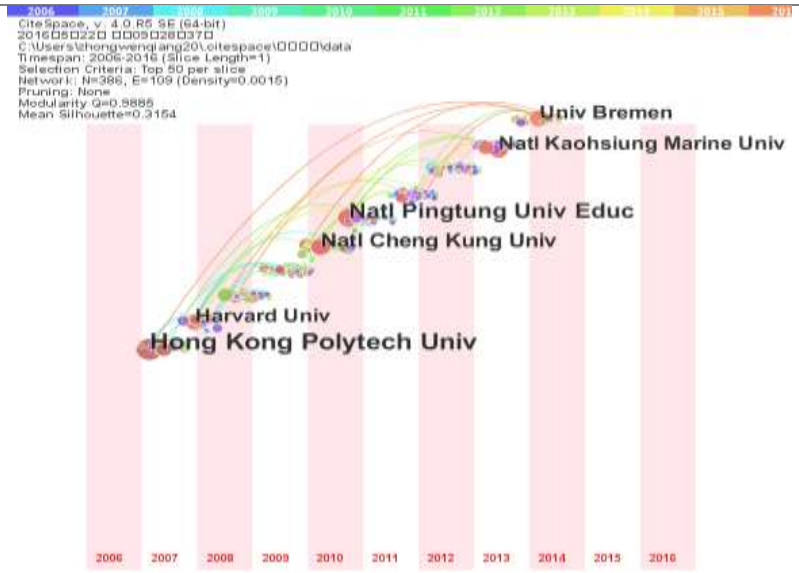

Figure 4. 2006-2016 years of intelligent research map

4.4 Country Analysis

After selecting suitable threshold value and the pathfinder route, then running the CiteSpace II software, we can obtain the time series chart of representative countries and articles in the field of intelligent logistics, which includes totally 56 nodes and 54 connecting lines. Ranking of times cited is as shown in Table 5, where the first is the USA (2007) with 117 citations, and similarly, the 2nd comes Peoplesr China (2007) with 64 citations, then Tai Wan (2007) with 57 citations.

The number of published articles can represent the research ability, development status and influence of a certain country. From Table 5 it can be seen that in America 117 papers on intelligent logistics, 22.7% of the total 514 articles, have been published in journals, meaning that the US plays a dominant role in research of this field. Then comes China, from which 64 papers in this field, 12.5% of the total, have been published.

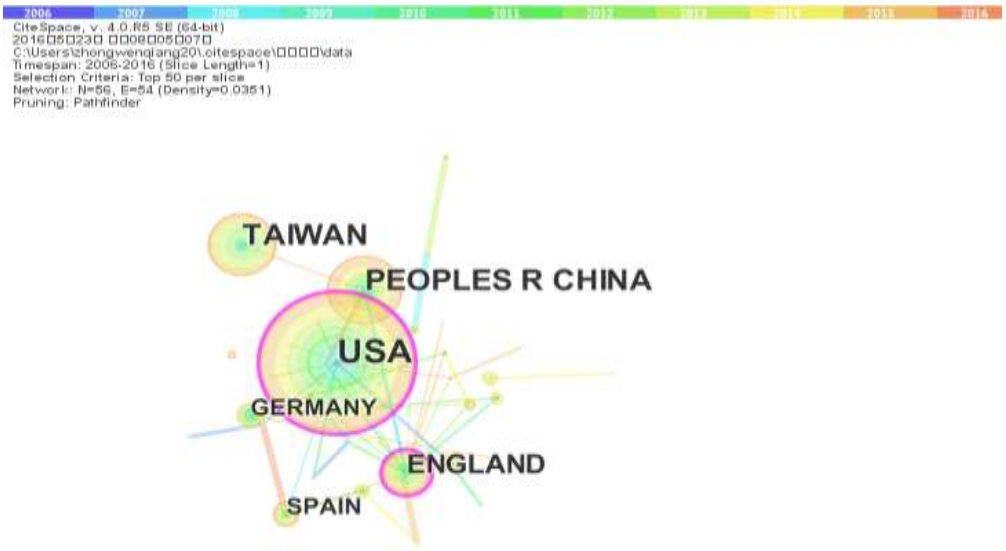

Figure 5. 2006-2016 the smart study of area maps

Table 5 2006-2016 the smart study of area maps

Nouns	Freq	Burst
1	117	USA
2	64	Peoplesr China
3	57	Tai Wan
4	41	England
5	28	Spain
6	26	Germany
7	22	South Korea
8	16	Japan
9	16	Brazil
10	15	Italy
11	15	India
12	15	Netherlands
13	14	Turkey
14	8	Australia

5. CONCLUSION

Based on the quantitative analysis results of articles on intelligent logistics, below conclusions can be drawn in combination of all information collected already:

(1). The number of literature on intelligent logistics has been increasing with years, showing that research in this field has been deepening continuously.

(2). Current levels of research in various aspects are more concentrated. This shows that researchers in this field emphasize its application at the same time of exploring the basic theory, and have already exerted great impact on such fields as automatic recognition, data mining, artificial intelligence, RFID technology, and navigation, etc.

(3). Intelligent logistics is studied more in such countries as America, China, France and Japan, etc. Whether in research width or depth, the US owns considerable advantage in this field.

In this field, China has seen increase in its number of published papers and is of upper level in the world, which is a result of emphasis on research, of investment increase in research and under the joint efforts of all researchers. However, from times cited it can be deducted that quality of these published papers are yet to be improved, indicating that domestic research in this field still requires additional efforts to improve the research quality in combination of subject research results.

ACKNOWLEDGMENTS

This work is supported by 2017 key scientific research projects in Colleges and universities in Henan Province(No.18B580004), 2018 key scientific research projects in Colleges and universities in Henan Province(No.18B580004) and Henan Province Social Science Union, Henan province by the Regiment Joint Research Project (SKL-2017-698).

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