

Research Hotspots and Frontiers of Intelligent Manufacturing

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ABSTRACT

With the arrival of the era of industry 4.0, domestic and foreign policies for industry 4.0, pointed out that the development of intelligent manufacturing is the top priority task, so it is very necessary to discuss the current research status, hot spots and trends in the field of intelligent manufacturing. Based on the relevant literatures of China National Knowledge Network (CNKI) and Web of Science(WOS)from 2008 to 2022, this paper makes a quantitative discussion on hot issues in the field of intelligent manufacturing. Through the application of bibliometric analysis and CiteSpace visualization technology, it is found that: the research on the integration of intelligent manufacturing and emerging technologies, the impact of intelligent manufacturing on the transformation and upgrading of the manufacturing industry, and the cultivation of high-level talents related to intelligent manufacturing are the development trends of intelligent manufacturing, and through this research result, the future research direction of intelligent manufacturing in China is summarized.

KEYWORDS

Intelligent manufacturing; Research hotspot; Intelligent manufacturing technology; Bibliometric analysis

The rapid development of the new generation of information technologies such as the Internet of Things, cloud computing, artificial intelligence, etc., and the rapid development of the Internet economy promote the fourth industrial revolution with intelligence as the core driving force, and promote the production and operation mode from factor driven to innovation-driven, from resource consumption production to intelligent precision manufacturing^[1], which promotes the development of traditional manufacturing to intelligent. It has accelerated the transformation and upgrading of domestic and international manufacturing industries. Germany launched the "Industry 4.0" strategy in April 2013, and it was quickly accepted by the world, especially the manufacturing developed countries. In 2015, in order to actively respond to the global call for industry 4.0, China promulgated the "Made in China 2025", which clarified the new direction and strategic objectives of the development of China's manufacturing industry. Subsequently, China issued the "intelligent manufacturing Development Plan" pointed out that in order to promote the development of manufacturing industry, build a new manufacturing system, and promote the manufacturing industry to the high-end, it is necessary to accelerate the development of intelligent manufacturing. It can be seen that intelligent manufacturing is the core technology of the new round of industrial revolution and the main direction of Made in China 2025^[2].

Intelligent manufacturing is the inevitable result of the integration of modern manufacturing technology, computer technology and artificial intelligence technology, and is the main trend of intelligent development of manufacturing industry in the future. With the arrival of the fourth Industrial revolution, the world's major companies are seeking to solve the problems in the modern

manufacturing system, in order to improve their production level and competitive advantages, so as to achieve global information exchange and knowledge sharing, intelligent manufacturing comes into being under this background. At present, the concept of intelligent manufacturing is still debated and not unified. The term Intelligent manufacturing first appeared in the book *Intelligent Manufacturing* written by American scholars Wright and Bourne. Intelligent manufacturing refers to the combination of knowledge engineering, manufacturing software, robot vision, robot control and other knowledge with workers' skills. So that there is no interference in small-scale production. The Ministry of Industry and Information Technology of China defines intelligent manufacturing as a new mode of production with self-perception, self-learning, self-decision-making, self-execution and self-adaptation, which is based on next-generation information and communication technology and advanced manufacturing technology and goes deep into the production process of design, production, management and service. At present, the global manufacturing industry is undergoing a more profound transformation, and the core of this transformation is the deep integration of modern information technology and manufacturing technology. However, the combination of the current two technologies is far from meeting the depth of integration required for change. To sum up, the research and development of intelligent manufacturing is extremely important. According to relevant literature, although there have been quite a lot of researches on intelligent manufacturing in the academic circle, the researches in this field at home and abroad are still scattered, and no unified theoretical model has been formed. Scholars from different countries pay different attention to and focus on this field. In addition, there are literature reviews in the field of intelligent manufacturing, which are published too early and lag behind in timeliness, and the field has undergone rapid changes in recent years, requiring a more comprehensive review and summary^[3]. Therefore, this paper makes a comparative analysis of the current research status of intelligent manufacturing at home and abroad, and puts forward a more suitable for China's future intelligent manufacturing research and development ideas.

1 Research design

Relevant literature data are from CNKI and WOS. A total of 2,671 records were retrieved from the CNKI core journal database with the title of "Intelligent manufacturing" from 2008 to 2022. In order to eliminate the interference of irrelevant literature and ensure the scientific, accurate and academic nature of the paper, the irrelevant literature was screened and cleared, and 1031 relevant literatures were obtained. In the same way, 1338 literatures were retrieved from the Web of Science database.

Through reading relevant literature, we know that intelligent manufacturing has been discussed from many aspects and angles at home and abroad, but intelligent manufacturing research involves many fields, and the research content is disordered. In order to better understand the current situation and existing problems of intelligent manufacturing at home and abroad, this paper adopts the bibliometric analysis method and the literature analysis software Citespace to conduct quantitative research on the relevant literature, and uses the graph generated by Citespace to study and analyze the hot issues of intelligent manufacturing at home and abroad.

2 Analysis of research results

2.1 Analysis of the research results of intelligent manufacturing in CNKI

Literature is an important medium for information transmission, and its quantity reflects the change of research subject in a sense. Excel software is used to make statistics on the number of publications in CNKI with intelligent manufacturing as the theme from 2008 to 2022, as shown in Fig.1.



Fig.1 Number of annual publications on intelligent manufacturing in CNKI

As can be seen from Figure 1, literature research in CNKI can be divided into two stages by year. From 2008 to 2013, the number of published articles per year was small and remained stable on the whole, with an average of only single digits per year, indicating that the intelligent manufacturing field received less attention from 2008 to 2013. However, since 2014, there has been a significant increase in the number of published papers, with 29 more papers in 2015 than in 2014, an increase of 181%. The number of published papers from 2014 to 2021 shows an overall linear change, with 193 papers in 2021. Therefore, it can be inferred that, The number of articles will continue to grow linearly in future publications. In terms of the overall trend of change, the changes in the volume of published literature from 2008 to 2022 show the degree of emphasis on intelligent manufacturing, especially after China put forward the development strategy of "manufacturing power" in 2015, scholars have conducted in-depth research on it.

The key words are the summary and refinement of the author's intention and research object. Based on the keywords of the literature, this paper uses LLR algorithm in Citespace software to conduct keyword cluster analysis of relevant literature. The clustering effect is usually evaluated by the structure and rationality of the keywords. The clustering time series diagram of intelligent manufacturing field in CNKI is obtained by Citespace software, as shown in Figure 2. As can be seen from Fig. 2, the clustering results of relevant literature analysis in the field of intelligent manufacturing in CNKI are as follows: $Q=0.6179$, $S=0.9549$. Generally, when the value of clustering module $Q > 0.3$, the clustering structure is considered to be significant. If the average value of the clustering contour $S > 0.5$, the effect can be considered reasonable, and if $S > 0.7$, the reliability of the clustering result is considered high. Therefore, clustering results obtained according to Citespace are basically accurate and reliable.

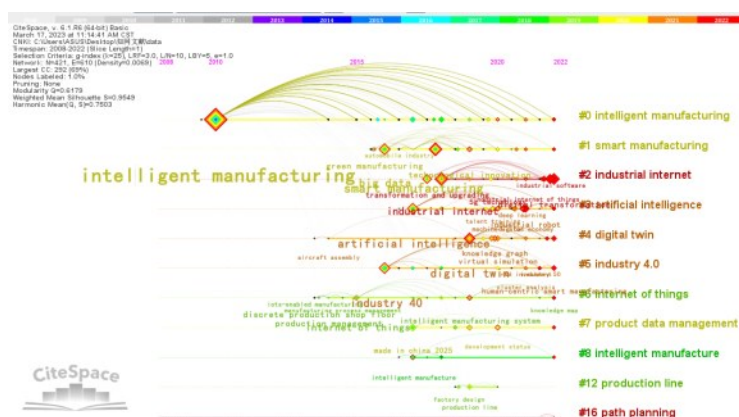


Fig.2 Clustering time series atlas of intelligent manufacturing field in CNKI

In order to analyze keywords more comprehensively and intuitively, the clustering of keywords in intelligent manufacturing field in CNKI is obtained through visualization analysis, as shown in Fig.3.



Fig.3 Clustering diagram of keywords in intelligent manufacturing field in CNKI

The keywords with high frequency in the field of intelligent manufacturing in CNKI are shown in Table 1.

Table 1 High frequency keywords in intelligent manufacturing field in CNKI

Serial number	Keywords	Frequency
1	Intelligent manufacturing	637
2	Manufacture	65
3	Artificial intelligence	59
4	Digital twins	56
5	Industry 4.0	42
6	Big data	39
7	Smart	36
8	Talent cultivation	28
9	Transformation and upgrading	26
10	Internet of Things	22

As can be seen from Table 1 and Fig.3, the top 10 hot research fields of intelligent manufacturing in CNKI in recent years are: intelligent manufacturing, manufacturing, artificial intelligence, digital twin, Industry 4.0, big data, intelligence, talent training, transformation and upgrading, Internet of Things. These keywords can be integrated into three categories: the first category is intelligent manufacturing technology, the second category is intelligent manufacturing talent training, and the third category is the impact of intelligent manufacturing on the transformation and upgrading of the manufacturing industry.

Intelligent manufacturing technology mainly includes: artificial intelligence, digital twin, big data, Internet of things, etc. The emergence of these new technologies has accelerated the rapid development of intelligent manufacturing. For example, the new generation of artificial intelligence is driven by data. It constantly revises and updates parameters according to current Settings and environmental information through the given learning framework, which is highly autonomous. Therefore, the new generation of artificial intelligence is linked with intelligent manufacturing, thus forming two different development paths. One is the intelligent manufacturing, in the original intelligent production line continues to deepen; The second is the manufacturing of intelligence, where all technology is embodied by an algorithm. Based on the above theories, Yao et al^[4] compared the first generation of intelligent manufacturing based on AI1.0 and the second generation of intelligent manufacturing based on AI2.0, and predicted the development direction and architecture of AI3.0 accordingly. Different from the previous two generations, AI3.0 has the

characteristics of human beings and is closer to humanization. It has the perception, psychology and thinking of human beings and can think and make decisions independently. At the same time, it can also have more communication with human beings and participate in social affairs, from possessing human knowledge to possessing higher level of wisdom and abiding by the laws of nature and society. It is truly super artificial intelligence. Intelligent manufacturing has become the inevitable trend of the development of the world's manufacturing industry, and how to realize the connection and integration of the information world and the physical world in the industrial production is an important problem facing the field of intelligent manufacturing. Digital twin technology is the organic combination of information and entity. On the one hand, it can realize the virtual-real interaction between the physical world and the real world. On the other hand, it can fully interact and integrate production conditions, environmental changes, sudden interference and other actual conditions with information spatial data such as simulation prediction, statistical analysis and domain knowledge, so as to improve the synchronization and coherence of production entity and information. All these show the application prospect of digital twin technology in intelligent manufacturing. Moreover, digital twin technology is an emerging intelligent technology that is very mature in product prediction, product maintenance, product service and other aspects. For example, it can be applied to production scheduling. Therefore, Liu et al^[5] proposed a new production scheduling platform - scheduling cloud platform on the basis of digital twin technology. The dispatching cloud platform of the whole production process is established to monitor the real-time running status of products. According to the real-time monitoring data of the whole life cycle monitoring system, the big data technology is used to forecast and diagnose the dynamic interference of multiple sources in workshop production, and on this basis, the corresponding interference strategy is determined in advance. In actual production, industrial big data technology can accurately perceive the changes of internal and external environment and scientifically analyze and optimize the production process, so as to optimize the production process, reduce costs and improve production efficiency. Industrial big data has become an important factor to promote intelligent manufacturing and industrial transformation and upgrading^[6]. Therefore, Ren et al^[7] proposed a new model of intelligent manufacturing services for complex products based on big data and life cycle according to the characteristics shown in the life cycle data of complex products. To sum up, technology driving is the driving force for the development of intelligent manufacturing^[8]. The combination of new technology innovation and intelligent manufacturing plays a role in promoting the development of intelligent manufacturing and is the research hotspot of intelligent manufacturing. Our country should improve relevant policies and systems to encourage innovation and make the development of intelligent manufacturing more rapid.

Research on the cultivation of intelligent manufacturing talents shows that there are many problems in the cultivation of talents in recent years, such as: lack of overall planning in the integration of production and education in colleges and universities, weak motivation of participants, lack of relevant theories, and mismatch of information resources in supply and demand^[9]. In the international environment, most of China's traditional manufacturing industry has begun to upgrade and transform, in the process of transformation and upgrading will produce new positions, the old employees in the traditional manufacturing industry may not adapt to the needs of new positions, so the enterprise needs to join the new high-level talents, the demand for talents will be increasing. To sum up, the current development of intelligent manufacturing in China is faced with a serious shortage of talents and an urgent need to modify the talent training program.

As for the impact of intelligent manufacturing on the transformation and upgrading of the manufacturing industry, some scholars have conducted empirical studies on the relationship between the two, proving that the use of advanced technologies such as intelligent manufacturing can promote the transformation and upgrading of the manufacturing industry^[10]. Therefore, we

should take "real economy" as the core, take "new industrialization" as the starting point, Chinese manufacturing should be based on a new historical starting point, take intelligent manufacturing as the core, deepen the strategy of "manufacturing power", further consolidate the foundation of the real economy, and write a new chapter in manufacturing power. The transformation from the traditional manufacturing industry to the intelligent manufacturing industry is a general trend that cannot be changed. It is necessary to strengthen the research on the upgrading and transformation of the manufacturing industry, deeply explore the influence mechanism, learn and summarize the experience of foreign advanced manufacturing industry, and form a manufacturing transformation mode that conforms to the current situation in China, so as to improve the level of China's manufacturing industry and strengthen the comprehensive national strength. In the international manufacturing power position is more stable.

2.2 Analysis of research results of intelligent manufacturing in WOS

Excel software was used to make statistics on the number of publications in the year 2008-2022 with intelligent manufacturing as the theme in WOS, and the results are shown in Fig.4. From Fig.4, it can be seen that the number of published papers increased year by year from 2008 to 2013, indicating that foreign literatures in the development and attention of intelligent manufacturing were relatively stable during this period, while the number of published papers increased rapidly in 2014, and the number of published papers from 2014 to 2022 showed a linear change, increasing to 157 by 2022. Therefore, There will be a gradual increase in the number of articles published in this field in the future. The number of published documents from 2008 to 2022 indicates that the field of intelligent manufacturing has received increasing attention in foreign literatures. First of all, Germany put forward Industry 4.0 in 2013. With the proposal of Industry 4.0, the European Union, the United States and Japan all put forward policies related to intelligent manufacturing. It can be seen that the proposal of Industry 4.0 has attracted more scholars' attention to intelligent manufacturing research. The clustering time series diagram of intelligent manufacturing field in WOS is obtained according to LLR algorithm, as shown in Fig.5.

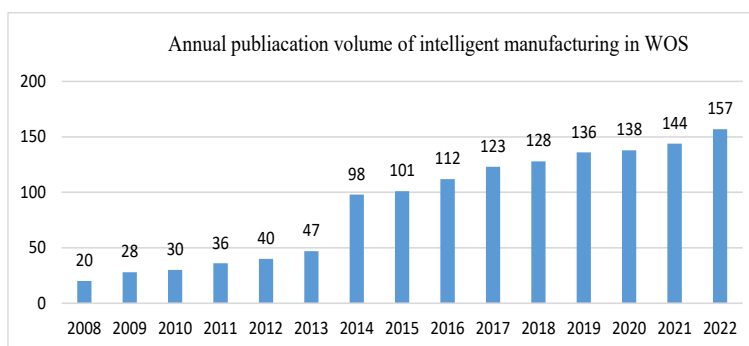


Fig.4 Number of annual publications on the subject of intelligent manufacturing in WOS

According to Fig.5, the clustering results of literature analysis results in the field of intelligent manufacturing in WOS are $Q=0.4233$, $S=0.7612$, so the clustering results obtained based on Citespace are basically accurate and reliable. In order to analyze keywords more comprehensively and intuitively, the high-frequency keywords in intelligent manufacturing field of WOS and the clustering results are obtained through visual analysis, as shown in Table 2 and Fig.6.

As can be seen from Table 2 and Fig.6, the top 10 hot research fields in intelligent manufacturing in foreign literature in recent years are: Intelligent manufacturing, Design, Model, Optimization, Framework, Architecture, Smart manufacturing, Additive manufacturing, Management, Cloud

manufacturing. It can be seen from these keywords and the clustering time series graph that the research on intelligent manufacturing in foreign literature is more technical. The country clustering diagram of published literature sources in intelligent manufacturing field in WOS is shown in Fig.7. As can be seen from Fig.7, USA, ENGLAND, CANADA, GERMANY, SOUTH KOREA and other countries contribute more to intelligent manufacturing research.

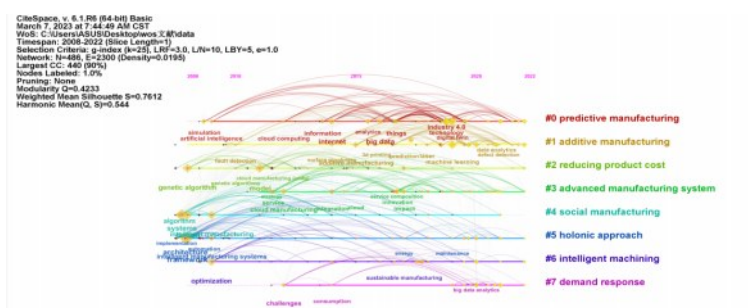


Fig.5 Clustering time series atlas of intelligent manufacturing field in WOS

Table 2 Keywords with high frequency in intelligent manufacturing field in WOS

Serial number	Keywords	Frequency
1	Intelligent manufacturing	116
2	Design	111
3	Model	83
4	Optimization	69
5	Framework	66
6	Architecture	56
7	Smart manufacturing	48
8	Additive manufacturing	47
9	Management	44
10	Cloud manufacturing	43

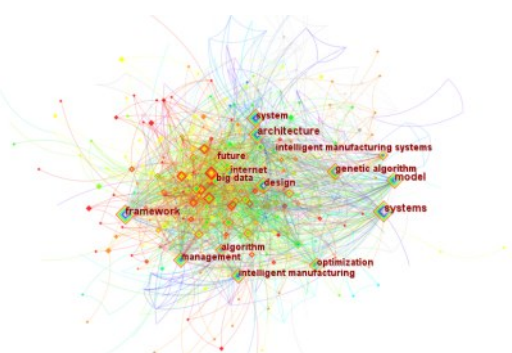


Fig.6 Keyword Clustering Diagram for Intelligent Manufacturing in WOS

American scholars have published a lot of relevant literature, so the American intelligent manufacturing as an example to analyze. The National Science and Technology Council of the United States promulgated the National Strategic Plan for Advanced Manufacturing in 2012, pointing out that in the process of implementing intelligent manufacturing, special attention should be paid to the leading role of innovation. A good atmosphere for innovation should be established, and the open innovation of the whole society should be vigorously promoted through crowd-sourcing, rewards and other means. The innovation-driven strategy should be put in the first place, so as to achieve breakthroughs in major core technology fields and seize the first opportunity

for the upgrading and development of manufacturing industry. The development of intelligent manufacturing in the United States is led by the government, relying on large enterprises with strong technological innovation ability and manufacturing research institutions, and attaching importance to the innovation achievements of small and medium-sized enterprises and the public. American enterprises take the lead in owning cloud computing technologies such as distributed architecture, virtual resource management and mass storage. Among them, American enterprises are among the top in the world in terms of RFID and wireless sensors. The United States has 59 percent of the world's RFID applications. Thus, the continuous improvement of intelligent manufacturing technology is an important reason for the long-term dominance of the United States.



Fig.7 Country Cluster Chart of Published Literature Sources in the Intelligent Manufacturing Field in WOS

2.3 Comparison of the research status of intelligent manufacturing in CNKI and WOS

Highly cited literature refers to a literature with a high number of citations. The number of citations reflects the research quality, academic innovation ability, and attention and recognition of the literature by scholars from the side, which is helpful to grasp the hot spots and key nodes in the research field. According to relevant literatures in CNKI, the top ten articles with high citation frequency are obtained, as shown in Table 3.

As can be seen from Table 3, the current citation volume is up to 3172, and the top two literatures cited are both researches on the development trend of intelligent manufacturing. It can be seen that the attention of intelligent manufacturing is gradually increasing. The remaining literatures cited frequently can be roughly divided into three categories, the first category is the construction of intelligent manufacturing system. The second category is the combination of intelligent manufacturing and emerging technologies; The third category is the factors affecting the development of intelligent manufacturing. To sum up, the research of CNKI medium and high citation literature focuses on the development trend and related theories in the field of intelligent manufacturing.

According to relevant literatures in WOS, the top ten articles with high citation frequency are obtained, as shown in Table 4.

As can be seen from Table 4, the maximum number of citations is 1077 at present, and most of the literatures with a high number of citations are review articles. It can be seen that relevant literatures in WOS are committed to establishing a unified intelligent manufacturing system, so that domestic and foreign scholars can better study the field of intelligent manufacturing. By comparison with Table 3 and Table 4, it can be seen that the literature in CNKI and WOS both want to establish a unified intelligent manufacturing system, but the difference is that the relevant literature in CNKI is more inclined to the construction of theories and concepts, while the literature in WOS is more inclined to the construction of a system integrating emerging technologies and intelligent manufacturing.

Through further mining of keywords, the comparative analysis of literature research trends in the field of intelligent manufacturing in CNKI and WOS is shown in Fig.8. As shown in Fig.8, on the left are the research trend keywords of relevant literatures in CNKI, and on the right are the research trend keywords of relevant literatures in WOS. Keywords shared by CNKI and WOS are Industry 4.0 and cloud computing. Thus, it can be seen that industry 4.0 has a deep influence on the research of intelligent manufacturing at home and abroad. By comparison of trends, it can be seen that after the introduction of Industry 4.0, the literature in WOS focuses on the research and development of intelligent manufacturing technology, while the literature in CNKI is more inclined to the research of intelligent manufacturing innovation and upgrading. Cloud computing is a representative of new technologies. With the advent of the information age, emerging technologies develop rapidly, and the integration of intelligent manufacturing and new technologies gradually becomes one of the development trends of intelligent manufacturing, which has also become a hot topic of common concern of scholars at home and abroad.

Table 3 Literatures with high citation frequency of intelligent manufacturing articles in CNKI

Author	Name of document	Journal	Citation frequency
Zhou(2015)	Intelligent Manufacturing -- the main direction of "Made in China 2025"	China Mechanical Engineering	3172
Lv(2015)	Intelligent Manufacturing: Global Trends and Chinese Strategy	People's Forum-Academic Frontier	319
Meng (2018)	Research on influencing factors of the development from traditional manufacturing to intelligent manufacturing	Scientific and technological progress and countermeasures	208
Lv(2019)	Industrial Internet intelligent manufacturing model and enterprise platform construction-Based on the case study of Haier Group	China Soft Science	165
Lu(2010)	Toward Green and Intelligent Manufacturing-The Road to Manufacturing Development in China	China Mechanical Engineering	157
Tang(2018)	Comprehensive Realization of digitization is the Only Way to Intelligent Manufacturing -- Interpretation of the Road to Intelligent Manufacturing: Digital Factory	China Mechanical Engineering	147
Xiao(2021)	Information technology drives the transformation and upgrading of Chinese manufacturing-a longitudinal case study of the leapfrog strategic transformation of Midea Intelligent Manufacturing	Manage the world	131
Tao(2018)	Service-oriented intelligent manufacturing	Journal of Mechanical Engineering	111
Liu(2020)	Research on theoretical architecture of intelligent manufacturing	China Mechanical Engineering	110
Li(2017)	Research on Intelligent Manufacturing Architecture, reference model and Standardization Framework	Computer Integrated Manufacturing System	109

Table 4 Literatures with high citation frequency of intelligent manufacturing articles in WOS

Author	Name of document	Journal	Citation frequency
Zhong (2017)	Intelligent Manufacturing in the Context of Industry 4.0: A Review	Engineering	1077
Kang (2016)	Smart Manufacturing: Past Research, Present Findings, and Future Directions	Internation Journal Of Precision Engineering And Manufacturing-GreenTechnology	659
Davis (2012)	Smart manufacturing, manufacturing intelligence and demand-dynamic performance	Computers & Chemical Engineering	401
Shen (2006)	Applications of agent-based systems in intelligent manufacturing: An updated review	Advanced Engineering Informatics	345
Zhou (2018)	Toward New-Generation Intelligent Manufacturing	Engineering	293
Li(2017)	Applications of artificial intelligence in intelligent manufacturing: a review	Frontiers Of Information Technology& Electronic Engineering	265
Zhong (2015)	Big Data Analytics for Physical Internet-based intelligent manufacturing shop floors	International Journal of Production Research	205
He(2020)	Digital twin-based sustainable intelligent manufacturing: a review	Advances In Manufacturing	159
Zhou (2019)	Human-Cyber-Physical Systems (HCPs) in the Context of New-Generation Intelligent Manufacturing	Engineering	159
Pacaux-Lemoine (2017)	Designing intelligent manufacturing systems through Human-Machine Cooperation principles: A human-centered approach	Computers & Industrial Engineering	143

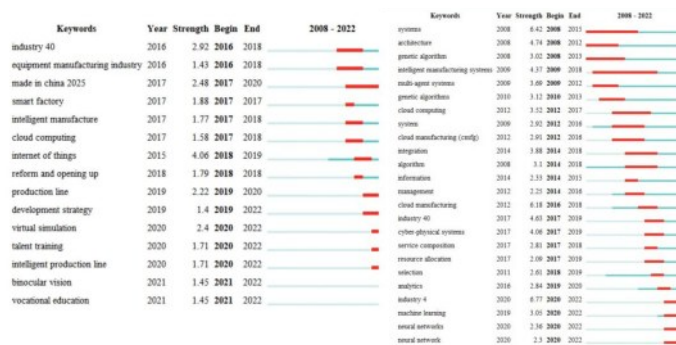


Fig.8 Comparative analysis of research trends of intelligent manufacturing in CNKI and WOS

3 Research frontiers of intelligent manufacturing

Based on the reading of relevant literature and the analysis of the above key words, this paper compares the research status and deficiencies of intelligent manufacturing literature in CNKI and WOS, and obtains three research frontiers of intelligent manufacturing in the future:

(1) Research on the integration of intelligent manufacturing and emerging technologies

According to the results of the research status of intelligent manufacturing, the research of relevant literature in CNKI is more inclined to theoretical construction, while the research of relevant literature in WOS is more inclined to technological innovation. At present, the relevant researches of

CNKI literature only stay in the concept of intelligent manufacturing and other aspects, without in-depth systematic mode. The existing researches only vaguely define and analyze it, without forming a set of theoretical system generally accepted by scholars. In the existing theoretical system of intelligent manufacturing, it is proposed that the supporting technology of intelligent manufacturing involves key technologies such as the new generation of information technology and artificial intelligence technology that support the development of intelligent manufacturing^[11]. However, no studies have detailed how the emerging technologies will integrate with the field of smart manufacturing. In today's technological change, how should intelligent manufacturing and technology better integrate? Intelligent factory, intelligent production, intelligent service, intelligent logistics and other related technical problems how to overcome; How can the government improve the relevant policies to effectively enhance the independent innovation ability of enterprises, break through the technical bottleneck, and make full use of emerging technologies; How our country can enhance our comprehensive strength according to foreign intelligent manufacturing experience under the new era; On the basis of the new technology, the future research can not only expand and optimize the existing technical means, but also conduct in-depth discussion on some existing problems, so as to solve the problems encountered in the actual production and provide some reference and enlightenment for the practical application. These are of great significance to the forefront of the subject, worthy of in-depth discussion by the majority of scholars.

(2)Research on intelligent manufacturing for intelligent transformation and upgrading of manufacturing industry

The issue of intelligent transformation and upgrading of manufacturing industry has always been the focus of academic circles, but a relatively perfect system has not yet been formed. The existing researches on policy and technology are mostly focused on the intelligent field of production and manufacturing^[12], and scholars have not explored the inherent law of the impact of intelligent manufacturing on the intelligent transformation of manufacturing industry. Moreover, there is a lack of empirical research on different kinds of enterprises. How to deeply discuss the role of intelligent manufacturing in the intelligent transformation and upgrading of manufacturing industry, as well as the intelligent transformation and upgrading path for various enterprises; How to establish a system to ensure the upgrading and transformation of small and medium-sized enterprises, so that intelligent manufacturing becomes the main driving force for development and innovation. This is undoubtedly a new area worthy of in-depth exploration, worthy of in-depth discussion.

(3)The cultivation of intelligent manufacturing talents

From the keywords obtained from the research results, it can be seen that how to train high-level talents related to intelligent manufacturing has been attached importance by the academic circle. In recent years, China's higher education has many problems, such as interdisciplinary teaching closed, it is difficult to cultivate compound talents; It is difficult for traditional practice teaching to cultivate students' practical ability required for intelligent manufacturing industry, and the current talent training model is not sufficiently connected with the demand for intelligent manufacturing practice innovation ability^[13]. At present, although the impact of intelligent manufacturing on talent training has become the focus of scholars, the relevant research has no focus, and the talent training program is improved separately from each profession. How to analyze the mechanism of intelligent manufacturing from various aspects, according to which to establish a set of high-level composite talent training program, this series of training programs can be generally accepted by colleges and universities, this aspect still needs further research.

The above are the cutting-edge theoretical knowledge obtained through research results and data analysis, which can be studied and discussed by future scholars from multiple perspectives. Intelligent manufacturing, as an emerging field, still has many problems to be discussed. Domestic research is mostly related to theories, and there are few technical fields. The combination of

domestic intelligent manufacturing and manufacturing industry, towards high-end development, to protect the development of small and medium-sized enterprises, reduce taxes, large enterprises to take the lead, so that the rapid development of domestic intelligent manufacturing. Foreign countries can do more technological research, open and innovate more emerging technologies, so as to benefit the whole world, achieve international win-win and common development.

About the Author

Peiying Yang, Master, Research direction: Intelligent manufacturing.

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