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A Frontier Exploration of Translation Industry Research in the Age of Artificial Intelligence

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Abstract

To understand the current status, hotspots, and future development trends of translation industry research in the age of artificial intelligence (AI) both in China and internationally, this paper uses the Chinese Academic Journals Database of CNKI (China National Knowledge Infrastructure) and the Web of Science (WoS) Core Collection as data sources. With the CiteSpace knowledge map analysis tool, this paper conducts a visual analysis of literature in the field of AI translation industry research. The results show that: (1) AI translation industry research is booming, with the annual number of publications showing an overall upward trend. Multiple author collaboration teams have formed, but there is a lack of cooperation among these teams, and a core author group has yet to emerge. (2) Published literature is largely confined to the discipline of Chinese Language and Linguistics. A multidimensional, multidisciplinary, and multilingual research framework needs to be established to gain attention and recognition from both Chinese and international academia. (3) The current hotspots of Chinese and international research are concentrated in four aspects: translation models, translation education, customer relations, and AI technologies. (4) Chinese literature tends to follow a research trajectory influenced by policy, and English literature evolves rapidly, marked by advanced technical complexity and a variety of experimental approaches. Research on human-machine ethics, digital humanities and translation, and deep neural network applications in the translation industry will be future research trends of Chinese and international research on the translation industry in the age of AI.

Keywords

Translation industry; Artificial intelligence; CiteSpace; Bibliometrics; Visual analysis

Introduction

With the rapid development of technology, artificial intelligence (AI) has gradually permeated all aspects of social life, including the translation industry. The application of technology in the translation field, such as ChatGPT, Gemini, iFLYTEK translation machines, and neural machine translation (NMT), not only has changed the traditional working mode of translation but also has a profound impact on translation quality, efficiency, and the industry ecosystem.

In recent years, the Chinese government has implemented a series of major policies in the AI field. For example, t*he Outline of the 14th Five-Year Plan (2021-2025) for National Economic and Social Development and Vision 2035 of the People's Republic of China* proposes, "focusing on artificial intelligence and other major innovation areas, we will establish a group of national laboratories and reorganize national key laboratories, thus establishing a laboratory system with a rational structure and efficient operation" (The State Council of the People's Republic of China, 2021).

These policies have not only provided macro-level guidance and support for the application of AI in the translation industry but also stimulated in-depth academic research on the relationship between AI and the translation industry. Besides, policy dynamics at the international level also have a significant impact on the application of AI in the translation field.

Research on the translation industry in the age of AI is increasing day by day, playing an important role in exploring the mechanism of AI translation, and its potential, and formulating relevant policies. However, current Chinese research remains relatively fragmented and lacks systematic and comprehensive analysis, especially in terms of industry development trends. Meanwhile, international research has limited attention to the Chinese translation industry, making it difficult to provide targeted guidance for the development of the Chinese translation industry. Therefore, this paper takes the Web of Science (WoS) Core Collection and the Chinese Academic Journals Database of CNKI (China National Knowledge Infrastructure) as data sources. Utilizing CiteSpace[1], this study conducts an analysis of the annual number of publications, authors, high-frequency keywords, keyword co-occurrence, clusters, timelines, and burst detection related to translation industry research in the age of AI. The aim is to present the Chinese and international research status of this field more objectively and scientifically, analyze the current hotspots and future trends, and provide reasonable suggestions for the future development of the translation industry.

1. Data Sources and Research Methods

1.1 Data Sources

Chinese literature is from the CNKI Chinese total database. The retrieval time is "December 31, 2023". The retrieval field is "literature retrieval", and the retrieval method is "subject terms found" as follows: subject terms = ("Translation Industry") and subject terms = ("AI Translation" OR "Machine Translation"). To ensure data accuracy, the irrelevant, duplicated essays and literature without authors are manually removed. The final Chinese dataset comprises 98 articles.

English literature is sourced from the WoS Core Collection. The search, with the same retrieval time on December 31, 2023, utilizes "topic" as the limit: topic = ("translation industry") and topic = ("AI translation" or "machine translation"). Manual screening is employed to eliminate irrelevant, duplicated, or non-research materials (e.g., news). The final English dataset which consists of 257 articles, is exported as plain text files, including full citations and references.

The cross-database comparison allows for a more nuanced understanding of the commonalities and differences in AI's impact on the global translation industry.

1.2 Data Processing

WoS data is exported as plain text files, while CNKI data is exported in RefWorks format. CiteSpace 6.2.R4 is used for visual analysis of both Chinese and English literature. The time range for Chinese literature is set to 2005-2023, and 2010-2023[2] for English literature, with one year per slice. Node types include author, institution, and keyword. The default threshold is retained. Network pruning combines "pathfinder" with "pruning the merged network". Finally, "go" is clicked to generate the visualization.

2. Fundamental Information

2.1 Annual Publication Volume

This study analyzes the annual publication volume of translation industry research in the age of AI, both in China and globally, using year-by-year data to illustrate publication trends.

Figure 1 shows that 98 Chinese articles can be categorized into three phases: Phase 1 (2005-2016), an exploratory phase with fewer than 5 publications annually; Phase 2 (2017-2020), a period of rapid growth, peaking at 17 publications in 2020. Phase Three (2021-2023), a shift towards a slower research trajectory in China. Following sixteen years of growth, it is characterized by a decline in scholarly output with 7 publications in 2023.

Figure 2 shows that 257 English articles exhibit a fluctuating upward trend from 2010 to 2023. Publications

[1] Visual Analytic Studies of Science, Citespace 6.2.R4 advanced edition, download website: https://citespace.podia.com/.
[2] The starting time for both datasets in the software corresponded to the year of the first publication related to translation industry research in the AI era.

remained low (under 5 annually) from 2010 to 2015, but steady growth began in 2016, culminating in a peak of 48 publications in 2023. This reflects the sustained interest in translation industry research in the AI era within the English academic community.

Overall, globally relevant research exhibits a robust and ongoing development, as evidenced by a consistently increasing number of annual publications. However, the academic impact of relevant research in Chinese requires further enhancement.

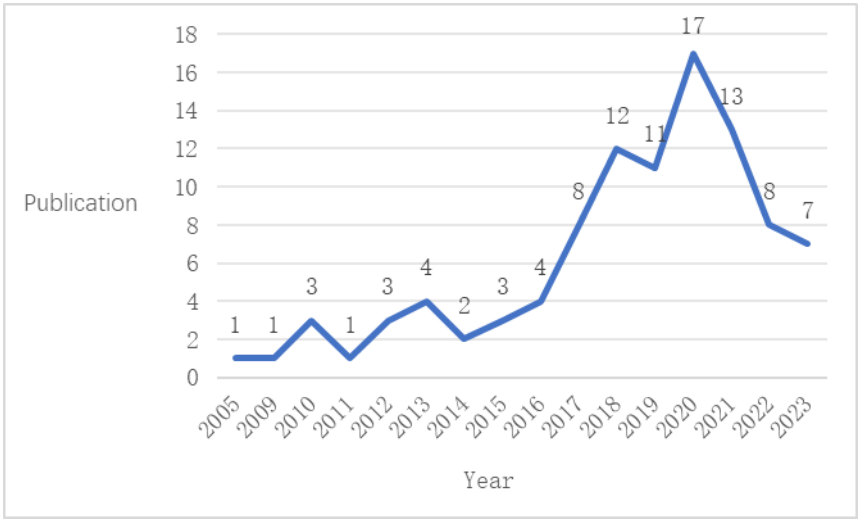

Figure 1. Annual Publication Trend in CNKI.

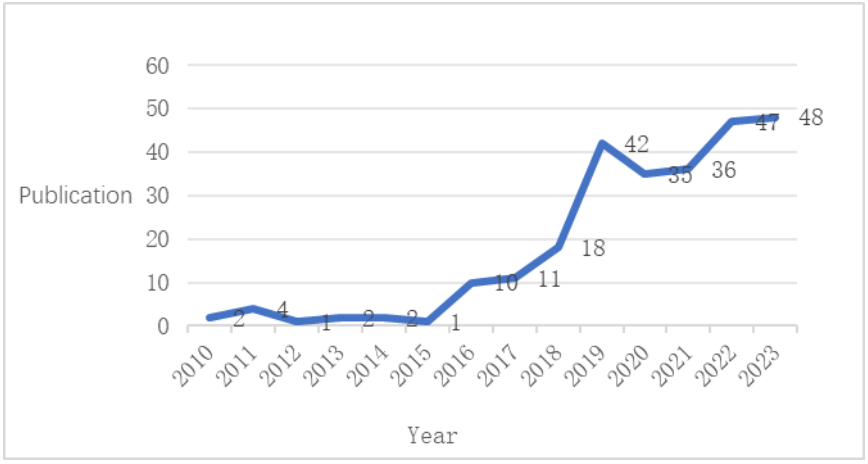

Figure 2. Annual Publication Trend in WoS Core Collection.

2.2 Disciplinary Distribution

This study analyzes the disciplinary distribution of literature on translation industry research in the age of AI, comparing data from the CNKI database for Chinese literature and the WoS database for English literature. The findings reveal significant differences in disciplinary focus between the two datasets.

CNKI literature indicates that 68% of relevant Chinese literature originated from the field of Chinese Language and Linguistics, with 8% from foreign languages, 8% from computer software and applications, 7% from automation technology, 6% from higher education, and the remaining 4% from other disciplines. This demonstrates a strong dominance of language and linguistics, particularly Chinese language and linguistics, highlighting its crucial role in both Chinese-to-foreign and foreign-to-Chinese translation. In contrast, the contribution from computer science and automation is considerably smaller.

Figure 4 illustrates the disciplinary distribution of English literature on translation industry research in the AI era

from the WoS database. The distribution is relatively even, with no single discipline dominating. The top four disciplines are: “Computer Science Theory& Methods” (20.46%), “Computer Science Artificial Intelligence” (17.76%), “Computer Science Information Systems” (14.29%), and “Linguistics” (14.29%), etc. This indicates a stronger emphasis on computer science compared to the Chinese literature, where linguistics, especially Chinese linguistics, held a significantly larger share. Noteworthy is that linguistics ranked only third/fourth in the English literature dataset.

In summary, the analysis reveals a marked difference in disciplinary focus between Chinese and English literature on translation industry research in the AI era. Chinese literature from CNKI shows a strong emphasis on language and linguistics, exceeding half of the total, while the contribution from computer science and automation is limited. This suggests a more comprehensive, multi-dimensional, and multilingual research framework is yet to be fully established. In contrast, the English literature from WoS exhibits a more balanced disciplinary distribution, with a prominent role in computer science research.

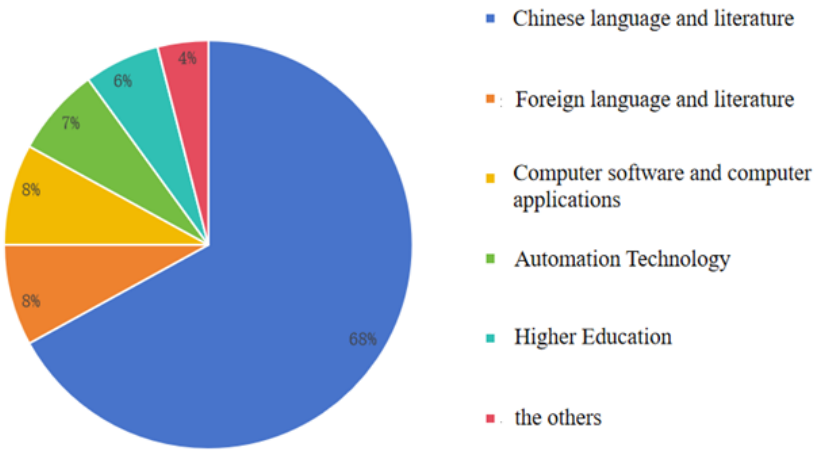

Figure 3. Disciplinary Distribution in CNKI.

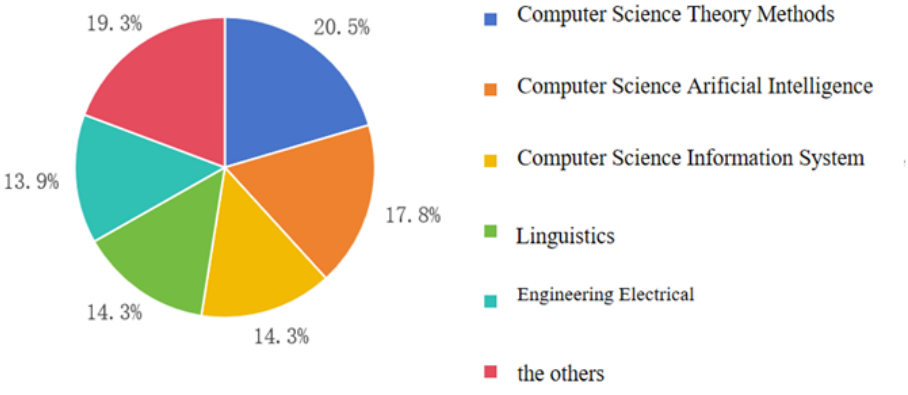

Figure 4. Disciplinary Distribution in WoS Core Collection.

3. Analysis of Author Collaboration Network

Analyzing highly influential authors and their collaborators in a given research field provides valuable insights into the research trends and collaborative patterns within that field. Scientific collaboration is defined as researchers working together towards the common goal of producing new scientific knowledge (Katz & Martin, 1997). Analysis of this part focuses solely on the co-authorship network provided by CiteSpace.

Through CiteSpace, the author's collaboration network is visualized within the CNKI dataset. Using “author” as the node type, key collaborative relationships were illustrated, enabling analysis of academic contributions, status,

and collaboration within the field. Nodes=111 and Edges=55, resulting in a low density (0.009). This indicates a loose connection and limited collaboration among Chinese authors. Further analysis uses Excel (Table 1) to show the top 6 authors by publication volume. Cui Qiliang leads with 4 essays, followed by Qin Meijuan and Wang Huashu with 3 each. This suggests Cui Qiliang's significant contribution to this field. Applying Price's Law ($M \approx 0.749 * \sqrt{4} = 1.498$), the core authors comprise 6 persons listed in Table 1. However, their publications (16 articles) are less than 50% of the total (98 articles), indicating that a core author group has not yet fully formed.

Analysis of the WoS dataset reveals 280 authors, with Benko, Ľubomir leading with 3 essays. The knowledge graph consists of 329 nodes, 545 links, and a density of 0.0101. The low network density indicates limited collaboration among authors. Applying Price's Law ($M \approx 0.749 * \sqrt{3} \approx 1.3$), the authors listed in Table 2 with 2 or more essays are considered core authors in this field. However, their publications (37 articles) account for less than 50% of the total (257 articles), indicating that a core author group has not yet fully formed either.

In summary, several author collaboration teams have emerged in the field of translation industry research in the AI era, but there is a lack of collaboration among teams, and a core author group has yet to solidify. Cui Qiliang, Qin Meijuan, Wang Huashu, and Ľubomír Benko, warrant particular attention.

Table 1. Authors with two or more published papers in CNKI

No.	Author(s)	Publications
1	Cui Qiliang	4
2	Qin Meijuan	3
3	Wang Huashu	3
4	Xiao Weiqing	2
5	Wang Shaoshuang	2
6	Li Yan	2

Table 2. Authors with two or more published papers in WoS Core Collection

No.	Publications	Author(s)	No.	Publications	Author(s)
1	3	Benko, L' ubomir	10	2	Munk, Michal
2	2	Alonso, Elisa	11	2	Munkova, Dasa
3	2	Boehm, Igor	12	2	Ramasamy, Vijayalakshmi
4	2	Cheluszka, Piotr	13	2	Sakamoto, Akiko
5	2	Franke, Bjoern	14	2	Singh, Maninder
6	2	Gao, Huiji	15	2	Subedi, Ishan Mani
7	2	Guo, Weiwei	16	2	Topham, Nigel
8	2	Kyle, Stephen	17	2	Walia, Gursimran Singh
9	2	Long, Bo	18	2	Zhang, Min

4. Research Hotspots, Frontiers, Evolutionary Paths, and Co-word Analysis

This section uses keyword co-occurrence, cluster, timeline, and burst detection analysis to comprehend the hotspots, frontiers, and evolutionary paths of translation industry research in the age of AI.

4.1 Keyword Co-occurrence Analysis

Co-word analysis employs a statistical methodology based on the frequency of pairwise co-occurrences of terms within a defined corpus. The resulting co-occurrence counts are interpreted as indicators of semantic relationships between the terms (Li & Chen, 2017). CiteSpace is used to calculate the frequency and centrality of each keyword, generating keyword co-occurrence maps. The co-occurrence analysis of keywords in Chinese literature results in a

map[3] with 105 keywords, 127 links, and a network density of 0.0233. Table 3 lists all keywords with a frequency of 3 or more in CNKI literature in the field of translation industry research in the era of artificial intelligence. Excluding retrieval subject words "translation industry", "artificial intelligence", and "machine translation", the keywords that appeared 6 or more times are "translation technology" and "human translation".

The analysis shows that "post-editing" and "translation technology" are core nodes and research hotspots in Chinese literature. "Post-editing" (0.11) exhibits high intermediary centrality, indicating its importance in information dissemination within this field.

The co-occurrence analysis of keywords in English literature results in a map with 290 keywords, 592 links, and a network density of 0.0141. Table 4 lists all keywords with a frequency of 3 or more in WoS literature in the field of translation industry research in the era of artificial intelligence. Excluding "artificial intelligence" and "machine translation", keywords that appeared 10 or more times include "machine learning", "deep learning", and "natural language processing". "Deep learning" (0.27) and "machine learning" (0.28) are core nodes, indicating that research hotspots are in the AI deep learning field. These keywords also have the highest betweenness centrality.

Overall, research hotspots in the translation industry in the age of AI focused on the field of "AI deep learning", "post-editing", and "translation technology". "Post-editing" plays a crucial role in information dissemination in Chinese literature, and "deep learning" and "machine learning" are the main hotspots in English literature.

Table 3. CNKI Keywords with Frequency ≥3

No.	Keywords	Frequency	Centrality	No.	Keywords	Frequency	Centrality
1	Translation Technology	12	0.08	6	Human Translation	6	0.06
2	Machine Translation	12	0.26	7	Post-editing	4	0.11
3	Translation Industry	8	0.21	8	Internet Plus	3	0.03
4	Translation	7	0.15	9	Translation Study	3	0.03
5	Artificial Intelligence	7	0.24	10	Language Service	3	0.06

Table 4. Keywords with Frequency ≥3 in WoS Core Collection

No.	Keywords	Frequency	Centrality	No.	Keywords	Frequency	Centrality
1	machine learning	34	0.28	13	classification	4	0.04
2	machine translation	33	0.3	14	data science	4	0.02
3	artificial intelligence	20	0.5	15	identification	3	0.11
4	deep learning	13	0.27	16	artificial neural networks	3	0.1
5	natural language processing	10	0.12	17	adoption	3	0.03
6	technology	8	0.11	18	framework	3	0.03
7	neural networks	8	0.06	19	machine vision	3	0.03
8	design	6	0.18	20	task analysis	3	0.01
9	quality	5	0.07	21	deep neural networks	3	0.01
10	translation technology	5	0.01	22	big data	3	0
11	statistical machine translation	4	0.21	23	natural language understanding	3	0
12	translation	4	0.05	24	neural network	3	0

[3] Due to space limitations, relevant visual figures are omitted from this section.

4.2 Keyword Cluster Analysis

Keyword cluster maps summarize the similarity among keyword nodes, grouping nodes with clear co-word relationships to accurately depict research frontiers. Figures 5 and 6 are keyword co-occurrence cluster maps, further exploring the main themes and their relationships in the translation industry research in the AI era. The distance between nodes reflects the similarity (including time and theme); closer nodes indicate higher similarity (Gong, 2019).

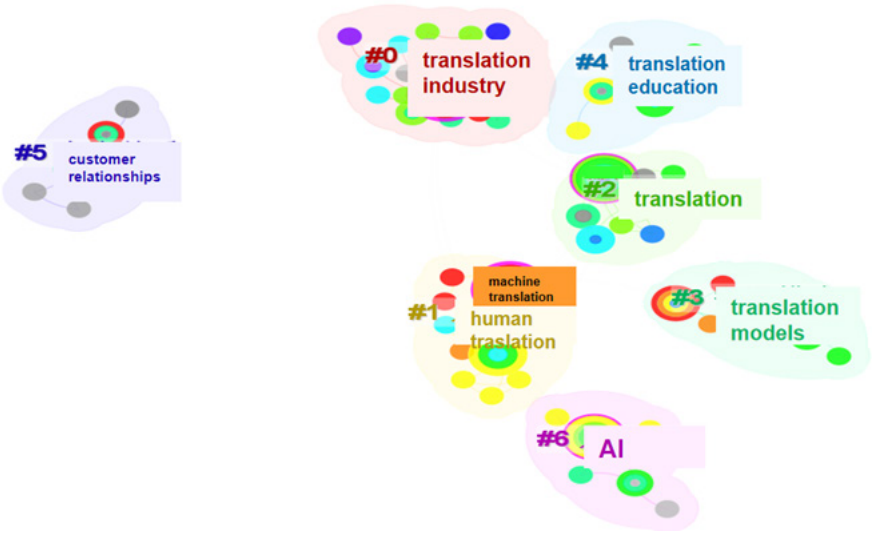

Figure 5. Keyword Cluster Map of Literature in CNKI.

Cluster analysis of 120 keywords from Chinese literature using the LLR algorithm (Figure 5) yields a modularity value (Q) = 0.831 and an average silhouette value (S) = 0.9183, indicating efficient and reliable clustering. 31 effective clusters are generated, summarizing four core themes: translation models, translation education, customer relationships, and AI. Overlapping clusters suggest close relationships among them (Xiao et al., 2023).

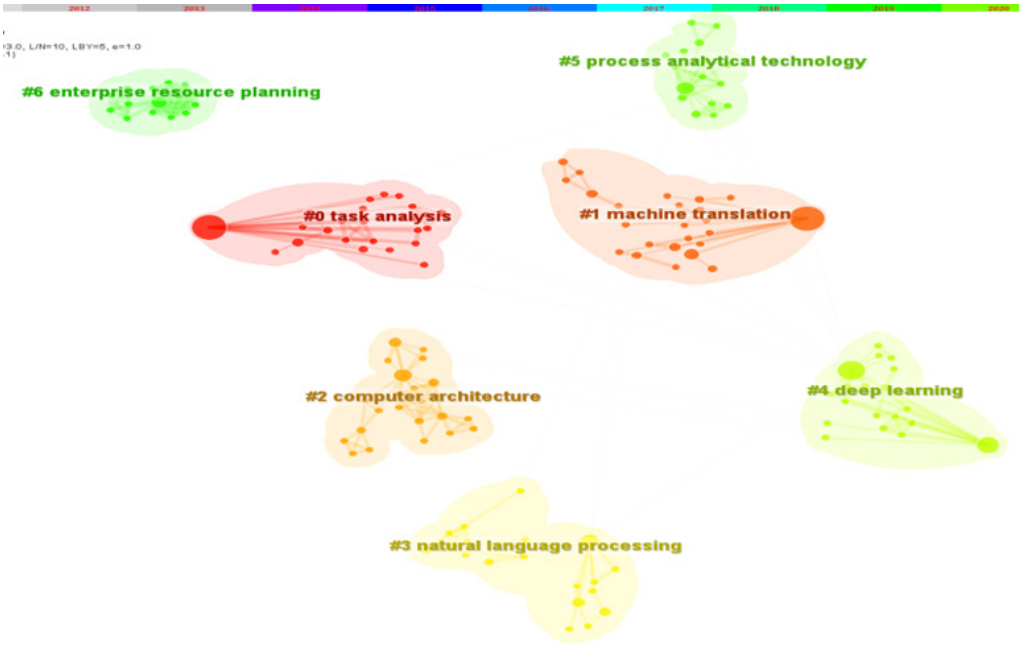

Figure 6. Keyword Cluster Map of Literature in WoS Core Collection.

LLR cluster analysis of 290 keywords from English literature yields 17 effective clusters (Q = 0.894, S = 0.9384). The seven largest clusters (Figure 6) are: #0 Task analysis, #1 MT, #2 Computer architecture, #3 Natural language processing, #4 Deep learning, #5 Process analytical technology, and #6 Enterprise resource planning. English literature themes are more focused, concentrating on AI technologies. The lack of overlapping clusters indicates looser relationships.

Chinese literature shows close relationships among research focuses, but English literature displays looser connections. The core themes in Chinese literature are translation models, translation education, customer relationships, and AI, while English literature focuses on AI technologies (natural language processing, deep learning, process analytical technology).

4.3 Timeline Cluster Analysis

Keyword timeline maps can visually show keyword evolution. Figure 7 shows that basic keywords like "translation industry" and "translation technology" emerged earliest and frequently co-occur with the latest keywords, demonstrating their lasting influence. Keywords like "Belt and Road", "Go Out policy", "customer relations", and "public signs" show a decline in research interest after 2020. Keywords like "digital society" and "translation ethics" first co-occurred in 2023, indicating emerging research directions.

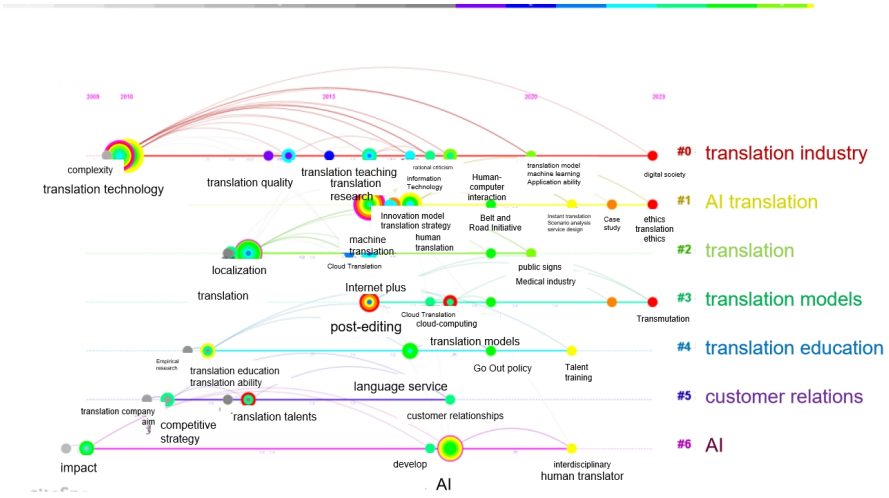

Figure 7. Keyword Timeline Cluster Map in CNKI.

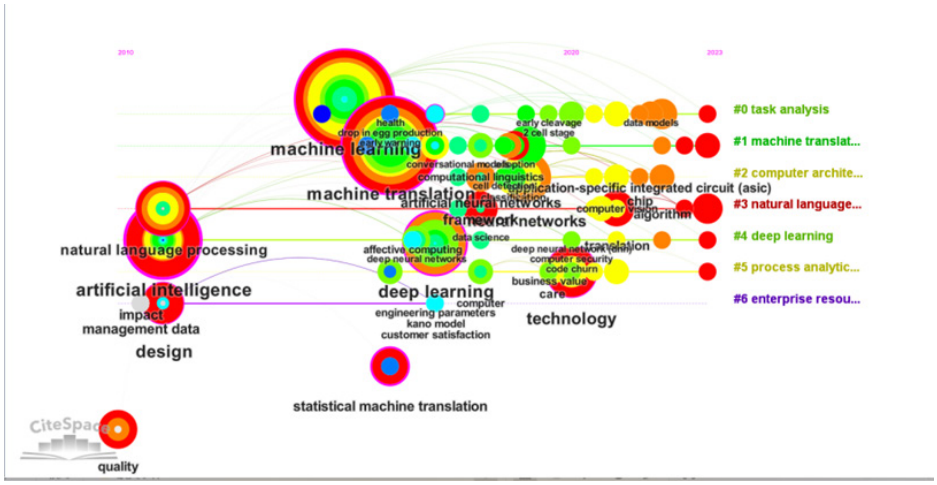

Figure 8. Keyword Timeline Cluster Map in WoS Core Collection.

Figure 8 shows that basic keywords like “natural language processing” and “AI” emerged earliest and frequently co-occur with the latest keywords, demonstrating their lasting influence. Besides, the research topics of “machine learning” and “MT” display the highest level of sustained attention. After 2020, “deep neural networks” gain prominence as a key method for improving AI translation quality.

Overall, significant research outcomes accumulate from 2016 to 2023, with strong continuity among the research topics. “Translation industry”, “translation technology”, “impact”, “natural language processing”, and “AI” have a lasting influence. Ethical issues and the development of deep neural networks warrant high attention.

4.4 Keyword Burst Detection Analysis

Keyword burst detection maps can vividly illustrate the surge of specific topics within a research field over time, aiding in the identification of significant shifts in research hotspots and their underlying mechanisms (Xiao & Li, 2020). To track the turning points in the translation industry research during the AI era, this study utilizes CiteSpace’s burst detection function to analyze keyword bursts, excluding the subject terms used for retrieval.

The keyword burst detection map for Chinese literature (Figure 9) reveals eight keywords. The map contains the first appearance year of the keyword (Year), the start and end years of the keyword as a burst (Begin and End), and the burst strength (Strength). Higher strength indicates greater attention. Red lines represent the period during which a keyword becomes a research hotspot, light blue lines indicate the absence of the node, and dark blue lines signify the emergence of the node. This allows for the identification of the rise and fall of keywords within specific timeframes. The rapid changes within a short period also highlight the rapid evolution of hotspots in this field. Figure 9 reveals that the research hotspots from 2016-2018 focused primarily on translation quality and the Internet+. The emergence of “cloud computing” as a hotspot in 2018-2019 may be linked to the release of *the Three-year Action Plan for Cloud Computing Development (2017-2019)* (The Ministry of Industry and Information Technology, 2017). From 2021-2023, the focus shifted to post-editing, potentially influenced by the release of the GB/T 40036-2021 *Translation services—Post-editing of machine translation output—Requirements* (Language and terminology, 2021). This standard, the first national standard for post-editing in China’s translation industry, provides a foundation for regulating and guiding the healthy development of the translation field. This phenomenon can be summarized as “policy first, research follows”, reflecting the policy-driven and practical nature of translation research in the AI era.

Figure 10 presents the keyword burst detection map for English literature. The timelines reveal that the research hotspots from 2010-2011 are “working unit”, “mining machine”, “pickbox setting”, and “stereometric parameters measurement”. From 2011-2013, the research frontiers were “dynamic binary translation” and “just-in-time compilation”. The focus shifted to “identification” from 2014-2017, followed by “deep learning” from 2018-2020, “technology” from 2020-2021, and finally “neural networks” from 2021 onwards, which exhibits the highest attention among all research frontiers since 2010. This indicates a more rapid and multifaceted evolution of research frontiers in English literature on translation industry research in the AI era, often involving complex experiments and higher technical challenges.

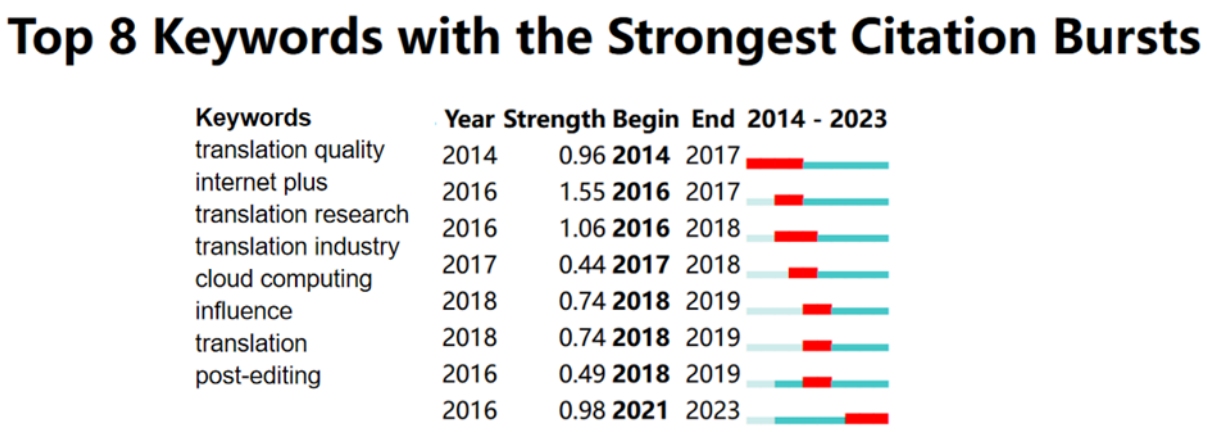

Figure 9. Keywords Burst Detection Map in CNKI.

In conclusion, the analysis reveals a significant difference in the evolution of research frontiers between Chinese and English literature on translation industry research in the AI era. Chinese literature exhibits a policy-driven and practical research trajectory, English literature shows a faster-paced evolution of research frontiers, characterized by a greater number of phases and a higher degree of technical complexity involving various experiments. The research frontiers in Chinese and English literature on the translation industry in the age of AI differ considerably.

Figure 10. Keywords Burst Detection Map in WoS Core Collection.

5. Conclusion

By employing a visual analytic approach to review the literature pertaining to translation industry research in the age of AI, the key future research directions are as follows.

5.1 Human-Machine Ethics

Translators' actions are influenced by their thoughts, ideologies, and values, reflecting underlying ethical systems' work. Conflicts in translation activities are inherently ethical issues, including translator responsibility, privacy protection, political sensitivity, and cultural respect. While early research focused on interpersonal ethics, future research should focus more on human-machine ethics to establish ethical frameworks to guide translator activities and criticism, promoting the discipline of translation ethics in the AI era (Li, 2023).

5.2 Digital Humanities and Translation

Digital humanities (DH) emerged from the intersection of computer science and the humanities, aiming to foster interdisciplinary talents. In 2024, Fudan University successfully launched four interdisciplinary undergraduate programs that combined foreign languages (English, German, Russian, and translation) with computer science. These programs will award graduates with both Bachelor of Arts and Bachelor of Science degrees, which marks a significant advancement in interdisciplinary education. However, this model is still in its nascent stages, and numerous methods for future relevant research remain. Therefore, we suggest further research into "computer science + translation" talent training modes, focusing on effective human-computer collaboration to enhance translation efficiency and promote innovative integration between "new humanities" and "new engineering". This approach could unlock significant potential for innovation in translation practices.

5.3 Deep Neural Network Applications in the Translation Industry

Currently, neural machine translation (NMT) demonstrates suboptimal performance in translating literary works, primarily due to practical engineering limitations and the model's autonomous comprehension constraint. Future research could focus on refining the model architecture and improving the attention mechanism to enhance its performance (Yang & Wang, 2020). A deep exploration of deep neural network applications in translation and their potential impact on human translators is warranted. This includes research into real-time interpretation systems based on deep neural networks. Such advancements hold the potential to facilitate a significant breakthrough in translation

technology.

In conclusion, research on the translation industry in the AI era is still to be growing. Relevant Chinese and international research hotspots focus on translation models, translation education, customer relationships, and AI technologies. Chinese literature exhibits a policy-driven and practical research trajectory, while English literature shows a faster-paced evolution of research frontiers, characterized by a greater number of phases and a higher degree of technical complexity involving various experiments. Future research should prioritize human-machine ethics, digital humanities and translation, and deep neural network applications in the translation industry, aiming to enhance research quality and provide suggestions for government policy, thereby fostering rapid growth in the translation industry.

Funding

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