

Research Hotspots and Cutting-Edge Discussions on Data Element Configuration: Analysis Based on Bibliometric Method and Knowledge Graph

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Abstract: In the era of digital economy, the strategic value of data as a key production factor has become increasingly prominent, and its efficient allocation has become a core issue driving economic growth and social governance innovation. This paper employs bibliometric analysis and knowledge mapping techniques to analyze literature from the Web of Science and CNKI databases, constructing a topic co-occurrence network, keyword evolution path, and author collaboration map. It systematically reviews the research trajectory and frontier trends in the field of data element allocation both domestically and internationally. The research findings are as follows: (1) data governance, data ownership confirmation, production factors, frontal crash reconstruction, and federal interagency are the current core focuses of research. (2) Data assetization, scenario-based configuration models, and digital economy governance systems are emerging as cutting-edge exploration directions. (3) the field is showing a trend of interdisciplinary integration, with a multitude of innovative achievements emerging in the intersection of economics, law, and computer science. This study provides theoretical references for policymakers to improve the market-oriented allocation system of data elements.

Keywords: Data Elements; Data Element Configuration; Bibliometrics; Knowledge Graph; Hotspots and Trends

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1.Introduction

As a core resource in the era of digital economy, the efficient allocation of data elements through orderly circulation and in-depth development has given rise to new economic forms of digitization, networking and intelligent integration, and has played a key role in reconfiguring the value chain of traditional industries and accelerating the fusion of digital technology and the real economy. This efficiency improvement has become the core driving force for unleashing productivity potential and shaping new competitive advantages^[1,2]. Under the digital era, the global digital transformation process is accelerating and technology is constantly evolving, and the importance of data, as a new form of supporting network systems in digital transformation, is becoming increasingly prominent^[3]. The new elements have given rise to new needs, promoting closer inter-regional connections and synergies under the data and information linkage^[4]. However, the current global level of data factor allocation is still relatively weak, facing challenges such as imperfect trading mechanisms, difficulties in asset valuation and pricing, data barriers and the phenomenon of silos, data security and privacy protection issues, as well as the unbalanced construction of digital information infrastructure, and insufficient capacity for independent control of core technologies

[5]. Therefore, how to play an efficient role in the allocation of data elements has become an important hot issue for the government and academia.

Since 2016, there has been an increasing abundance of research on the topic and perspective of data elements, with an increasing trend of academic research output. In general, many insights have been provided on the utilization of data factor allocation in the digital era. In order to systematize the development and trend of the field of “data factor allocation”, this article is based on the research results from China Knowledge Network (CNN) and weibo.com. The article takes the research papers on the topic of “data factor allocation” published in China Knowledge Network and web of science in the past 10 years as the object, and utilizes the bibliometric and knowledge mapping methods to sort out the trend of publication and explore the evolution path of the research hotspots, so as to provide a reference for the future research.

2. Research data and methodology

2.1 Data sources

The article selects China Knowledge Network (CNKI) and Web of science (WOS) domestic and international core anthology databases as the source of literature, and the search time is up to February 2025. In the CNKI database, 604 articles were retrieved by direct search with “data elements” as the title or keywords highly relevant to the topic of “data element configuration”, and 556 articles were retrieved after manual screening, spanning the period from 2016 to 2025. In Web of Science, 604 articles were retrieved with “Data elements” as the title or keywords highly relevant to the topic of “data element configuration”. 2025. In Web of Science, we searched the literature with “Data element” as the title or “Data element configuration” as the keyword, and eliminated the literature that was not related to the research topic. The total number of literature obtained was 228, excluding those that were not related to the research topic.

2.2 Research methodology

The article combines bibliometrics and knowledge graph technology to mine and analyze multiple knowledge nodes and their logical relationships through network structuring and graph visualization at . Through the integration of knowledge mapping technology and bibliometrics, the powerful computing power and intuitive graph form can statistically and reveal the evolution dynamics, research hotspots and potential trends of a certain subject area [6]. Based on this, the article explores the research lineage and development frontiers of data element configuration with the help of CiteSpace software. At the same time, in order to reduce the possible bias of the analysis results of CiteSpace software, the article combines the traditional literature combing method, combines the quantitative analysis results of CiteSpace with the subjective analysis of the traditional literature, in order to comprehensively, systematically, and objectively present the development dynamics and characteristics of the field [7]. The specific principles are detailed in Ref.

3. Statistical analysis of communications

3.1 Distribution of publications

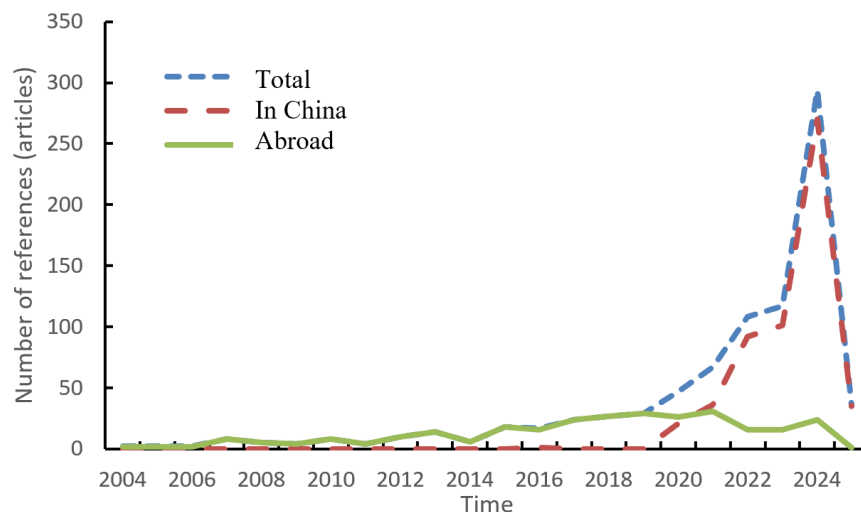
As a key indicator for assessing the activity level of a research field, the time series distribution of the number of articles can intuitively map out the development trajectory and stage characteristics of the field, which provides an important reference basis for in-depth investigation of research hotspots and scientific prediction of the future development direction. According to the analysis of the core collection of articles collected by CNKI and WOS, it is found that since 2004, the field of data element configuration has shown an obvious upward trend. Specifically, as shown in Figure 1.

From Figure 1, it can be found that foreign research in this field is more important than domestic, although in 2004 foreign scholars began to pay attention to this field, but the growth rate of the number of publications after that is relatively flat. However, for the domestic, although the domestic start is late, in 2016 only began to publish the core journals in this field, but after 2019, the number of domestic literature is growing rapidly, and the distance with the level of foreign research in the same period has widened.

For the country, 2019 and 2023 are two important time turning points. In October 2019, the Fourth Plenary Session of the 19th CPC Central Committee proposed for the first time to incorporate data into the socialist market economic system as a new factor of production, which promoted in-depth research on data factors in academia, and the number of related researches

increased rapidly. In 2023, the “Opinions of the Central Committee of the Communist Party of China and the State Council on Constructing a More Perfect Factor Market-based Allocation In 2023, the Opinions of the CPC Central Committee and State Council on Constructing a More Perfect Institutional Mechanism for the Marketized Allocation of Factors was released, which further stimulated the enthusiasm of the academic community, causing the growth rate of the number of articles issued from 2023 to 2024 to reach a peak.

Figure 1 Statistical distribution of the number of publications



3.2 Analysis of national and international literature sources, institutions and authors

With the help of Cite Space 6.3 software to extract the publication information, the top 10 journals in terms of the number of literature in the field of data element configuration were analyzed in the WOS and CNKI databases during the period of 2004-2025, and the results are shown in Table 1.

In the WOS database, Sustainability Journal contains the most literature in the field of data element configuration, totaling 25 articles. 12 articles each from JAMIA and Traffic Injury Prevention, and a total of 8 articles from BMJ Open. In the CNKI database, on the other hand, the literature in the field of data element configuration was mainly from EGovernment, Statistics and Decision Making, Books and Intelligence, Journal of Information Resources Management, and Science and Technology Progress and Countermeasures, which were relatively less dispersed.

Table 1 Top 10 journals in WOS and CNKI databases that contain literature in the field of data element configuration

Literature sources	Article Count	Literature sources	Article Count
Sustainability	25	E-Government	23
JAMIA	12	Statistics and Decision Making	17
Traffic Injury Prevention	12	Library and Information	15
BMJ Open	8	Journal of Information Resource Management	14
J NURS SCHOLARSHIP	6	Technological Progress and Countermeasures	11
IEEE Template	4	Information Intelligence Theory and Practice	11
ARCH PHYS MED REHAB	4	Management Review	9
CIN	4	Business Research	9
J NEUROTRAUM	4	Shanghai Economic Research	9
JAIS	3	Jiangxi Social Sciences	8

The analysis of the number of papers issued by research institutions shows that Chinese research institutions are more active in publishing research articles on data element allocation in Chinese journals, up to 13. The main institutions include the School of Economics and Management of Northwest University, the School of Management of Wuhan Information University, the School of Information Resources Management of Renmin University of China, and the Big Data Development Department of the National Information Center. From the perspective of cooperation relationships among domestic research institutions (Figure 2 (a)), the figure contains 169 nodes and 107 connections, indicating that the cooperation circle is closely connected. Internationally, WOS data shows that research institutions are more active in publishing in this field, with institutions with higher publication volumes including the National Institutes of Health (18 articles), University of California (14 articles), Harvard University (12 articles), Ohio University (11 articles), and University of Texas (10 articles). From the analysis of cooperation relationships among global scientific research institutions (Figure 2 (b)), the graph contains 294 nodes and 687 connections, indicating a higher density of institutional cooperation networks and closer connections within the cooperation circle compared to China.

Figure 2 Research institution publication volume chart

(a) Obtained from CNKI



(b) Obtained from WOS



An analysis of the CNKI database shows that in the field of data factor allocation research, Chinese scholars Ouyang, Rihui (9 articles), Chen, Bing (8 articles), Wang, Jiandong (6 articles), Lin, Zhenyan (5 articles), Yu, Liuyi (5 articles), Xia, Yikun (5 articles), and Huang, Qianqian (5 articles) are more prominent in the number of articles published. From the analysis of WOS database, Abdallah, Chadi G (4 articles), Austin, Joan K (3 articles), Bailey, Donald E (3 articles), Bakken, Suzanne (2 articles), Barton, Debra (2 articles), and Corazzini, Kirsten (2 articles) have published more papers in this field with a high number of publications.

3.3 Cooperation between countries and regions

Interregional exchanges and cooperation have helped to deepen the breadth and depth of research. As of February 2025, 54 countries have participated in research in the field of data factor allocation. There are significant differences in the number of publications across countries (Table 2), with the United States leading with 91, followed by China (41), England (22), Australia (17), the Netherlands (17), and Italy (13). The country cooperation mapping (Fig. 3) showed a total of 54 nodes and 167 connecting lines, with a network density of 0.1667, indicating that cooperation exists between most countries, but their connections are not strong.

Table 2 Top 10 countries in terms of number of publications in the area of data factor allocation

Nations	Article Count	Proportion
USA	91	31.06%
China	41	13.99%
England	22	7.51%

Nations	Article Count	Proportion
Australia	17	5.80%
The Netherlands	17	5.80%
Italy	13	4.44%
Canada	12	4.10%
Germany	10	3.41%
Switzerland	10	3.41%
Brazil	8	2.73%
Other countries	52	17.75%
Total	293	100.00%

Figure 3 Mapping of country cooperation in the area of data factorization

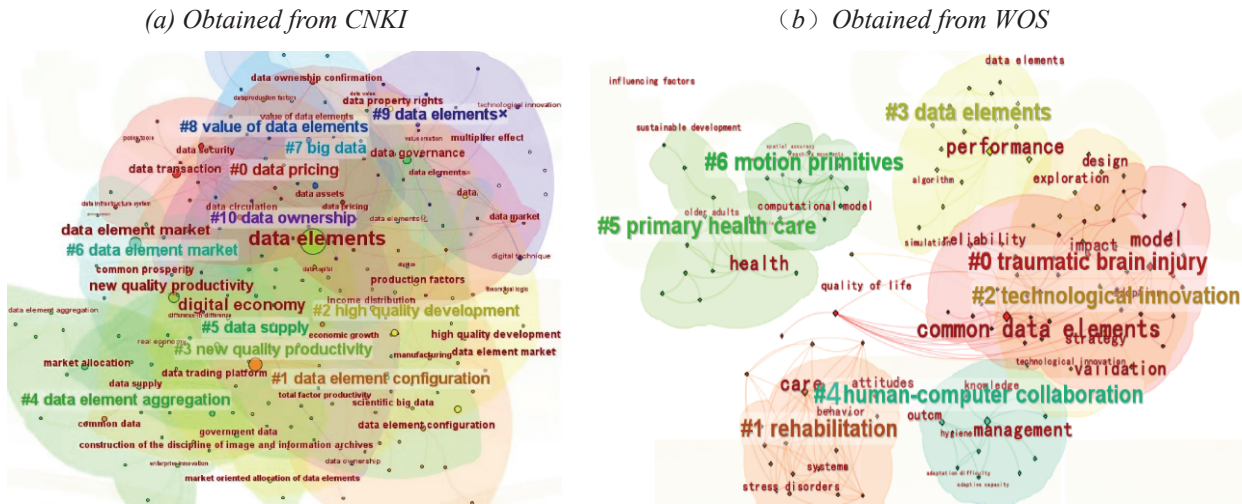


3.4 Differences in research hotspots in China and abroad

Through CiteSpace analysis, a keyword clustering map of data element configuration was generated (Figure 4). For domestic literature (Figure 4a), the map contains 240 nodes and 500 connections, with a density of 0.0174, a Q value of 0.5226, and an S value of 0.9324. The clustering results are reasonable and of research value. The clustering results show that keywords such as “digital economy”, “data governance”, “data confirmation”, “production factors”, and “income distribution” are located at the center of the cluster, forming seven main clusters, including data pricing (#0), data element configuration (#1), high-quality development (#2), net quality of productivity (#3), data element aggregation (#4), data supply (#5), data element market (#6), big data (#7), value of data elements (#8), data elements x (#9), and data ownership (#10).

The keyword map of foreign literature (Figure 4b) comprises 280 nodes and 549 connections, with a density of 0.0141, a Q value of 0.8641, and an S value of 0.9649. The clustering effect is good, and the results are reasonable. In the keyword clustering map of foreign literature, keywords such as “frontal crash reconstruction”, “federal interagency”, “toe framework-a”, and “visual workspace” are at the center of the clusters. A total of six clustering results are obtained, including traumatic brain injury (#0), rehabilitation (#1), technological innovation (#2), data element (#3), human-computer collaboration (#4), primary health care (#5), and motion primitives (#6).

Figure 4 Keyword co-occurrence mapping



4. Discussion

4.1 Literature review of data factor allocation

By analyzing and comparing the results of the data factor allocation literature obtained from two different literature databases, it is possible to classify the research on data factor allocation into four phases, namely, the early exploration phase, the theory and market research phase, the empirical analysis and application phase, and the future outlook phase.

4.1.1 Early Exploratory Phase

In the early exploration stage (2015-2017), scholars preliminarily explored the importance and definition of data as a new production factor, focusing on understanding the basic principles and potential socio-economic impacts of data element allocation. For example, Zhong et al. ^[11] proposed that from the perspective of data-driven factors, the key to high-quality digital transformation of enterprises lies in optimizing resource allocation through the use of data elements. Soete et al ^[12] pointed out that market-oriented allocation of data elements is a dual combination of “production factor oriented” and “allocation market-oriented”. The key lies in endowing data with the attribute of “commodity” and promoting the transformation of stakeholders from internal closed circulation to cross subject open circulation. These studies have laid an important theoretical foundation for understanding the configuration of data elements.

4.1.2 Theoretical framework and market mechanism research stage

In the research phase of theoretical framework and market mechanism (2018-2020), more scholars have constructed a specific theoretical framework for data factor allocation and analyzed the market mechanism in depth, which provides an important foundation for subsequent research ^[15]. For example, Kishi ^[16] established the “data demand - data supply - data transaction” as the core of the value movement path of “value discovery - value realization - value distribution”. Lai ^[17] built a theoretical framework of market allocation of data production factors with “data demand - data supply - data transaction” as the core, revealing the basic structure of the market, the internal mechanism, and the relationship between data demand, production, and transaction in the digital economy. Haaland et al. ^[18] also pointed out that the use of the Internet plays a positive role in the market allocation of factors of production in agriculture through the mechanism of information access. positive effect.

4.1.3 Empirical analysis and application promotion phase

The phase of empirical analysis and application promotion (2021-2023) has seen the emergence of a large number of empirical studies, which have verified theoretical assumptions and explored practical application scenarios, enriched theoretical understanding and provided scientific basis for policy formulation, for example, Yang’s ^[19] study shows that public data openness can significantly enhance the enterprise’s total factor productivity, and that the local government should improve the environment of openness of data elements to improve the the level of public data openness. The empirical study of Guo ^[20] shows that market-based allocation of data factors significantly enhances urban economic resilience, mainly through improving the efficiency of capital and labor allocation. Both studies emphasize the importance of data trading platforms and their positive impact on regional economic development.

4.1.4 Integrated assessment and future outlook phase

Research in the comprehensive assessment and future outlook phase (2024 to present) focuses more on comprehensively assessing the data element configuration system, predicting future development trends, and emphasizing interdisciplinary cooperation, multidimensional analysis, and long-term planning in order to better respond to the challenges and seize the development opportunities ^[21]. Scholars have attempted to synthesize the research related to data factor allocation, which is mainly categorized into the synthesis on the influencing factors of data factor allocation, the synthesis on data factor allocation itself and the synthesis on the impact of data factor allocation ^[22]. Among them, regarding the synthesis of factors affecting data factor allocation, Yin et al. ^[23] summarize how these points affect data factor allocation from the aspects of market supply and demand mechanism, price mechanism and competition mechanism. In the review on data factor allocation itself, Gereffi ^[24] points out that data factor allocation needs to take into account its characteristics such as non-competitiveness, complementarity, externality and exponential proliferation. The fact that data can be used by multiple users simultaneously without compromising its utility promotes its shareability. The fusion of data from different sources enhances its value, requiring configuration to focus on data diversity and fusion ^[25]. However, data externality may lead to negative effects such as privacy leakage, so privacy protection and regulation need to be strengthened. Meanwhile, the exponential proliferation of data implies that it can generate more new data during its use, requiring configuration systems that can support the continuous growth and iteration of data.

5. Conclusions of the study

5.1 Conclusions of the study

Based on CNKI and WOS databases, using bibliometrics and knowledge mapping methods, the following conclusions are drawn from the literature on the topic of “data factor allocation” in the past 20 years at home and abroad:

First, between 2004 and 2025, the overall upward trend in the number of articles issued. Foreign scholars have taken the lead in focusing on the problem of data factor allocation, and the research has focused on the initial application in the fields of health care, transportation, environment, etc., but the overall growth rate has been flat, and a large-scale research system has not yet been formed. Domestic research lags behind the international, core journal papers were first published in 2016, focusing on policy interpretation and theoretical framework construction, but the number of articles is relatively small, in the exploration period.

Secondly, in terms of keywords, relevant studies cover a wide range of topics, including “data governance”, “digital economy”, “rights-based”, “production”, “production factors” and “revenue distribution”, “frontal crash reconstruction”, “federal crash reconstruction”, and “data governance”. factors” and “distribution of benefits”, “frontal crash reconstruction”, “federal interagency”, and “data governance”. interagency”, “toe framework-a” and “visual workspace”. Among them, data governance and the digital economy are important elements in the area of data factorization.

Thirdly, papers come from a wide range of sources, with a relatively decentralized distribution of authors, but there is close cooperation between highly productive and research-intensive institutions. International research maintains multidisciplinary penetration, and domestic research deepens the integration of theory and practice, but the density of international cooperation networks is low, and there is a need to strengthen cross-regional knowledge flow.

Fourthly, from the content point of view, the research on data factor allocation presents a significant “governance-technology” dual-track differentiation pattern: domestic research takes policy interpretation and mechanism design as the core driving force, and focuses highly on the institutional issues in the market allocation of data factors (e.g., the system of confirming the right, the mode of revenue distribution, and the shape of the digital economy), forming a “policy-driven” research paradigm. The research paradigm is “policy-driven”, with disciplinary crossover focusing on the fields of public management, economics and law, and the methodology focusing on the analysis of policy texts and the design of governance frameworks. International research pays more attention to the technical application scenarios, and carries out empirical explorations around the technological pain points such as medical data sharing, traffic trauma analysis, and human-machine collaboration, which presents a “problem-oriented” research paradigm. The international research focuses more on technology application scenarios and empirical explorations around medical data sharing, transportation trauma analysis,

human-computer collaboration and other technological pain points, presenting a “problem-oriented” feature, with disciplines integrating computer science, medical science, engineering, etc., and a tendency towards quantitative model construction and technological ethical reflections in methodology.

The conclusions are more relevant.

The analysis shows that research attention to the topic of “data factor allocation” is characterized by the following features:

First, strong policy-driven. Domestic research is directly influenced by policy, and the post-2019 literature surge is highly synchronized with policy nodes. International research is more pulled by technological needs (e.g., medical data applications). Second, there are differences in the distribution of disciplines. Domestic focus on governance and economy (e.g., digital economy, rights allocation), journals are concentrated in public management and information management. International focus on technology and social issues (e.g., medical rehabilitation, technological innovation), with a higher proportion of interdisciplinary journals.

Third, the heterogeneity of cooperation networks. The cooperation network of domestic scientific research institutions has begun to take shape but has a low density (169 nodes, 107 connections), while the international cooperation network is more compact (294 nodes, 687 connections), and needs to be strengthened for domestic synergies.

Fourth, research hotspots are stratified. Domestic hot spots revolve around market-oriented allocation mechanisms (such as revenue distribution and multiplier effects), while foreign countries focus on technological application scenarios (such as trauma reconstruction and human-computer collaboration), reflecting the dual-track approach of “governance” and “technology”.

5.2 Shortcomings and Prospects of Current Research

Scholars have different means of defining data factor allocation and measuring the level of allocation, which has triggered many debates on data factor allocation. How to define and measure the configuration level and measurement index of data elements has not yet formed a unified standard. In view of this status quo, future research on data elements needs to carry out in-depth studies in the following aspects: first, firstly, the conceptual connotation of data element configuration must be further improved and unified, and the difference between the stock and increment of data must be fully considered in order to more accurately describe and assess its configuration status. Secondly, a set of scientific, comprehensive and operable indicator system should be constructed for accurately measuring the configuration level of data elements, which should cover multiple dimensions such as configuration efficiency, utilization rate, security, etc., so as to provide empirical support for optimal configuration. Finally, to address the real problems of data silos and data barriers, it is necessary to synthesize the needs and interests of the government, society, enterprises, scholars and other parties to explore and propose effective mitigation countermeasures, and jointly promote the efficient allocation and full use of data elements.

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Conflict of Interests

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