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Applications and Innovations of Big Data Visual Analytics in Supporting Think Tank Research (Postprint)

Authors: Xiong Li, Wang Kun, Zhao Minghui

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Abstract

Abstract: [Purpose/Significance] Think tank research in the big data environment primarily aims at the effective collection, processing, and analysis of massive information, excavating logical patterns embedded within the information, and visualizing large amounts of unstructured data, which represents a hot topic in contemporary think tank research. [Method/Process] This article analyzes the current research status of think tanks and big data visualization both domestically and internationally, organizes relevant theories on research methods for big data visualization in think tanks, examines the application and innovation of big data visualization methods in think tank research, and employs CiteSpace software to analyze the current state of think tank research in China. [Results/Conclusion] The results indicate that current research methods for think tanks in China remain relatively singular, while big data visualization research involves multidisciplinary and industry applications. Research methods for big data visualization in think tanks are developing rapidly, encompassing technologies such as massive data processing, visualization algorithms, graphical visualization, human-computer interaction, and distributed processing that support big data visualization analysis for think tanks. The application of big data visualization analysis in think tank research facilitates efficient processing of think tank data, scientific and accurate decision-making, visualization of complex graphics, simplification of complex problems, good user interaction, resource aggregation and sharing, and enhances the role and influence of think tanks.

Full Text

Preamble

Application and Innovation of Big Data Visualization Analysis in Supporting Think Tank Research

Xiong Li, Wang Kun, Zhao Minghui

School of Management, Shanghai University, Shanghai 200444

Abstract

[Purpose/Significance] Think tank research in the big data environment aims to effectively collect, process, and analyze massive information, excavate the logical rules contained within it, and visualize large amounts of irregular data—making this a hot topic in contemporary think tank research. **[Method/Process]** This article analyzes the current research status of think tanks and big data visualization both domestically and internationally, systematically reviewing relevant theories on big data visualization-based think tank research methods. It examines the application and innovation of big data visualization methods in think tank research and employs CiteSpace software to analyze the current state of think tank research in China. **[Result/Conclusion]** The findings indicate that China's current think tank research methods remain relatively singular, while big data visualization research involves multiple disciplines and industry applications. Big data visualization-based think tank research methods are developing rapidly, encompassing technologies such as massive data processing, visualization algorithms, graphic visualization, human-computer interaction, and distributed processing that support big data visualization analysis in think tank research. The application of big data visualization analysis in think tank research facilitates efficient data processing, scientific and accurate decision-making, visualization of complex graphics, simplification of complex problems, enhanced user interaction, resource aggregation and sharing, and improved think tank effectiveness and influence.

Keywords: think tank, big data, visualization, visualization analysis, research methods

Think tank research is fundamentally built upon scientific data analysis to forecast future research trends and directions, thereby establishing competitiveness and influence. As the issues confronting think tank research become increasingly complex, achieving specialization and refinement to meet the challenges of new-type think tanks will be key to determining their future success. As early as January 2015, the “Opinions on Strengthening the Construction of New-Type Think Tanks with Chinese Characteristics” issued by the General Office of the CPC Central Committee and the State Council emphasized the importance of policy consultation, calling for reform and innovation as driving forces to build a new think tank system with Chinese characteristics, thereby

vigorously promoting future research on characteristic new-type think tanks. With the rapid development of the Internet, big data collection, storage, and analysis have brought new impetus and challenges to China's think tank research. Particularly, the application of big data visualization methods—from the perspectives of policy operation, government management, and decision-making—helps decision-makers and the public understand key issues and obtain effective information based on massive data processing and analysis, representing a fundamental trend in future think tank research.

1.1 Think Tank Research Status

Think tank research has currently entered a stage of rapid development. In terms of institutional numbers, the “2015 Global Go To Think Tank Index Report” released by the University of Pennsylvania on February 9, 2016, indicated that the number of global think tanks reached 6,846, with the United States ranking first globally at 1,835 institutions, and China ranking second at 435 institutions.

Scholars both domestic and abroad have conducted in-depth research on think tanks. Jacques Peter employed scientometric methods to statistically measure think tank data and analyze the operational mechanisms of traditional American think tanks. Domestic scholar Lü Hong conducted bibliometric analysis and information mining based on WOS to summarize current international think tank research hotspots: (1) development and operational status of think tank groups and their social influence; (2) role positioning and decision-making functions of think tanks; (3) classification, fields, and functional research of think tanks; and (4) case studies of think tanks.

Research on literature quantity can characterize changes in research fields to some extent. Therefore, by retrieving domestic and international literature and comparing publication volumes, we can understand trends in think tank research. For domestic literature retrieval, we selected the CSSCI journal database from CNKI, using “think tank” as the exact title search term, excluding conference notices and reports, with a time span of 2000–2016, yielding 721 articles. For international literature retrieval, we selected the WOS Core Collection database, using “Think tanks” as the topic and “Article” as the document type, with a time span of 2000–2016, yielding 384 articles. The retrieval was conducted on July 19, 2017, and the results are shown in [Figure 1: see original paper].

[Figure 1: see original paper] shows that before 2011, international literature on think tank research outnumbered domestic publications, indicating that foreign scholars began researching think tanks earlier and accumulated a certain volume of literature, with related papers showing steady growth over the past 16 years. Domestic think tank research started relatively later, gradually beginning at the turn of the century, but the number of related papers has increased since 2011.

1.2 Big Data Visualization Research Status

Big data visualization analysis is currently one of the most important methods for big data analytics. Massive data are processed and analyzed and then displayed intuitively through graphics and images. These data typically originate from databases, HTML, XML files, source code, etc., and through storage and analysis, enable statistical analysis, knowledge representation, user interaction, visual presentation, human cognition, perception, and exploratory decision-making. Big data visualization technology fully utilizes data analysis, combining the advantages of machines and humans to analyze and solve problems, achieving visual perception.

Big data visualization methods originated from scientific visualization and information visualization that emerged with information growth, collectively known as data visualization. Nightingale employed traditional data visualization methods to collect and analyze medical and public health information, most notably using pie charts. With the development of Internet technology and increasing information volume, big data visualization is no longer confined to traditional graphic visualization. Based on massive data, it gradually incorporates interactive functions in content-rich graphics. Interactive data visualization facilitates the selection and representation of complex data, helping users interact with systems. Due to different industry applications and data types, big data visualization analysis methods vary, with applications spanning politics, economics, finance, healthcare, and other industries, processing data types including structured data, text, networks, and images.

1.3 Problem Statement

Through comparative analysis of domestic and international think tank research literature and review of current research status, we find that foreign think tank research started earlier, while China's think tank research, though yielding certain achievements, still employs relatively singular methods and has not yet formed a mature research system. The big data era presents new challenges for China's think tank research: How can we conduct big data-driven think tank research? Current big data visualization methods can intuitively display information from massive data, with applications involving multiple data types and industry decision analysis across interdisciplinary research. Therefore, how can we apply big data visualization analysis to support the application and innovation of think tank research?

This article elaborates on think tank research methods and theories, systematically reviews big data visualization-based think tank research methods and theories, analyzes the application and innovation of think tank research methods from a big data visualization perspective, employs CiteSpace software to conduct visualization analysis of selected think tank research literature from CNKI, and provides future prospects.

2 Development Trends in Think Tank Research Methods

American scholar Paul Dickson first studied and analyzed think tanks in his 1971 publication *Think Tanks*, examining their functions. Subsequently, an increasing number of people recognized the importance of think tanks, and scholars both domestic and abroad began researching them, covering government policy, economics, education, and many other fields. Think tank research methods have continuously evolved alongside this growing body of research.

2.1 Traditional Statistical Methods

Initially, foreign scholars conducted think tank research primarily on the basis of theoretical research, using qualitative and quantitative analysis methods. Abelson employed quantitative analysis to measure the influence of think tanks on society, politics, and the economy. Meanwhile, methods such as questionnaires, expert interviews, and visits were gradually applied to think tank research. Rich was the first to apply regression analysis from statistics to think tank research, conducting empirical studies on the role of think tanks in U.S. healthcare reform and government policy formulation. To analyze the state of domestic and international think tank research, Zhao Rongying et al. used bibliometric methods to analyze the cumulative volume of think tank research literature and grasp current research trends. From theoretical research to statistical analysis, traditional measurement methods have played important roles in think tank research, laying the foundation for emerging think tank research methods in the big data era.

2.2 Think Tank Research Methods in the Big Data Environment

Research can only provide effective scientific decision-making and consultation suggestions by completing the entire Data-Information-Intelligence-Solution process.

In the big data environment, data-driven thinking has gradually spread in think tank research, with big data visualization analysis methods being flexibly applied to achieve massive data analysis and intuitive graphic display. For example, constructing network maps of inter-regional cooperation in international think tank research visually displays collaboration patterns and can draw co-occurrence network graphs of high-frequency keywords, combining visualization with literature analysis for comparative analysis of domestic and international think tank research to grasp current trends and hotspots.

Network maps can intuitively display hotspots and trends in think tank research, providing a basis for decision-making by governments and educational institutions. Current tools for visualizing think tank research include Pajek (collaborative network mapping software), CiteSpace, and VOSviewer. The importance of think tank research to politics, economics, and education is gradually increasing, and big data visualization-based research methods are more convenient and

intuitive, better enabling decision-makers to grasp hotspots and trends in think tank research.

2.3 Big Data Visualization-Based Think Tank Research Methods

Big data visualization technology is currently an important means for data representation, data processing, and decision analysis in think tank research. Current big data visualization-based think tank research methods mainly include: massive unstructured data processing technology for think tanks, big data visualization algorithm technology for think tank research, complex information graphic visualization technology for think tanks, human-computer interaction technology supporting visual analysis for think tank research, and distributed processing technology in visualized think tank research.

Massive unstructured data processing technology is an important foundation for analyzing think tank information and data, primarily focusing on quantitative analysis of massive unstructured data. Current big data analysis platforms can achieve mining and analysis of real-time collected massive unstructured data. Meanwhile, the rapid development of cloud storage technology can improve storage and retrieval of massive data, enhancing data processing efficiency. Big data visualization algorithms for think tank research are derived from improved and optimized classical algorithms, such as classification, decision trees, Naive Bayes, Apriori algorithms, neural networks, and genetic algorithms. These primarily involve improvements in computer processing technology and graphic analysis technology based on classical algorithms, promoting big data visualization-based think tank research. For example, currently used machine learning algorithms can predict development trends of uncertain events based on massive data through deep learning, with rich graphic expression and good user interactivity.

The rapid development of Internet and information technology has caused information to grow exponentially, and think tank information has also grown rapidly, bringing challenges to information collection, storage, and analysis. Complex think tank information graphic visualization technology presents different visualization results based on different data types, involving data including text data, network data, spatiotemporal data, multidimensional data, etc., with real-time interactive functions. Currently, virtual reality technology and visualization simulation technology have been applied in think tank complex information visualization, with more comprehensive content and richer interaction forms, promoting the rapid development of big data visualization-based think tank research. In the big data environment, human-computer interaction technology supporting think tank visual analysis has gradually become an important method in big data visualization-based think tank research.

With the rapid increase in information volume processed in think tank research and the need for resource sharing, distributed processing technology in visualized think tank research has gradually been applied. Distributed computing such

as cloud computing technology, with its deep learning capabilities for image recognition, speech recognition, and data analysis, features rapid resource access and multi-user sharing, wide distribution, large user bases, and strong network system performance. It is widely used in current big data visualization-based think tank research, helping to concretize and multidimensionalize shared data visualization analysis results.

3 Analysis of Think Tank Application Research from a Big Data Visualization Perspective

Countries worldwide increasingly emphasize think tank construction, viewing think tank research results as important foundations for political and economic decision-making. With the arrival of the big data era and the continuous surge in information volume, how to effectively conduct massive data collection and perform effective, dynamic, and intuitive analysis has become a challenge for think tank research. Big data visualization-based think tank research methods are currently relatively emerging approaches in think tank research. Social network analysis, knowledge mapping, and co-occurrence network analysis are currently commonly used visualization methods in think tank research, which not only strongly promote think tank research but also facilitate efficient and accurate data collection, processing, analysis, and prediction. Therefore, this article analyzes think tank application research and innovation from a big data visualization perspective and uses CiteSpace software to conduct visualization analysis and exploration of selected think tank research journal articles from CNKI. We explore big data visualization-based think tank application research and innovation from seven aspects: rapid and efficient processing of think tank data, scientific and accurate decision-making in think tank research methods, visualization application of complex graphics in think tank reports, simplification of complex problems in think tank research results, user interaction supporting visual analysis in think tank research processes, methodological innovation in think tank data resource aggregation and sharing, and big data visualization enhancing think tank role and influence.

3.1 Rapid and Efficient Processing of Think Tank Data

Big data visualization-based think tank research methods offer faster speed and higher efficiency in the data processing stage compared to traditional methods. The collected think tank data include both traditional structured data and massive unstructured data, which are more comprehensive and specific than traditional statistical data.

The article's data source is the CSSCI database from CNKI, retrieved on July 19, 2017, with 795 journal articles containing "think tank" in the title from 2000 to 2017. By importing the data into CiteSpace for data conversion and processing, it quickly became standard format data for visualization processing. Selecting the "keyword" option, setting the selection criteria parameter to top50,

Threshold interpolation to (2, 1, 10; 2, 1, 10; 2, 1, 10), and choosing Pruning sliced networks and Minimum spanning tree methods for keyword field identification and visualization analysis, we rapidly obtained analysis results. The spatial state of literature data visualization analysis is represented in data form as shown in .

shows that except for 10 citations in 2001, all other data from 2000 to 2006 were 0, so only data from 2007 to 2017 are listed. The table clearly shows that citation numbers related to think tank research literature have been increasing from 2008 to 2017, with the highest number of citations being 736 in 2016, indicating that domestic think tank research has been gaining momentum since 2007. The 逐年递增 (year-by-year increase) in clustering nodes and connection numbers also indirectly demonstrates that the number of articles on think tank research in the CSSCI database has gradually increased, reflecting strengthening research trends. Based on traditional think tank research methods, big data visualization methods can quickly process and analyze large amounts of think tank data and obtain objective and detailed data analysis results in a timely manner, providing certain support for efficient think tank research.

3.2 Scientific and Accurate Decision-Making in Think Tank Research Methods

Big data visualization-based think tank research methods rely on scientific research approaches. Based on think tank data statistics and supported by computer technology and big data visualization algorithms, they achieve efficient and scientific analysis of massive think tank data, ensuring scientific and accurate decision-making. Building upon keyword co-occurrence network analysis of think tank research literature, we conducted cluster algorithm analysis on the results and displayed visualization outcomes as shown in [Figure 3: see original paper].

[Figure 3: see original paper] shows that through cluster algorithms, keyword categories are displayed in different colors in the visualization graph, allowing us to intuitively see that among retrieved articles related to think tank research, high-frequency keywords can be roughly divided into three categories: think tanks, think tank construction and university think tanks, and Chinese characteristics and decision consultation. Different colored node areas represent different research emphases in think tank research. Therefore, based on identifying think tank research hotspots, visualization results from cluster algorithms can reveal main branch directions and research focuses. Scientific computational methods help think tank researchers conduct scientific analysis quickly, efficiently, and accurately. On January 19, 2015, the Big Data Engineering Technology Research Center of Shanghai Jiao Tong University's School of Electronic Information and Electrical Engineering was established, with one of its goals being to build a top-tier think tank for the big data industry under the big data environment, strengthening think tank construction while promoting rapid big data industry development and enhancing social influence. Researchers from

Shanghai Jiao Tong University analyze data from high-dimensional space based on big data analysis algorithms, discovering the most essential information according to data's inherent patterns and structural relationships. Therefore, strict data processing workflow design and optimization of big data visualization algorithms help scientifically improve think tank research processes, visually display analysis results, show main viewpoints, and improve decision-making scientificity and accuracy.

3.3 Visualization Application of Complex Graphics in Think Tank Reports

The application of big data visualization methods in think tank research compensates for traditional methods' deficiencies in graphic visualization. Using computer technology to effectively process large-scale clustered information, it displays correlations between data through multidimensional visual graphics, particularly in the visualization application of complex graphics in think tank research reports, enabling users to intuitively see relationships between data and the overall network formed by data connections. Currently, virtual reality technology and visualization simulation technology are developing rapidly and gradually appearing in think tank reports, with more comprehensive content and richer interaction forms.

The World Resources Institute (WRI) uses big data visualization technology in its self-built database to help users quickly query visualization graphics such as research field distribution maps, hotspot maps, and spatiotemporal graphs, helping users intuitively and accurately observe regional distribution, hotspots, and trends of research fields when querying related reports. CNKI also uses big data visualization methods for literature visualization analysis in its database and related reports, displaying report content through complex graphics to help users understand citation networks, related authors, similar literature, and other visualization graphics, intuitively showing research hotspots, related researchers, and extended literature. Currently, scientific knowledge mapping is a commonly used visualization analysis method in domestic and international think tank research reports. Important nodes and their relationships can be intuitively displayed through graphics, helping to grasp think tank research trends. By displaying collected literature information using co-occurrence networks in CiteSpace, users can intuitively see keywords throughout the network system and judge hotspot issues and trends in think tank research through node sizes. The visualization result is shown in [Figure 2: see original paper].

In [Figure 2: see original paper], node sizes represent the frequency of keywords related to think tank research, and connections between nodes represent correlation degrees. The most frequently appearing keywords in think tank research literature since 2000 include "think tank," "university think tank," "Chinese characteristics," "think tank construction," "new-type think tank," "decision consultation," and "research results." Judging from node sizes, these keywords are currently hotspots in think tank research. The output graphics also include

related specific graphic data, including specific keywords, frequencies, centrality, and years, as shown in .

is sorted in descending order of keyword frequency to judge domestic think tank research hotspots in recent years. The keyword “think tank” has a frequency of 200 and centrality of 0.37. Combined with focal color changes in the graph, we find that literature containing this keyword has the longest time span. Except for “decision consultation” with centrality of 0.35, other keywords show gradually decreasing frequencies and centrality, with shorter time spans. This intuitively demonstrates that domestic think tank research has gradually increased since 2007 and derived multiple research branch directions. Complex graphic visualization intuitively displays content, distribution, correlation, and node characteristics of related literature keywords. The color change of annual rings from the focal center to the periphery can judge hotspots and trends in think tank research across years. Although complex graphic visualization requires massive data support, its intuitive display of graphic information in think tank research reports helps the public and researchers concretely understand abstract problems and improve research efficiency.

3.4 Simplification of Complex Problems in Think Tank Research Results

Think tank research based on big data visualization can effectively display research results, using graphics to intuitively present numerous professional results, greatly simplifying problems and facilitating accurate understanding and macro-analysis by more users, thereby jointly participating in policy formulation and think tank research. Major international think tanks publish annual research reports related to think tank research, and big data visualization methods are used in these reports to visualize research results, simplifying complex problems for public reading. The Royal Institute of International Affairs uses knowledge mapping in its published research reports to intuitively, simply, and efficiently display research results. In recent years, the development and application of big data visualization software have provided convenience for domestic and international think tank research, allowing massive complex data to be processed by software to generate intuitive graphic displays of computational results, simplifying analysis processes and improving decision-making efficiency.

Traditional analysis methods can abstract and simplify data but struggle to accurately represent relationships and structures between think tank data, and their descriptions of think tank results are professional and not easily understood. Big data visualization methods, however, enable users to efficiently obtain knowledge resources from intuitively displayed graphic information, using multidimensional graphics to present think tank research results, such as hierarchical and network structure visualization and spatiotemporal visualization, helping to simplify complex problems and understand analysis efficiently.

Thus, big data visualization-based think tank research methods can present com-

plex problems in think tank research results in simple and understandable ways, making it easier for the public to accept think tank research results, thereby increasing public participation in government policy formulation processes and recognition of think tank research results. Time series visualization analysis, for example, is also commonly used in think tank research to judge research trends in various years. This visualization result is shown in [Figure 4: see original paper].

[Figure 4: see original paper] clearly shows that think tank research hotspots have gradually shifted from decision consultation and new-type think tanks to think tank construction since 2000, and after 2010, gradually transitioned from university think tanks to new-type think tanks with Chinese characteristics. This indicates that under development over the past few years, China's think tank research has developed multiple new research branches with good development momentum. Unlike the cumbersome and complex traditional bibliometric statistics, time series visualization methods intuitively display complex problems by setting certain time intervals, completely presenting abstract data temporal changes and even specific details, including focal sizes and correlation relationships, enriching information meaning, simplifying analysis processes, intuitively showing current development trends in China's think tank research, making results more easily accepted by the public—representing one of the application innovations of big data visualization methods in think tank research.

3.5 User Interaction Supporting Visual Analysis in Think Tank Research Processes

Think tank research trends and hotspots can be displayed through big data visualization, but to make it easier for users to understand and analyze, user interaction functions have been applied to big data visualization-based think tank research, allowing certain processing and manipulation of data or graphic results to analyze and understand data. Nowadays, massive unstructured data makes traditional visualization analysis methods somewhat limited in helping users understand data, while user interaction functions supporting visual analysis in think tank research processes can improve this situation. Scientific knowledge mapping software provides good user interaction functions in think tank research visual analysis and is one of the big data visualization-based think tank research methods. By conducting visualization analysis of think tank research literature authors in CiteSpace software, we generated a literature author co-occurrence network and captured dynamic operation process graphs of the network graph, adjusting node sizes in real-time according to needs to highlight focal points, as shown in [Figure 5: see original paper].

The literature author co-occurrence network is dynamically displayed through an interactive interface. Figure (a) shows the initial operation period of the network graph, where connection lines between nodes are relatively chaotic and focal points are not obvious. Figure (b) shows the later operation period, where connection lines between nodes gradually become clear, and through adjustment

of text and node sizes, main author distributions are displayed, highlighting network focal points. The visualized interactive interface helps improve the flexibility and efficiency of think tank research, enabling information relationship graphs to transmit data information to users through interactive functions.

At the Second New Economy Think Tank Conference held on January 7, 2017, Justine Cassel, Associate Dean of Carnegie Mellon University's School of Computer Science, argued that next-generation human-computer interaction interfaces need two attributes: natural interaction through conversation and body language; and adoption of social models rather than task models. Intuitive and natural human-computer interaction will help improve future think tank platforms and technological innovation. RAND Corporation possesses data from multiple U.S. administrative agencies and industries, and good interaction among information demanders, suppliers, and multiple databases enhances the flexibility of subsequent analysis. Big data visualization interaction functions make think tank research analysis processes more flexible, intuitive, and convenient, while ensuring result accuracy and acceptability.

3.6 Methodological Innovation in Think Tank Data Resource Aggregation and Sharing

Think tank data resource aggregation and sharing is an inevitable trend for future think tank development. Think tank research typically involves accessing numerous knowledge-based databases, and obtaining and processing large amounts of information from databases presents certain difficulties. Since data between institutions are relatively independent, resource sharing is limited. Moreover, public users cannot intuitively judge research status of think tank research institutions, connections between institutions, and database resource information using traditional query and statistical methods. With the application and popularization of Internet and multimedia technology, think tank research institutions have used Internet platforms for data collection, analysis, visualization results display, and think tank data resource sharing, achieving mutual exchange between institutions and joint participation in learning and research by the general public.

Currently, many think tanks use distributed processing technology to establish knowledge-based databases, integrate related data resources, build open data resource platforms, use big data visualization analysis methods to intuitively display data resource distribution, enable public participation in analysis and judgment, efficiently obtain think tank data resources, and achieve think tank data resource sharing. Many internationally renowned think tanks have established powerful databases to preserve important literature and research reports while providing network resource sharing platforms to strengthen knowledge learning and sharing. The Royal Institute of International Affairs has established a dedicated digital resources department to support resource sharing based on perfecting its database construction. The Carnegie Endowment for International Peace also provides think tank knowledge resource sharing services for its regis-

tered members. The China Social Sciences Network Data Center of the Chinese Academy of Social Sciences integrates and aggregates academic journals and social survey materials in the social sciences field in an open platform to achieve resource sharing. Meanwhile, the establishment of cloud platforms and development of related supporting systems have greatly improved think tank storage and utilization efficiency, made information communication between databases more convenient, enabled users to access databases easily, reduced information acquisition costs, effectively realized resource sharing, and satisfied user needs.

With the support of big data visualization software, users can conveniently identify think tank research-related institutions to understand the research status and inter-institutional connections of China's think tank research institutions, thereby indirectly judging inter-institutional cooperation and resource sharing. [Figure 6: see original paper] shows that within the selected literature scope, research institutions that have conducted more related research on think tanks mainly include University of Chinese Academy of Sciences, Documentation and Information Center of Chinese Academy of Sciences, School of Information Management of Nanjing University, School of Information Management of Wuhan University, Center for Studies of Information Resources of Wuhan University, School of Public Policy and Management of Tsinghua University, and Department of Information Management of Peking University. Different node colors indicate different node categories, and a few nodes have connection lines representing relationships. In the visualization results of think tank research institutions, China has a considerable number of think tank research institutions, but connections between institutions are weak, and institutions maintain certain independence. Therefore, for in-depth research and construction of China's think tanks, institutions should strengthen cooperation, share resources, and avoid island effects. Users should not only be able to conveniently identify and access mainstream research institutions and databases but also better share think tank data and visualization analysis results based on big data cloud service functions, achieving seamless communication of resources for more efficient and accurate resource sharing.

3.7 Big Data Visualization Enhancing Think Tank Role and Influence

Dr. James McGann, Director of the Think Tanks and Civil Societies Program at the University of Pennsylvania, once stated that big data can be used not only to collect massive data but more importantly to conduct professional analysis of massive data. Through data analysis results, social problems such as health and transportation can be identified, providing decision-making foundations for future problem-solving by governments and researchers. Good utilization of big data technology can boost the role and influence of think tanks.

The application and innovation of big data visualization analysis methods in think tank research enable think tank researchers to fully integrate the Internet, computer technology, database technology, etc., to conduct in-depth think tank research, use big data visualization analysis methods to analyze problems, and

help decision-makers and the public understand problems and obtain knowledge resources, boosting scientific decision-making by governments in solving social problems. In recent years, big data visualization has gradually derived numerous emerging technologies, which will well promote future think tank research. However, at the social level, big data visualization analysis technology requires user-friendly interactive systems for the public, enabling not only think tank workers to quickly master big data visualization analysis technology to meet researchers' needs but also more social members to understand problems, participate in government decision-making, promote public cognition and learning of think tank research results, achieve think tank data resource sharing, and effectively enhance think tanks' social influence.

4 Conclusion

This article elaborates on the research status of think tanks and big data visualization, systematically reviews theories related to big data visualization-based think tank research methods, and analyzes the application and innovation of think tank research supported by big data visualization analysis. The results show:

- (1) Think tank construction has gradually received widespread attention from governments worldwide, with increasing scholars conducting related research on think tanks, making it a hotspot in academic research. However, China's think tank research methods remain relatively singular, without forming a complete research system. In the big data era, collection, processing, and analysis of massive information have become difficult. Big data visualization analysis methods, based on traditional visualization methods, can efficiently process massive data and intuitively display data analysis results in graphics and space with certain acceptability, making it necessary to apply big data visualization methods to think tank research.
- (2) Think tank research methods mainly evolved from traditional measurement analysis methods, but facing massive think tank information, big data visualization-based think tank research methods have developed rapidly. Current big data visualization-based think tank research methods mainly include massive unstructured data processing technology, big data visualization algorithm technology, complex information graphic visualization technology, human-computer interaction technology supporting visual analysis, and distributed processing technology in visualized think tank research.
- (3) Big data visualization technology is gradually being applied in think tank research, providing strong support for methodological and technological innovation in think tank research. Massive think tank data can be quickly and accurately obtained through computer software platforms and efficiently preprocessed. Scientific data collection, processing, and analysis methods make think tank research decision-making scientific and accu-

rate. Multidimensional graphic interfaces display complex data structures through visualization, simplifying complex problems. Meanwhile, good interaction technology enables users to manipulate, analyze, and understand data more accurately. Big data cloud sharing technology based on cloud services can help more users access knowledge-based databases, collect data in real-time, and share analysis results, effectively realizing resource sharing.

- (4) Big data visualization-supported think tank research methods currently have certain applications and represent significant improvements over traditional research methods, providing strong support for think tank research application and innovation. This is not only an initial exploration of current think tank research methods but also a future development trend for this research field.

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Author Contributions:

Xiong Li: Responsible for research topic selection, research and methodology design, and paper writing;

Wang Kun: Responsible for data collection and paper writing;

Zhao Minghui: Responsible for literature review and paper writing.

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