



JME

Journal of Measurement and Evaluation

JME, Vol. 1, No. 1, 2026, pp.101-122.

Print ISSN: 3135-4661; Online ISSN: 3135-467X

Journal homepage: <https://www.jmeacta.com>

DOI: <https://doi.org/10.64058/JME.26.1.06>



Analysis of the Application of Research Methods in Core Journals in the Field of Management Science in China

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Abstract: By sorting out the application of research methods in the field of management science in China from 2008 to 2022, we assist researchers in correctly understanding and selecting research methods and provide reference for subsequent research. This article uses bibliometrics, cluster analysis, co-occurrence analysis, and network analysis to analyze four dimensions: "method-quantity", "method-topic", "method-author", and "method-method" to summarize the application patterns of research methods. The research shows that quantitative research is more than qualitative research, with increasing attention to qualitative research methods such as case studies and rooting theory in recent years; single research methods are more than mixed research methods, and the use of multiple research methods in combination is gradually increasing; there is a clear bias in the use of research methods under different research themes; and the distribution of research methods used by core authors is more dispersed.

Keywords: Management Science; Research methods; Research topic; Bibliometrics; Co-occurrence analysis

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Received: 04 Jan 2026 / Revised: 01 Feb 2026 / Accepted: 15 Feb 2026 / Published online: 30 Apr 2026 / Print published: 30 May 2026.

This article is an English translation of the following Chinese article: Wei, R., & Li, B. (2023). Analysis of the application of research methods in core journals in the field of management science in China. *Information Research*, (12), 69-78. <https://doi.org/10.3969/j.issn.1005-8095.2023.12.009>

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1. Introduction

With the continuous advancement of information technology and data science, interdisciplinary research questions and contexts have become increasingly prevalent. Consequently, selecting appropriate research methodologies is crucial for enhancing researchers' scientific literacy, upholding research standards, and driving disciplinary progress. Research methods serve as a vital catalyst for disciplinary development, playing a pivotal role in the scientific research process (Li Bowen, 2019). As an integral component of a discipline's knowledge system, research methodology serves to reveal a field's theoretical structure while reflecting its intrinsic developmental patterns and characteristics (Gao Dan, 2022). The advancement of any discipline invariably relies on in-depth exploration of theory, methodology, and application. Theory constitutes the foundation, application represents the ultimate objective, and methodology acts as the bridge connecting theory and application (Qiu Junping, 2022). For the interdisciplinary field of management science, the importance of research methods is self-evident. Currently, research examining the application of methods is scarce, necessitating a systematic review of relevant methodologies within management science. This review aims to establish a coherent framework for management science research methods, elucidating the relationships between research methods and knowledge elements such as research themes and core authors. Consequently, it seeks to provide valuable insights and references for related research and work in management science, while offering decision support to policymakers.

This paper focuses on addressing the following questions: What is the overall landscape of research method application within China's management science field in recent years? What correspondences exist between research methods and research themes? How are research methods distributed among core authors? Which research methods are frequently used in combination? Answers to these questions can reveal the general characteristics and features of management science research and its methodological application. The appropriate application of different research methods in conducting relevant studies provides further reference for enhancing scholars' in-depth understanding of research methods within the management science field.

2. Related Research

2.1 Research on Methodology in China's Management Science Field

Numerous domestic scholars have actively explored management theories and methodological frameworks based on indigenous Chinese management phenomena and challenges. Du Rong et al. (Du Rong, 2008) contend that for the Chinese school of management science to gain global recognition, it

must identify commonalities between Eastern and Western management practices, encompassing management concepts, philosophies, theories, and methodologies. They analyzed these shared elements from a systems methodology perspective. Not all Western management theories and methodologies are universally applicable to China's indigenous management phenomena and challenges; systematic summarization of practical experience requires diverse research approaches (Wu Zhaoyun, 2018). Other scholars are actively exploring cutting-edge management methodologies tailored to the Chinese context. For instance, Wang Shouyang et al. (Wang Shouyang, 2021) examined complex systems management theories and methods by synthesizing international research trends and expert insights. This field emerges from the convergence of complex systems and management science. Sheng Zhaohan and Yu Jingyuan (Sheng Zhaohan, 2021) elaborated on the methodology and framework of complex systems management, aligning it with China's current developmental stage. Given that research into management science methodology commenced relatively late in China, it has garnered significant attention in recent years. However, a systematic management science methodology framework has yet to be established domestically, creating an urgent academic need for broadly applicable scientific systems and methodologies.

2.2 Analysis of Management Science Research Method Applications

As research outputs within management science proliferate, employing diverse methodologies, scholars have commenced analyzing the application of specific research methods within this domain. Primary techniques for examining method usage include bibliometrics, the Delphi method, and machine learning, with Citespace serving as a key analytical tool. Zhou Jun (Zhou Jun, 2018) and Liu Zezhao (Liu Zezhao, 2021) employed Citespace bibliometric software to systematically review the application of social network analysis and experimental methods respectively. Li Zhiguo and Zhong Jiang (Li Zhiguo, 2018) utilized the Delphi method to gather expert opinions for classifying literature on data science research methods. Huang Cui and Lyu Liyuan (Huang Cui, 2020; Lyu Liyuan, 2022) provided a typological analysis framework for reviewing text analysis and network analysis applications. Chen Liping and Ren Fei (Chen Liping, 2023) analyzed econometric model papers based on secondary data using bibliometrics combined with LDA and DTM thematic modelling.

A review of the literature reveals that, in recent years, scholars have explored research methodology systems for management science within the Chinese context. However, a systematic methodology framework for management science research has yet to be established. Analysis of research methodology applications indicates involvement with approaches such as social network analysis, data science, text analysis, and econometric modelling. Nevertheless, studies offering a systematic analysis of primary research methodologies within the management science domain remain scarce.

3. Data Sources and Research Methods

3.1 Data Sources

Academic journals serve as the primary platform for the exchange and dissemination of scholarly ideas, predominantly publishing highly specialized academic papers that showcase research priorities and developmental trends across various disciplines. Consequently, this paper employs academic journal articles as the concentrated manifestation of scholarly achievements within the field of management science. It analyses the landscape of research methodology application in China's management science sector from 2008 to 2022, uncovering characteristics of academic research and disciplinary development through the lens of methodological utilization. The Management Science Division of the National Natural Science Foundation of China encompasses four sub-disciplines: G01 Management Science and Engineering, G02 Business Administration, G03 Economic Science, and G04 Macro Management and Policy. Owing to the interdisciplinary and complex nature of management science, journals in this field are widely distributed. Authoritative journal lists currently include the FMS High-Quality Journals in Management Science and the key journals recognized by the Management Science Division of the National Natural Science Foundation of China. When compiling statistics on academic publications in Management Science and Engineering, Sheng Zhaohan et al. (Sheng Zhaohan, 2021) employed the FMS High-Quality Journals in Management Science list for domestic core publications. Conversely, Zhou Zejiang et al. (Zhou Zejiang, 2021) in examining the distinctive characteristics of China's management studies system, selected the NSFC's 22 Category A journals as their data source. This study selected 20 journals appearing concurrently in both the FMS High-Quality Management Science Journals List (Category T1) and the NSFC Management Science Division's Class A list as its data source, covering the period 2008–2022. The specific journal list is as follows: Journal of Public Administration, Journal of Management Engineering, Management Science, Journal of Management Science, Management Review, Management World, Accounting Research, Financial Research, Studies in Science of Science, Science and Technology Management, Nankai Management Review, Journal of Information Science, Quantitative Economics and Technical Economics, Systems Engineering: Theory and Practice, Journal of Systems Engineering, Forecasting (now renamed Frontiers of Engineering Management Science and Technology), Chinese Journal of Industrial Economics, Chinese Journal of Management Science, Chinese Journal of Rural Economics, Chinese Journal of Soft Science. These 20 selected journals encompass key publications across four sub-disciplines within management science: Management Science and Engineering, Business Administration, Economic Science, and Macro Management and Policy.

3.2 Research Method Coding

This study determined the research methods list based on the frequency of research methods appearing in keywords. First, bibliographic information for the 20 target journals was extracted from CNKI,

spanning 2008 to 2022, yielding 47,196 articles. This bibliographic data was imported into Vosviewer, where deduplication resulted in 82,155 unique keywords. The most frequently occurring keyword was ‘influencing factors’ (550 occurrences), while the most prevalent research method keyword was ‘case study’ (298 occurrences). To ensure representativeness of research methods, keywords appearing 20 times or more were listed separately, totaling 987. Some research methods appeared under multiple distinct formulations within keywords, such as Data Envelopment Analysis (178 times), DEA (92 times), Data Envelopment Analysis (DEA) (32 times), and DEA Model (26 times). These variations were consolidated into single entries. Twenty-seven distinct research methodologies were identified among keywords appearing 20 times or more. These 27 methodologies were coded; specific research methods are detailed in Table 1.

Primary Categories	Secondary Categories	Specific Methods
Data Collection Methods	—	Questionnaire surveys, interview methodology
Data Analysis Methods	Qualitative Research	Case studies, grounded theory
	Mathematical Analysis Methods	Game theory models, genetic algorithms, Monte Carlo simulations
	Network Analysis Methods	Complex networks, social network analysis
	Statistical Analysis Methods	Quantile regression, principal component analysis, spatial econometrics, hierarchical analysis, propensity score matching, ordinary least squares, factor analysis, double difference, vector autoregression, data envelopment analysis, structural equation modelling
	Computer Technology	Text analysis, machine learning, data mining, support vector machines, cluster analysis
	Other	Content analysis, bibliometrics

Table 1. Research Methodology Coding

Research methodologies typically appear in article titles, keywords, or abstracts. This paper posits that methodologies cited in these sections constitute the primary research methods employed within the literature. Should multiple methodologies be referenced in the title, keywords, or abstract, the literature is deemed to have utilized multiple research approaches. The 27 identified research methods were retrieved across 20 journal catalogues. Utilizing CNKI's ‘Article-Keyword-Abstract Search’, each research method was employed as a search term. Taking grounded theory as an example, the search formula was constructed as follows.

TKA = “grounded theory” AND (JN = “Journal of Public Administration” OR JN = “Journal of Management Engineering”) OR JN = “Management Science” OR JN = “Journal of Management Science” OR JN = “Management Review” OR JN = “Management World” OR JN = “Accounting Research” OR JN = “Financial Research” OR JN = “Science of Science Research” OR JN = “Science and Technology Management” OR JN = “Nankai Management Review” OR JN = ‘Journal of

Information Science' OR JN = "Journal of Quantitative Economics and Technical Economics" OR JN = "Theory and Practice of Systems Engineering" OR JN = "Journal of Systems Engineering" OR JN = "China Industrial Economics" OR JN = "China Management Science" OR JN = "China Rural Economics" OR JN = "China Soft Science" OR JN = "Frontiers of Engineering Management Science and Technology" OR JN = "Forecasting").

Using the above search terms, 27 research methodologies were individually searched, yielding 16,252 results. After excluding irrelevant papers such as book reviews and conference summaries, 16,188 documents remained. As some articles employed multiple research methods, duplicate entries were removed by treating article titles as unique identifiers. This yielded 13,823 target research documents, which collectively referenced research methods 16,188 times.

3.3 Research Methods

This study employs a combination of bibliometric analysis, co-occurrence analysis, cluster analysis, and network analysis. Firstly, bibliometric analysis was used to examine the frequency of each research method's application, while also summarizing trends over time and across publishing journals. Subsequently, Vosviewer software and literature review were utilized to analyze the association between research themes and methodologies. Subsequently, SPSS software was employed to conduct systematic cluster analysis of core authors' primary research methods and content, followed by systematization and comparison. Finally, Bib excel generated a co-occurrence matrix of research methods, while Gephi visualized the co-occurrence network diagram. Analysis of these co-occurrence results was conducted in conjunction with specific literature.

4. Data Statistics and Analysis

4.1 Analysis of the Frequency of Research Method Applications

The 13,823 articles collected in this study collectively mention research methods 16,188 times. The frequency of application for each research method is summarized in Figure 1. Based on the frequency of application, these methods can be divided into three categories. The first category comprises case studies, game theory models and questionnaire surveys, which are used significantly more frequently than other research methods; the second category comprises structural equation modelling, data envelopment analysis, vector autoregression and least squares methods, with frequencies ranging from 400 to 1,000; the third category includes propensity score matching, grounded theory, the Analytic Hierarchy Process and text analysis, with frequencies ranging from 100 to 400. The frequency of research method application is closely linked to journal distribution. Game theory is a common research method in the field of management science and engineering, frequently used in supply chain management research. The journals selected for this study include the *Journal of Management Engineering*, *Management Science*, *Journal of Management Science*, *Forecasting* (now

renamed *Frontiers of Engineering Management Science and Technology*), *Theory and Practice of Systems Engineering*, *Journal of Systems Engineering*, and *Chinese Journal of Management Science*, which are core journals in the field of management science and engineering; these journals account for 37.9% of the total number of articles. Case studies and questionnaire surveys are important research methods in the fields of business administration and macro-management and policy, accounting for 19.8% and 30.8% of the total number of articles respectively. Statistical analysis methods such as structural equation modelling and data envelopment analysis are common research methods in the field of economic science, accounting for 11.5% of the total number of articles. It can thus be seen that there is a certain correlation between the frequency of research method application and the distribution of journals collected in this study. When combined with the data on the disciplinary distribution of funded projects in the field of Management Science and Engineering provided by Yu Yugang et al. (Yu Yu-gang, 2023), the fields with the largest proportions are Transport Management, Logistics and Supply Chain Theory, and Operations Research and Management. Game theory models are frequently used research methods in these fields, indirectly reflecting the correlation between the frequency of research method application and research content.

Further analysis of the temporal distribution of each research method reveals that, within the first category of methods, case studies have shown a year-on-year upward trend in recent years, whilst game theory has remained relatively stable. Among game theory applications, Stackelberg games and differential games appear most frequently. Questionnaire surveys are a common data collection method, frequently employed in social science research, and have shown a relatively stable trend in recent years. Among the research methods in the second and third categories, grounded theory, text analysis and propensity score matching have shown a gradual upward trend, whilst factor analysis, vector autoregression, data envelopment analysis and structural equation modelling have shown a downward trend. Methods such as the Analytic Hierarchy Process, principal component analysis, least squares and genetic algorithms have exhibited an inverted U-shaped trend, whilst interview methods, cluster analysis and support vector machines have shown a stable trend. Among the first category of research methods, only case studies and grounded theory have shown an upward trend. This indirectly reflects the growing attention paid to qualitative research in the field of management science in China in recent years, which is partly related to the requirements of some journals to move away from a 'quantitative-only bias'. Qualitative research has now been widely adopted domestically and has become an important tool for bridging the gap between management science theory and practice.

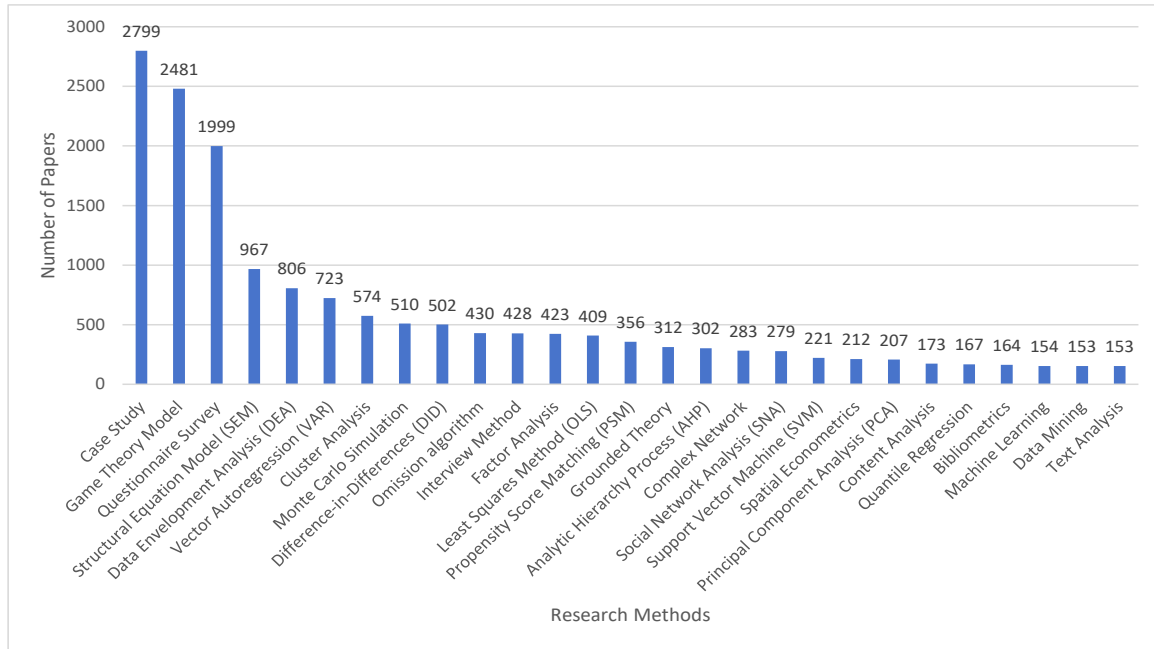


Figure 1. Frequency of use of research methods

A statistical analysis of the categories of research methods is presented in Figure 2. Data collection methods account for 15 per cent, whilst data analysis methods account for 85 per cent. Among data collection methods, questionnaire surveys account for the largest proportion; among data analysis methods, statistical analysis, mathematical analysis and qualitative research account for the largest proportions, whilst computer technology and network analysis account for a smaller proportion. Questionnaire surveys have long been a common research method within data collection techniques. Owing to their ability to collect data objectively and accurately, they have gradually gained recognition within the management science community. Statistical analysis and mathematical analysis are relatively common quantitative analysis methods; statistical analysis is frequently combined with questionnaire surveys to test and analyze the collected data, whilst mathematical analysis appears more frequently in the fields of management science and engineering, typically involving the establishment of mathematical models followed by the use of numerical simulation to analyze the results.

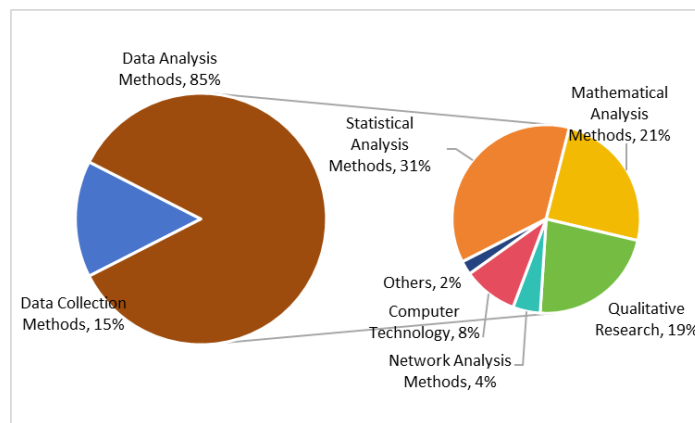


Figure 2. Distribution of research methods

4.2 Methodology – Topic Association Analysis

A co-occurrence network of keywords was generated using Vosviewer, as shown in Figure 3. This network illustrates the co-occurrence patterns between research methods and research themes. The colors represent cluster categories, with the data divided into six research themes. Based on keyword clustering and specific literature, these six themes are summarized as follows: economic growth and technological innovation; supply chain and e-commerce; efficiency evaluation and indicator system construction; corporate innovation and performance; network analysis and knowledge management; and business models and value. These six research themes encompass research content across various sub-disciplines within the field of management science, including Management Science and Engineering, Business Administration, Economics, and Macro-management and Policy. Below, we provide a detailed analysis of the application of research methods under these six themes, drawing on specific literature and the keyword co-occurrence network.

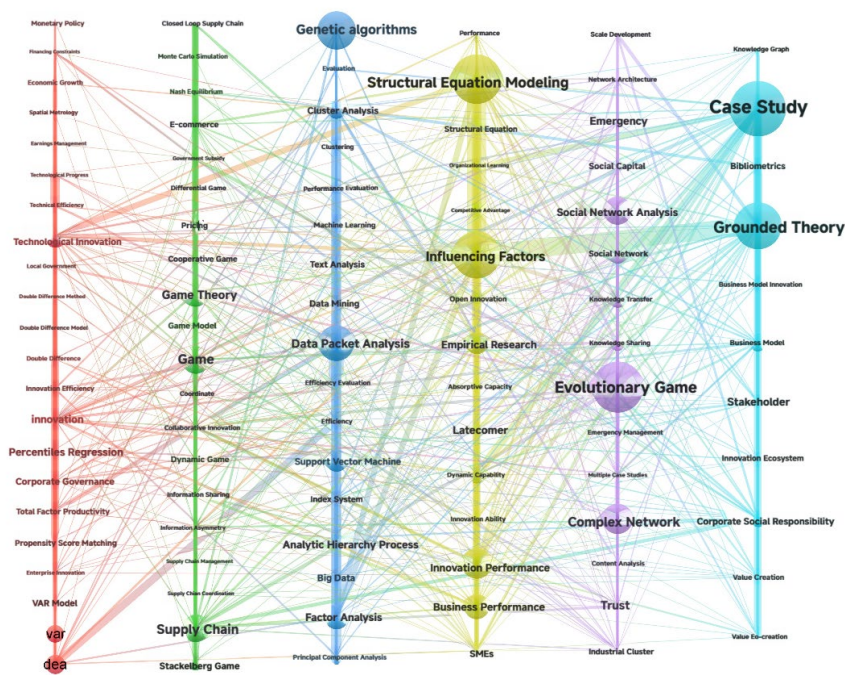


Figure 3. Keyword co-occurrence network

4.2.1 Economic Growth and Technological Innovation

Under this topic, the most frequently employed research methods include quantile regression, propensity score matching, difference-in-differences, VAR models, data envelopment analysis and structural equation modelling, the majority of which are statistical methods. Wang Shengquan et al. (Wang Shengquan, 2020) examined the correlation between the occurrence of asset bubbles, technological innovation and economic growth from both theoretical and empirical perspectives, employing FF-TVP-SV-VAR and TVAR models for empirical testing. Liang Lina and Yu Bo (Liang Lina, 2021) utilized spatial econometric models to analyze the impact of different technological

innovation patterns on regional economic development. Qian Haizhang et al. (Qian Haizhang, 2020) employed research methods such as panel data models and mediation effect models to conduct empirical tests on panel data from 31 provinces, exploring the impact of digital finance development on economic growth.

4.2.2 Supply Chains and E-commerce

Under this theme, the most frequently employed research methods include game theory models and Monte Carlo simulations. Among game theory models, the Stackelberg game appears most frequently. The application of mathematical models to study supply chain and e-commerce issues has primarily focused on research questions concerning manufacturers, retailers, consumers, pricing strategies and government subsidies. Ji Qingkai et al. (Ji Qingkai, 2022) examined the pricing decisions of manufacturers and retailers in a dual-channel supply chain subject to capacity constraints, based on the Stackelberg game. He Juan et al. (He Juan, 2015) proposed a more generalized method for long-term risk prediction of commodity portfolios based on Monte Carlo simulation, thereby mitigating current risk issues in supply chain finance. Wang Zhaohua et al. (Wang Zhaohua, 2022) utilized group game modelling and simulation techniques to analyze optimal product pricing for suppliers under two scenarios, and discussed the impact of product costs and transaction costs on product pricing.

4.2.3 Efficiency Evaluation and Construction of Indicator Systems

Under this theme, frequently employed research methods include genetic algorithms, cluster analysis, machine learning, text analysis, support vector machines and factor analysis, involving computer technology, statistical analysis and mathematical analysis methods. Yan Zhenjun and Hou Han (Yan Zhenjun, 2019) utilized data envelopment analysis to evaluate the comprehensive efficiency, pure technical efficiency and scale efficiency of incubators across 30 provinces in China, and classified the results using the K-means clustering method. Jiang Wenbo et al. (Jiang Wenbo, 2018) constructed an evaluation indicator system using literature review and factor analysis, and employed the DEA-Malmquist method to measure the decision-making efficiency of optimizing eco-economic governance. Wang Yu and Yang Shanshan (Wang Yu, 2021) used data envelopment analysis to evaluate the relative efficiency of listed companies, and adopted three techniques — support vector machines, artificial neural networks and decision trees — to validate the effectiveness of the proposed model.

4.2.4 Corporate Innovation and Performance

Under this theme, the most frequently employed research methods include structural equation modelling, grounded theory and factor analysis, with specific research questions covering corporate performance, innovation capacity and organizational learning. Hu Hao et al. (Hu Hao, 2022) utilized structural equation modelling to analyze survey data and perform model fitting in order to investigate the relationship between information technology fit and corporate agility. Zhou Xiaogang et al. (Zhou Xiaogang, 2021) employed hierarchical linear regression and structural equation modelling to examine

the mechanisms through which big data capabilities and technological innovation influence the competitiveness of human resources service enterprises, and utilized the Bootstrap method to test the mediating effect of technological innovation on the relationship between big data capabilities and the competitiveness of human resources service enterprises. Wei Wu et al. (Wei Wu, 2019) analyzed questionnaire data using factor analysis, structural equation modelling and moderation models to explore the mediating role of organizational attention in the relationship between organizational learning and corporate forecasting capabilities.

4.2.5 Network Analysis and Knowledge Management

Under this theme, the most frequently cited research methods include social network analysis, complex networks and text analysis, with research questions covering emergency management, knowledge management and industrial clusters. Wei Jing et al. (Wei Jing, 2014) proposed an evolutionary model of online knowledge transfer networks based on the PageRank algorithm to investigate the evolutionary patterns of such networks. Jia Ruixue and Li Weidong (Jia Ruixue, 2018) employed social network analysis to conduct an empirical study of the Shanghai Bund stampede incident, exploring the mechanisms of government image perception dissemination based on the evolution of social networks. Lin Jie and Yang Zhaojie (Lin Jie, 2021), utilizing data from the 'Autohome' forum, employed text analysis and statistical analysis of user network behavior characteristics, and utilized two-stage least squares modelling to analyze the relationship between user network behavior characteristics and professional knowledge levels.

4.2.6 Business Models and Value

Under this theme, the most frequently employed research methods include case studies, bibliometrics, grounded theory and knowledge graphs, with a greater emphasis on qualitative research methods. Research questions cover areas such as value co-creation, corporate social responsibility and corporate ecology, with grounded theory being particularly associated with studies on influencing factors. Wang Lin and Chen Zhijun (Wang Lin, 2020) employed an inductive case study, adopting a dual perspective of structural and process dependencies to examine how value co-creation influences the improvisational capabilities of innovative enterprises. Song Yun et al. (Song Yun, 2022) utilized grounded theory to study Chinese manufacturing enterprises that have successfully restructured their global value chains, exploring the process mechanisms underlying this restructuring. Zha Xianjin et al. (Zha Xianjin, 2022) employed grounded theory to conduct coding analysis on raw data obtained from interviews, thereby constructing a theoretical model of the mechanisms influencing satisfaction with intelligent information recommendation services in digital libraries.

4.3 Methodology – Analysis of Authors' Applications

Following the approach of Huang Qianqian and Yang Jianlin (Huang Qianqian, 2022), this study conducted a systematic cluster analysis of high-frequency authors to identify their research

methodology usage patterns. Twenty-two authors with 16 or more publications were selected for analysis. The primary research content of core authors within a field reflects research trends in that field, whilst their choice of research methods can reveal the combinatorial patterns of mainstream knowledge. Based on the frequency of research method usage among these 22 authors, a matrix of core authors' research methods was generated and imported into SPSS for systematic clustering; the clustering results are shown in Figure 4.

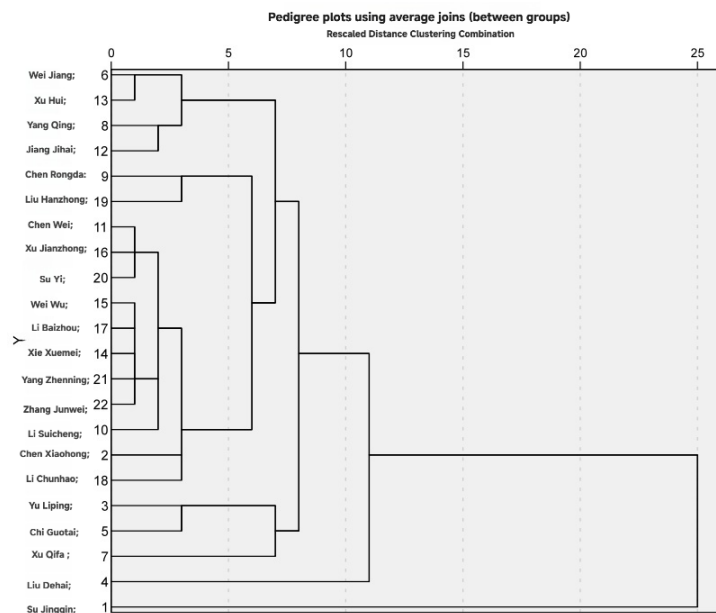


Figure 4. Clustering of Core Authors

By integrating the authors' specific research methods and literature data with the aforementioned clustering results, the core authors were further categorized into four groups, as shown in Table 2. Among them, scholars represented by Wei Jiang and Xu Hui have conducted extensive research in corporate economics, trade economics, industrial economics, and scientific research management. They primarily employ research methods such as case studies, questionnaire surveys, and structural equation modeling, with their publications concentrated in journals such as **Scientific Research Management**, **Management World**, and **Management Review**; Scholars such as Chen Rongda and Liu Hansuo focus more on finance and mathematics. Compared to the previous group, they employ research methods such as Monte Carlo simulation, vector autoregression, and least squares analysis more frequently, with their publications concentrated in journals such as **Journal of Management Science** and **Research on Quantitative Economics and Technical Economics**; Scholars represented by Chen Wei, Xu Jianzhong, and Su Yi, as well as those represented by Yu Liping and Chi Guotai, both focus on corporate economics, macroeconomic management, and sustainable development. However, the former group frequently combines research methods such as structural equation modeling, questionnaire surveys, factor analysis, data envelopment analysis, and case studies, while the latter

group primarily employs methods such as quantile regression, principal component analysis, and vector autoregression; The third group of authors primarily publishes in journals such as *Research in Science Studies*, *Research Management*, and *Theory and Practice of Systems Engineering*, while the fourth group focuses on journals including *Chinese Journal of Management Science*, *Journal of Systems Engineering*, and *Theory and Practice of Systems Engineering*. By analyzing the research methods and primary research topics employed by these core authors, and considering the journals in which they publish, we can gain insight into the mainstream knowledge integration patterns of these core authors.

List of Authors	Main Research Methods	Main Research Areas
Wei Jiang, Xu Hui, Yang Qing, Jiang Jihai, Su Jingqin	Case studies, surveys, structural equation modeling	Business Economics, Trade Economics, Industrial Economics, Research Management
Chen Rongda, Liu Hanzhong	Monte Carlo simulation, vector autoregression, least squares method	Finance, Mathematics
Chen Wei, Xu Jianzhong, Su Yi, Wei Wu, Li Bozhou, Xie Xuemei, Yang Zhenning, Zhang Junwei, Li Suicheng, Chen Xiaohong, Li Chunhao	Structural equation modeling, surveys, factor analysis, data envelopment analysis, case studies	Business Economics, Macroeconomic Management and Sustainable Development;
Yu Liping, Chi Guotai, Xu Qifa, Liu Dehai	Quantile regression, principal component analysis, vector autoregression	Business Economics, Macroeconomic Management and Sustainable Development

Table 2. Key Research Methods and Topics of Core Authors

4.4 Co-occurrence Analysis of Research Methods

Different research methods are often required to be used in combination at various stages of a study, such as questionnaire surveys and interviews during the data collection phase, and cluster analysis, data envelopment analysis, and structural equation modeling during the data analysis phase. Conducting a co-occurrence analysis of research methods can provide guidance for designing combinations of research methods in future studies. Among the 13,823 target publications, the number of research methods used per publication is shown in Figure 5. Most publications employed only one or two research methods, while a small number utilized three or four methods.

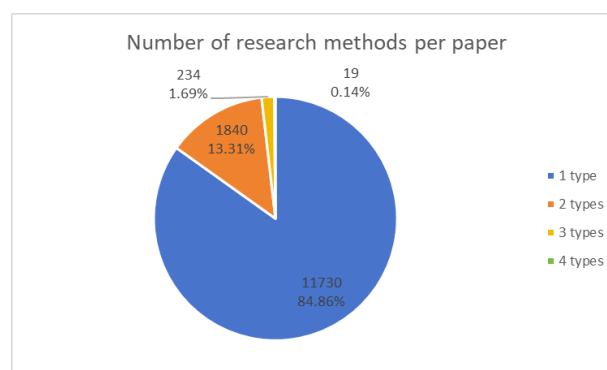


Figure 5. Distribution of Research Methods by Number

This paper first compiles the research methods used in each article, counts the number of times a single method appears two or more times within an article, and uses BibExcel to generate a co-occurrence matrix. This matrix is then imported into Gephi software to visualize the co-occurrence of research methods. The co-occurrence patterns of the 27 research methods are shown in Figure 6. A total of 19 articles featured four research methods simultaneously. Among data collection methods, interviews and questionnaire surveys appeared most frequently, while among data analysis methods, grounded theory, factor analysis, and structural equation modeling appeared most frequently. As shown in the research method co-occurrence matrix in Figure 6, questionnaire surveys and structural equation modeling co-occurred the most frequently. There are five combinations with over 100 co-occurrences, specifically: questionnaire surveys + structural equation modeling (329 times), questionnaire surveys + interviews (162 times), questionnaire surveys + factor analysis (130 times), case studies + game theory (109 times), and grounded theory + case studies (117 times). Combinations with a higher frequency of co-occurrence involving three research methods include: questionnaire survey + interview method + structural equation modeling; questionnaire survey + interview method + factor analysis; questionnaire survey + interview method + data envelopment analysis; and questionnaire survey + interview method + grounded theory. There were 19 articles that combined four research methods, among which the combination of interviews + questionnaires + structural equation modeling + factor analysis appeared three times. The research process primarily involved collecting data through questionnaires and interviews, followed by statistical analysis of the collected data using factor analysis and structural equation modeling. Research topics included supply chain logistics coordination (Xie Lei, 2012; Xie Lei, 2014) and the market-oriented structure of nonprofit organizations (Hu Yangcheng, 2009). The remaining studies primarily selected interviews and questionnaires as data collection methods, and employed research methods such as factor analysis, grounded theory, structural equation modeling, and data envelopment analysis for data analysis.

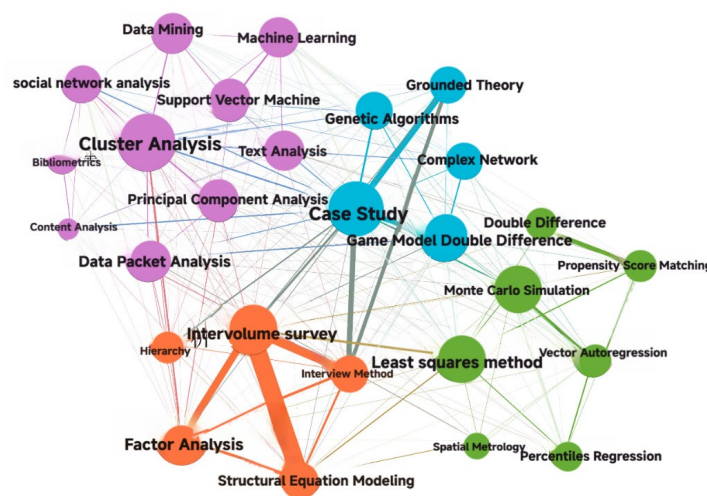


Figure 6. Co-occurrence network of research methods

5. Research Implications

Based on an understanding of the current status and evolutionary trends in the application of research methods within the field of management science in China, this study offers further insights to help researchers better utilize and understand these methods.

5.1 Enhancing Understanding of Qualitative Research Methods

In recent years, qualitative research methods have garnered widespread attention in the field of management science in China. In particular, there has been a growing number of research findings represented by case studies, which are gradually becoming more standardized. An increasing number of journals in the field of management science have also begun to emphasize qualitative research. In 2005, the journal *Management World* and Renmin University of China jointly hosted the “Forum on Chinese Enterprise Management Cases and Qualitative Research,” which delved deeply into outstanding practices in local enterprise management. In 2008, Dalian University of Technology launched the *Journal of Management Case Studies and Reviews*, which significantly advanced the development of case studies in China. Since 2013, grounded theory research methods have shown a rapid growth trend in the field of management science in China. Many scholars have actively employed grounded theory to construct indigenous Chinese management theories. Jia Xudong and Liang Cheng (Jia Xudong, 2016), drawing on research experience and classic works in grounded theory, proposed the “Chinese Management Grounded Research Paradigm.” Zhang Binghong et al. (Zhang Binghong, 2022) constructed a research framework model for Chinese management theory based on knowledge maps and grounded theory. In addition, qualitative research has seen the emergence of methods such as ethnography (Du Songhua, 2022), qualitative comparative analysis (Du Yunzhou, 2017), and discourse analysis (Lü Yuan, 2012). Qualitative research can better engage with practice, highlight context, and demonstrate processes — features that quantitative research lacks. Therefore, qualitative research is particularly important for the development of Chinese management science; it can enhance the practical relevance of management research, contribute to the construction of management theories with Chinese characteristics, and simultaneously illustrate the evolutionary processes of interesting phenomena (Mao Jiye, 2018). Qualitative research is also characterized by diversity and a lack of fixed procedures, relying heavily on experience, which makes it difficult for beginners to master through imitation; this is one of the reasons for the relatively limited output of qualitative research.

5.2 Emphasizing the Integration of Multiple Research Methods in Complex Contexts

With the rapid development of new-generation information technologies, the complexity of systems continues to increase, presenting new research challenges for the field of Chinese management science. A single research method struggles to adapt to changes in complex environments; therefore, developing and expanding management research methodologies helps address research problems in complex contexts and meets the demands of social development under new circumstances. In the application of

mixed-methods research, qualitative methods are often combined with quantitative methods. For example, Su Yufeng et al. (Su Yufeng, 2017) employed grounded theory to explore a model of local entrepreneurship through multi-case induction; In the integration of qualitative and quantitative research methods, the most common approach is the combination of case studies and game theory models. Huang Wei et al. (Huang Wei, 2020) employed a mixed-strategy game theory model to study rational decision-making behavior between two entities, validating their findings through analysis of real-world cases; In the combination of quantitative research methods with quantitative research methods, the most common approach is the integration of factor analysis with structural equation modeling. Zhou Linbo (Zhou Linbo, 2023) conducted exploratory and confirmatory factor analyses on survey data regarding youth volunteer service participation in Chongqing, and used higher-order measurement structural equation modeling to perform fit tests. In the face of an increasingly complex management environment, the combined use of multiple research methods has become increasingly common. Therefore, the application of mixed research methods will facilitate research in the field of management science, reflecting the exploration and application of diversified research methods in China's management science sector in recent years.

5.3 Actively Building a Research Methodology System for Management Science with Chinese Characteristics

On May 17, 2016, General Secretary Xi Jinping delivered an important speech at the Symposium on Philosophy and Social Sciences, proposing that the effort to build philosophy and social sciences with Chinese characteristics ultimately boils down to constructing a knowledge system independent of China. As an interdisciplinary field spanning natural sciences, engineering sciences, and social sciences, management science explores the universal objective laws of management activities. Research methods constitute a vital component of this knowledge system; a research methodology system is an organic whole composed of interconnected, interactive, and mutually constraining elements (Luo Jinzeng, 2014), rather than a simple aggregation of individual methods. Such a system is crucial to the development of the discipline, and establishing a research methodology system that meets practical needs remains an ongoing goal for the academic community. Chen Hongyan and Zhang Xinping (Chen Hongyan, 2012) point out that constructing a methodological system for educational management has become an urgent and practical task. Yin Shuang (Yin Shang, 2009) explores the construction of a theoretical research methodology system for public administration from three levels: methodology, basic methods, and specific methods. Tang Mingwei et al. (Tang Mingwei, 2020) employed research methods such as feature analysis and literature analysis to study the methodological and technical system of information science in a big data environment. Currently, China is entering a new stage of development. Driven by the need to address major practical issues and amid increasing managerial complexity, the construction of a scientific research methodology system for management with Chinese

characteristics holds significant practical significance. Research methods serve as a bridge connecting theory and practice; the refinement of the methodological system contributes to disciplinary development and the generation of theoretical outcomes, carrying important theoretical significance.

5.4 Emphasizing the Applicability and Standardization of Research Methods

The applicability of research method selection and the standardization of their use are particularly important. The rational selection of research methods should be problem-oriented; problems serve as the starting point for theoretical research. Regarding the contribution and practicality of management theory, the primary challenge lies in the problems themselves. The problem-oriented principle requires starting from the national conditions of one's own country to address China's practical problems and guide China's management practices (Sheng Zhaohan, 2019). In the problem-oriented process, new methods and techniques for solving problems are proposed, and their scientific significance is validated through practice. However, in reality, many studies are method-oriented, prioritizing the ease of implementation of research methods, which leads to the selection of simpler, more easily executable methods. Scientific research should focus on the problem and select appropriate research methods based on the specific research question. The standardized use of research methods embodies scientific rigor and precision. Each research method has its own specific conditions and applicable scenarios. Currently, many research methods in China's management science field suffer from a lack of standardization. Wang Mengxun and Fang Weihua (Wang Mengxun, 2019) examined the application conditions and research design of case studies and found that some research findings were derived from subjective experience-based analysis, failing to truly apply case analysis methods in a standardized manner. The standardized use of research methods facilitates the production of rigorous research outcomes and contributes to the development and integration of the management science field, thereby helping to establish a research methodology system for management science within the Chinese context.

6. Conclusions and Outlook

This paper uses 20 core journals in the field of management science as its data source to analyze the application of research methods across these journals, conducting an in-depth analysis of aspects such as frequency of use, thematic associations, author usage, and method co-occurrence. The findings reveal that quantitative research, single research methods, and applied articles dominate the field, while qualitative research and mixed-methods approaches have gradually increased in recent years. In the future, researchers in the field of management science should enhance the standardization, applicability, and theoretical grounding of research methods, enrich research content, and establish a research methodology system for management science with Chinese characteristics.

Since this study only counted research methods appearing in abstracts and did not analyze all journal articles, there is a certain gap in reflecting the full panorama of research method applications in

the field of management science. Future work will expand the data sources and utilize advanced technologies to more accurately identify research methods in literature, thereby providing a reference for the application of research methods in the field of management science.

Funding: One of the research achievements of the Graduate Student Scientific Research and Innovation Fund Project of Anhui University of Finance and Economics, 'Knowledge Graph Construction and Application Research Oriented Towards "Theme-Method-Tool"' (Project Number: ACYC2022002).

Conflict of Interest: The authors declare no conflict of interest.

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