

Visual Analysis of the Employee Performance Research Literature

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Abstract. To visualize the current state of employee performance research, this paper uses CiteSpace visualization software to mine and analyze the content of research in this field during 2012-2021, and then presents it in the form of a knowledge graph. The study specifically explores the distribution of journal publications, authors, institutions, and hot topics and trends in the field of employee performance. Through the visual analysis of 656 publications, we found that: (1) the output size of employee performance research field showed a growing trend during 2012-2021. (2) A European research team with GEORGIOS BOUSTRAS as the core has been formed, but the amount of articles issued by each author is relatively small; research institutions are concentrated in universities, and the connection between institutions is relatively close. (3) The hot areas can be summarized into three key words: "organization", "management", and "model". (4) The "critical success factor", "mediating role", and "workplace" are the cutting-edge developments and trends in this field.

Keywords: Employee Performance; Bibliometrics; CiteSpace; Web of Science.

1. Introduction

Employee performance is not only related to employees' own compensation, but also an important aspect that affects corporate performance and is related to the achievement of organizational goals, therefore, it is important to study employee performance. With the changes in work and organizational environment, the concept and connotation of job performance have been continuously expanded. Scholars at home and abroad have done a lot of research and studies on the connotation, dimensions, and influencing factors of job performance. In terms of connotation, three perspectives include the outcome-oriented view of job performance[1], the behavior-oriented view of job performance[2], and the comprehensive view of performance[3]. In terms of dimensions, scholars have proposed various dimensions of job performance including two-dimensional[4], three-dimensional, and four-dimensional. With regard to influencing factors, scholars have conducted research on the antecedent variables of job performance in three main areas: individual factors[5], task factors, and environmental factors[6]. With the accumulation of research results, there is an urgent need for academics to summarize and analyze relevant studies, summarize the distribution of literature and research frontiers, and look forward to future research directions.

Currently, scholars have reviewed the research related to employee performance from different aspects. In China, scholars have summarized employee performance in terms of the relationship between employee insider identity perception, organizational identity and job performance[6], the relationship between psychological capital and employee performance, and the factors influencing employee performance. In abroad, scholars have done research reviews on the relationship between employee empowerment and employee performance[7], the impact of employee performance on leader performance[8], and the factors influencing employee performance[9]. However, few studies based on information visualization and econometric analysis have been reported. Therefore, in this paper, we use CiteSpaceV to summarize and analyze the literature in the field of employee performance for 10 years from 2012 to 2021, and by constructing a knowledge map to sort out the basic research status of researchers in the field of employee performance, reveal the existing problems and put forward targeted suggestions in the future of employee performance, in order to provide a reference for the subsequent research and development in the field of employee performance.

2. Study Design

2.1 Data Sources

The Web of Science database provides the most influential data for researchers by covering the entire world citation universe. The data in this study were obtained from the Web of Science core collection, using the advanced search function of the database, the topic= "employee performance", and research directions = "Operation Research Management Science", "Management", "Business", year of publication = "2012-2021", the document type = "thesis". A total of 709 theses were searched. The search results were downloaded and saved as plain text files in the format of "Abstract, Full Record (with cited references)" as a sample of the in-text analysis data. After CiteSpace de-duplication, we finally got 656 documents, and data analysis was performed on the de-duplicated documents.

2.2 Research Tools

Knowledge mapping is a metrological method for visualizing and analyzing a large amount of scientific literature information by means of statistics, graph theory, and computer technology to show the structure and disciplinary characteristics and development changes within the scientific discipline system. By analyzing the literature, visualization technology can deconstruct the literature information as a whole using simple image techniques, simplifying the potential information hidden in the vast amount of literature and making it easy to analyze and interpret the meaning expressed by the data. This study uses CiteSpace (CiteSpace 5.8 R3), a data mining and analysis tool developed by Professor Chaomei Chen of Drexel University, USA, for data processing and analysis, which is one of the most popular tools for knowledge mapping. CiteSpace is a visual analysis tool to explore the research frontiers and trends of a discipline or field by using the basic principles of information visualization methods, bibliometric methods and data mining algorithms integration, drawing visual maps, establishing associations between nodes to analyze the co-occurrence and co-citation relationships between research objects[10].

2.3 Research Methodology

Bibliometric method is a quantitative method combining mathematics and statistics, which mainly performs descriptive statistical analysis of the literature system and bibliometric features from different dimensions (such as keywords, etc.). In this study, the data of 656 theses are imported into CiteSpace, and the knowledge graphs are constructed by using the classification criteria of author, institution and keyword in turn, and the required relevant knowledge graphs are generated by adjusting the visualization effect.

2.4 Research Process

According to the description of CiteSpace in Dr. Chaomei Chen's "Scientific Knowledge Mapping Methods and Their Applications in Science and Technology Intelligence", the literature data information required for CiteSpace operation was converted and merged. The input and output folders were created to convert the Web of Science exported data into a format recognizable by the CiteSpace software, and the converted data files were stored in the output folder. Create new folders data and project, import the converted data files into the data folder and then enter the main interface of the system to import the relevant data. The time setting is 2012 - 2021, the length of single time zone segmentation is limited to 1 year, the source of subject terms is selected as title, abstract, author keywords(DE),keywords plus(ID), and the final threshold is kept as default; the node types are selected as Keyword, Reference, Cited Journal and other settings are kept as default settings, and CiteSpace will automatically parse the literature data information on a yearly basis after running the analysis.

3. Basic Characteristics of Employee Performance Research

The publication status of a certain discipline or field is, to a certain extent, a visual reflection of the research level and research intensity of the discipline or field, and is an important indicator of its maturity. The relationship between the number of theses published in the field of employee performance and the time of publication is indicative of the history of research in the field, the rate of development, and can also predict trends in its development. Figure 1 shows the number of theses published and the trend of employee performance-related research in the Web of Science core collection from 2012 to 2021. As can be seen from Figure 1, the number of publications in the field of employee performance varies between years, but the number of publications is high every year, especially in 2021, when the number of publications exceeds one hundred. Overall, the number of theses shows a growing trend, which indicates that employee performance has been an area of greater academic interest and has received widespread attention from scholars. It can be seen that the research on employee performance has become increasingly hot in recent years, and it can be expected that the number of scientific papers will continue to grow in the future.

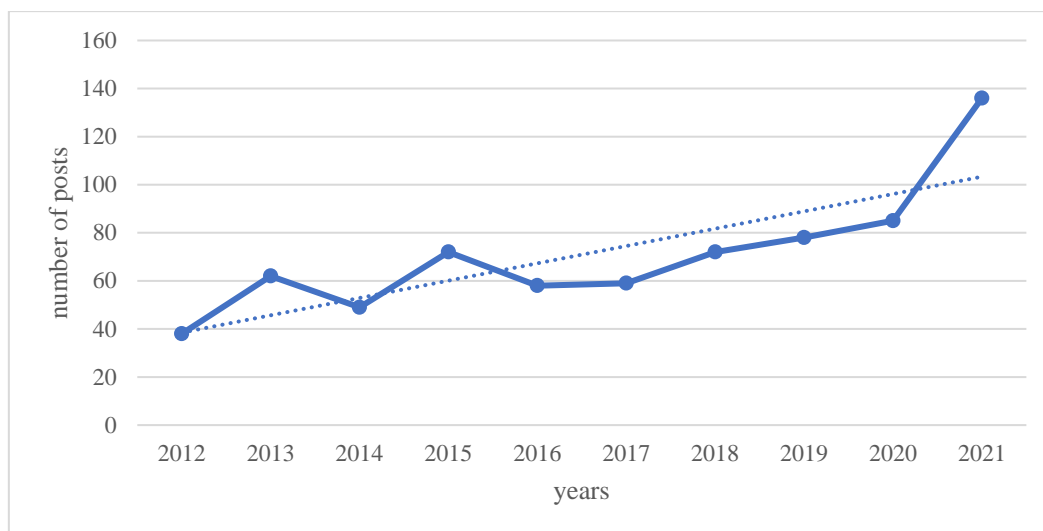


Fig. 1 Time-series distribution of employee performance-related research literature

4. Employee Performance Research Hotspots and Future Trends

4.1 Analysis of Employee Performance Hotspot Areas

4.1.1 Keyword Co-occurrence Analysis

Keywords are the condensation and distillation of an article's content. Keywords that appear repeatedly in a certain field (high-frequency keywords) can better reflect the research hotspots in that field. Run CiteSpace, set the time slice to 1 year, and the node type to keyword, and conduct keyword co-occurrence analysis. Figure 2 shows the keyword co-occurrence knowledge map of employee performance-related research with 365 network nodes, 1507 connections, and 0.0227 network density. The size of the circle indicates the frequency of the keyword, and if the keyword connection at a node is more dense and complex, it means that the keyword is a hot spot for scholars' research. From Figure 2, we can see that "organization", "management", and "model" are the hot spots that scholars in the field of employee performance have focused on in the past decade.

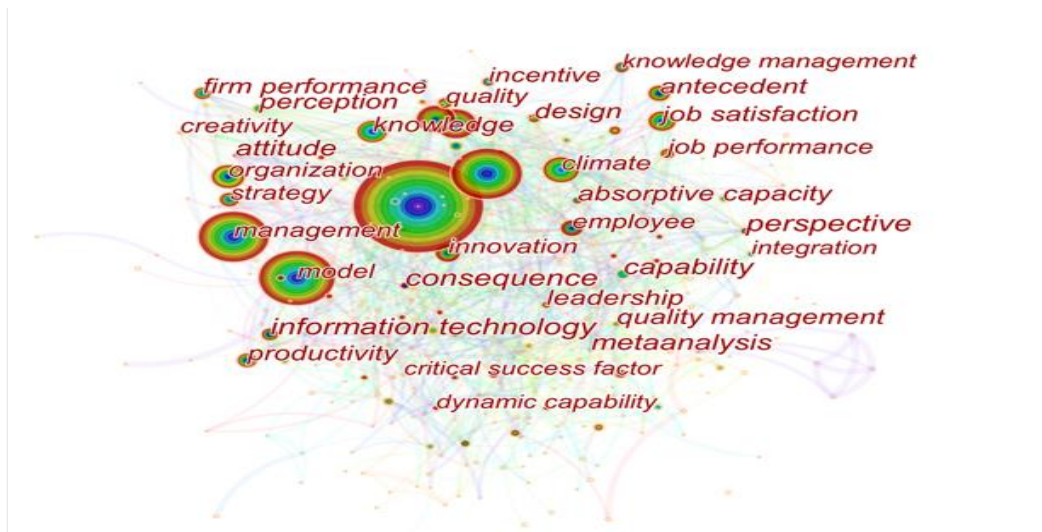


Fig. 2 Keyword co-occurrence knowledge graph

The higher frequency of the keyword indicates that the keyword is more likely to be paid attention to by scholars and reflects the research direction of the field. In the keyword co-occurrence knowledge graph, performance is the word with the highest co-occurrence frequency of 302 times. According to the formula of Price's law, the minimum frequency of high-frequency keywords in employee performance research $M=0.749\sqrt{N_{max}}=0.749\sqrt{302}\approx 12.622$, and then the keywords with no less than 12 frequencies and keyword centrality ≥ 0.1 were counted and classified as hot keywords (Table 1). As can be seen from Table 1, "consequence", "information technology", and "perspective" have a strong academic influence in the scientific literature related to employee performance. It can be seen that academic research on employee performance mainly focuses on three major aspects: consequences of employee performance, different perspectives, and the impact of information technology.

Table 1. Distribution of hot keywords for employee performance research

Keywords	word frequency	Centrality	Year
consequence	19	0.12	2012
information technology	31	0.11	2012
perspective	19	0.10	2013

4.1.2 Keyword Clustering Mapping

The basic principle of clustering is to categorize and pool keywords with similar degree of connection within the search scope to form independent categories. Keyword clustering highlights the structural features of keyword key nodes and important links. The keyword network mapping was clustered by using the log-likelihood algorithm (LLR) to form a keyword clustering structure mapping in the field of employee performance research, as shown in Figure 3. Different numbers represent different clustering numbers, and employee performance is the subject of keyword clustering concentrated in five larger categories. The information modularity (Q) of the figure is 0.3486, which is greater than 0.3 implying that the structure of the delineated associations is significant, and the profile coefficient (S) of the map is 0.6862, which is generally considered reasonable for clustering with S above 0.5. The magnitude of the values of Q and S indicates that the keyword clustering map is reasonable and can basically reflect the general situation of the research area.



Fig. 3 Knowledge mapping of keyword clustering

4.2 Analysis of Future Research Trends in Employee Performance

The concept of research frontiers was first introduced in 1965 by the bibliometrician Price and has since been used to describe the dynamics of the research field and to consider research frontiers as emerging theoretical trends and the emergence of new themes. Keyword burst detection can identify emerging trends in the research field, reacting to a topic that has received special attention from the academic community over a certain period of time. With the function of CiteSpace 's emergent words, the keywords of employee performance-related research from 2012-2021 were analyzed, with the time slice set to 1 year and $\gamma = 1.0$, and the top 10 emergent words were selected to generate a knowledge graph (Figure 4), with the red range indicating the time period with the greatest change in frequency of occurrence, i.e., the most influential during that time period. From Figure 4, we can see that "firm" and "customer satisfaction" are the keywords that appear earlier (2013) and have a shorter duration, lasting only one year, but "firm" has a high intensity of 4.32, which indicates that it is more meaningful in employee performance research. "critical success factor", "mediating role", and "workplace" are the most recently emerged keywords, indicating that these are the hottest research terms in employee performance today, reflecting the cutting-edge dynamics and development trend of employee performance research.

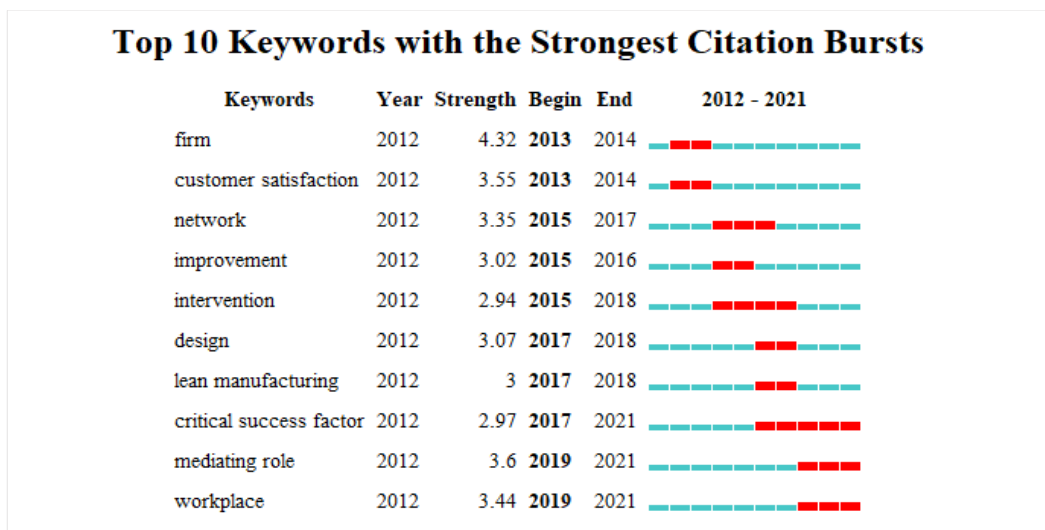


Fig. 4 Employee performance keyword emergent knowledge map

5. Conclusion

Based on the information visualization software CiteSpace, the article visualized and analyzed the data of English papers on employee performance research included in the Web of Science database from 2012-2021. After analyzing the literature in the field of employee performance research in terms of temporal distribution, authors, institutions, and highly cited literature, analyzing the hot spots and core research themes in the research field, and analyzing the evolutionary trends and research frontiers in the research field, the following main conclusions were drawn:

First, in terms of the number of theses in the current employee performance research, the number of theses shows a growing trend. This indicates that employee performance has been an area of greater academic interest, and scholars have paid particular attention to this area of research in recent years.

Second, from the hot keyword analysis and keyword co-occurrence knowledge mapping analysis, we found that the hot topics in the field of employee performance research in the past 10 years mainly revolve around the themes of "organization", "management", "model" and "knowledge". It is stated that scholars have mainly studied employee performance from three major aspects: organizational management, research models of employee performance, and employee knowledge.

Third, from the keyword co-occurrence cluster analysis and knowledge mapping analysis, it was found that the core research themes in the field of employee performance research in the past 10 years were mainly focused on five areas: first, safety climate, safety leadership; safety compliance was a theme related to it; second, lean manufacturing, process wastes is a related theme; third is continuous improvement, knowledge management; organization development is a related theme; fourth is economics, knowledge sharing is a related theme; fifth is enterprise social media, employee stress and job satisfaction is a related topic.

Fourth, from the evolutionary trend, the emergent knowledge map of keywords shows that "critical success factor", "mediating role", and "workplace" are the hot topics in recent years, and the emergent value of "mediating role" is the highest among the three, at 3.6., which indicates that it is more meaningful in employee performance research. Thus, it seems that the key factors for improving employee performance, mediators affecting employee performance, and employees' workplace are hot topics of research in the recent and future period.

The results of this study show that the management of employees and the development of related models are the aspects that have received general academic attention in the last decade. Research on the role of mediation and the employee workplace is a hot topic of interest for scholars starting in 2019. Overall, the field of employee performance research has accumulated a considerable amount of research output literature in the last decade, of which the foundational literature has generally laid down a macro research framework for the field, and with the continuous accumulation of research, a stable and prominent core research theme in this field has been formed in general.

6. Limitations and Prospects

This study mainly uses CiteSpace to conduct scientific knowledge mapping analysis of employee performance research, which overcomes the subjectivity of previous literature reviews and expert judgments and can better reflect the research frontiers and hot spots in the field of employee performance research, but the research still has the following shortcomings. This study mainly uses papers published in Web of Science core journals between 2012 and 2021 as data sources to analyze the characteristics of literature, research topics, and research frontiers in the field of employee performance research, and the data analysis does not include other data sources that respond to the characteristics of the field of employee performance research, such as proceedings of the conference, review papers, publish online, editorial material, etc., Inevitably, there are limitations such as literature omissions and insufficient analysis. And the search terms used in this paper are limited to one - "employee performance". which is one of the limitations of this paper's findings. In addition, this paper mainly analyzes the characteristics of the literature and the content characteristics of the

research area with quantitative analysis methods, and needs improvement in combining qualitative analysis methods to analyze the research themes and hot spots in the field of employee performance.

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