

## Using Baidu Index to Investigate the Spatiotemporal Characteristics of Public Concern Towards Knowledge Management in China

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**Abstract.** In the era of knowledge economy, knowledge has become the guide to creating economic and social value. Knowledge economy calls for knowledge management, and modern knowledge management is a new management theory and management method emerging in the time of knowledge economy, which explains the relevance of this research. Baidu is the largest Chinese search engine in the world, and the Baidu Index developed by Baidu is one of the most important statistical analysis platforms of the Internet and even the whole data age. The purpose of this paper is to investigate spatiotemporal characteristics of Chinese public attention to knowledge management through the Baidu index. Text analysis and process tracing are used to explain the reasons for the spatial and temporal characteristics of the Chinese public's attention to knowledge management. Through Baidu index network search engine, this paper analyses search trend, demand graph, and demographic and geographic distribution. This paper selects the time period from January 1, 2011 to January 1, 2022. The results of the study show that the search trend of "knowledge management" in the past 11 years peaked at the end of 2016, and the decrease appeared around the Spring Festival and National Day each year. "Learning organization", "knowledge base" and "information management" are the words most concerned by the public. It was stated that the groups concerned about "knowledge management" were mainly distributed in Guangdong, Beijing, and Shanghai. Among them, the predominant group was male aged 20-29. The factors that affect the changes in the search volume of "knowledge management" mainly include the traditional Chinese holidays, the Spring Festival, the National Day, and the release of knowledge management-related norms. In addition, the study found similar search trends for "knowledge management" and "knowledge management system". This paper only takes "knowledge management" in Baidu Index as the research object. Whether it is suitable for all network engines, needs to be tested furtherly

**Keywords:** knowledge economy, search engine, web search query data, computational social science

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## Introduction

With the development and change of global economy and the intensification of industrial competition, the virtual, information-based, networked and intelligent knowledge-based economy has gradually replaced the industrial economy, which has become the distinctive label of this era [1]. The research of knowledge management (KM) started with the advent of knowledge economy era [2]. Although discussion of knowledge management has been going on for many years, its definition has not formed a unified understanding and definition. However, the academic world has never lacked the definition of knowledge management. Sensuse et al. believe that knowledge management is a new concept of managing, developing, and retaining organizational knowledge [3]. Knowledge management is considered to solve the organizational problems of managing their organizational and individual knowledge. Lönnqvist considers the added value that knowledge management as an approach can bring to the management of knowledge-intensive organizations [4]. Palacios et al. [5] recognize that the importance of knowledge management for organizational competitive advantage, which seems to be a widely accepted issue in most management works of today, and acknowledges that effective and efficient knowledge management leads to superior organizational performance. Garcia's findings suggest that business organizations should promote and implement more knowledge management to positively impact organizational performance in the short and long term [6]. Demircioglu found that the theoretical and empirical evidence of knowledge management in organizations could prove that knowledge creation might occur internally or through knowledge spillovers [7]. Hussain et al. [8] agreed with Bhatt that knowledge management is knowledge creation, followed by knowledge organization, knowledge sharing, knowledge dissemination, knowledge application and use. And through the study, it was pointed out that knowledge creation, knowledge collection, knowledge organization, knowledge dissemination and knowledge application had a positive and significant impact on the innovation capability of SMEs. Koloniari et al. [9] concluded that knowledge management had obvious benefits for improving the organizational and competitive performance of the library and information major, as well as future career choices.

In summary, when knowledge management is used in enterprise organization management, knowledge management can bring competitive advantage and significant performance to the enterprise in the short or long term. Knowledge management is not only applied to enterprise management, but also to other various fields, mainly including the application in cultivating the core competitiveness of the organization; application in knowledge innovation; in new product development; in marketing, etc. In the era of knowledge economy, knowledge has become an important intangible asset and core competitiveness. Today, China's economy has shifted from a stage of high-speed growth to a stage of high-quality development.

Knowledge management is the driving force for economic development. Strengthening knowledge management is of great significance to improving China's international competitiveness and comprehensive national strength, and reaching China's goal of becoming an innovative country.

Today, the Fourth Industrial Revolution is at hand [10]. The rapid development of emerging technologies such as the Internet, the Internet of Things, and 5G communication networks has brought opportunities for people to make full use of the enormous value of network Big Data [11]. As an important way for users to obtain information, search engine plays a leading role. Baidu (Baidu.com) is the largest search engine in China. Baidu's Baidu Index Big Data Intelligent Analysis Platform can be used in academic research, social behaviour research and other aspects.

Today, the research on knowledge management in China using network search data is less concerned. Thus, this study uses Baidu index to analyse the spatiotemporal characteristics of the public's attention to knowledge management.

*The purpose of this paper* is to investigate spatiotemporal characteristics of Chinese public attention to knowledge management through the Baidu index.

## Materials and Methods

The geospatial scope covered by the data analyzed in this study mainly includes 31 provinces (municipalities and autonomous regions) in China (excluding relevant data from Hong Kong, Macau and Taiwan). This study uses Baidu index as a research tool to evaluate the spatiotemporal characteristics (the changing characteristics of the spatial distribution of a certain thing in the temporal dimension) of the knowledge management of the public at different times uses "knowledge management" as the search keyword to study the online search trend, demand graph, and demographic and geographic distribution of "knowledge management" from January 1, 2011 to January 1, 2022. At the same time, the related keyword "knowledge management system" of "knowledge management" is compared with the search trend in the same period.

The data presented by the Baidu Index Demand Graph is the relevant search term demand shown by the user in the change of search behaviour before and after searching for a certain term. Microsoft Excel was used to analyse the collected information. Based on this, it is possible to analyse which keywords the user has a demand for in addition to the keyword and develop derivative products for the industry and products and services for reference. The demand graph summarizes the data in one year with the "week" as the statistical unit.

However, the Baidu Index can only be used in the Baidu search engine, and the data source is limited to China. Therefore, this study did not evaluate data obtained by other search engines. Although Baidu Index can analyse trend research, demand maps and crowd portraits, it cannot obtain demographic data for the time being. Baidu Index



**Table 1.** Top 10 Search Terms Related to knowledge management in the Baidu Index

| Order | Keywords                        | Frequency |
|-------|---------------------------------|-----------|
| 1     | Learning organization           | 25        |
| 2     | Knowledge base                  | 24        |
| 3     | Information management          | 16        |
| 4     | Knowledge                       | 13        |
| 5     | Knowledge management system     | 13        |
| 6     | Knowledge economy               | 8         |
| 7     | Landray group                   | 6         |
| 8     | Process reengineering           | 6         |
| 9     | Knowledge graph                 | 5         |
| 10    | Information resource management | 5         |

The search trend of Baidu Index can be divided into 3 sections: personal computer (PC) trend, mobile trend, and PC trend + mobile trend. The main reasons for the peak in the search trend of “knowledge management” at the end of 2016 are: First, on December 13, 2016, the national standard “Intellectual Property Management Regulations for Colleges and Universities” (GB/T 33251-2016) was approved by the National Quality Supervision of the People's Republic of China Released by the General Administration of Inspection and Quarantine and the Standardization Administration of China. Intellectual property, also known as “knowledge (property) ownership” and “intelligence (property) ownership”, refers to the rights that the right holder enjoys in accordance with the law to the results of one's intellectual labor [12]. Intellectual property management is an important part of enterprise knowledge management. For innovative enterprises and knowledge enterprises, intellectual property management will become the core of enterprise knowledge management. Colleges and universities are the cradle of knowledge and the origin of national scientific and technological innovation. According to statistics, 70% of the important scientific and technological achievements affecting people's lives come from inventions in colleges and universities [13]. Strengthening management of intellectual property rights Chinese universities is of great significance for enhancing the core competitiveness of China's scientific and technological achievements in the world [13], and the management of intellectual property rights in universities is of great significance. The release of this specification has attracted widespread attention. Second, the online academic journal “Knowledge Management Forum” (ISSN 2095-5472, CN11-6036/C) published by the “Library and Information Work” magazine, which oversees the Chinese Academy of Sciences and sponsored by the Documentation and Information Center of the Chinese Academy of Sciences, was newly revised in 2016 and formed a new editorial board. “Knowledge Management Forum” is the only professional academic journal in the field of knowledge management, focusing on all knowledge-related research results and practical cases, including: Internet and knowledge innovation, big data and knowledge computing, data protection and knowledge organization, community of practice and

knowledge operation Content management and knowledge sharing [14]. The new establishment of the editorial board of the “Knowledge Management Forum” is of great significance in promoting the creation, organization, and effective use of knowledge in the age of knowledge, and promoting the rapid, extensive, and effective dissemination of knowledge management research results, leading to the public's attention to “knowledge management”. The valley value of “knowledge management” generally occurs around the Spring Festival and National Day each year. Every year from the end of January to the beginning of February is the most grand and traditional festival in China, the Spring Festival. The Spring Festival and the National Day are both official holidays in China, and the vacation time generally comprises seven days. Whether it is the Spring Festival or the National Day, people stop working or study to spend the festival, which leads to a decrease in the search index of “knowledge management” each year.

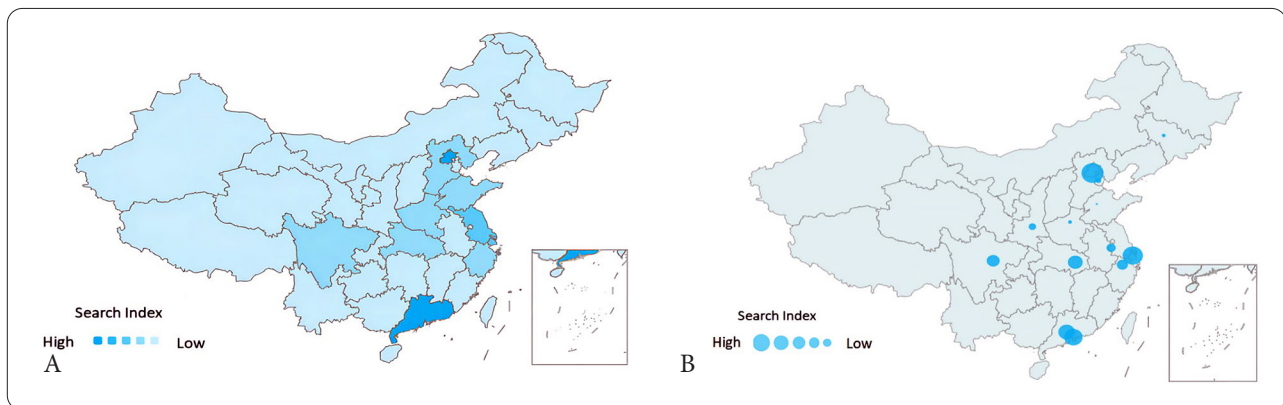
Comparing the PC computer terminal and the mobile terminal, it is found that the search trend of the PC computer terminal is not consistent with the search trend of the mobile terminal. From the perspective of the trend, overall PC computer terminal shows a downward trend, while the mobile phone terminal shows an upward trend. The number of netizens using mobile phones in China is huge. Based on the 48<sup>th</sup> “Statistical Report on Internet Development in China” released by the China Internet Network Information Center, the number of mobile netizens in China is 1.007 billion, an increase from December 2020. There are 20.92 million mobile netizens, and 99.6% of netizens use mobile phones to access the Internet [15]. Obviously, mobile phones have successfully become the preferred way for people to communicate with the world due to their advantages of simple operation and convenient carrying, which naturally leads to an increase in the search trend of mobile phones and a decline in the search trend of Personal computers.

This study summarizes top ten related words of “knowledge management” weekly search popularity from December 2020 to December 2021, and top 10 related words with the highest popularity words were recorded (Table 1). Among them, “learning organization” and “knowledge base” are the most frequently searched. Marquardt described the

“Learning organization” as follows: “learning as an entire organization at all levels to adapt and succeed with the environment that continually changes” [16]. “Knowledge base” refers to many facts with various entities and relationships [17]. It can be seen from the above definitions that learning organizations are based on information and knowledge, and knowledge management and learning organizations have an inseparable and close relationship. Learning organizations are one of the carriers for knowledge management to be implemented, and knowledge management is learning the core and essence of the organization. When the searcher searches for “knowledge management” in the Baidu index, the keywords “learning organization” and “knowledge

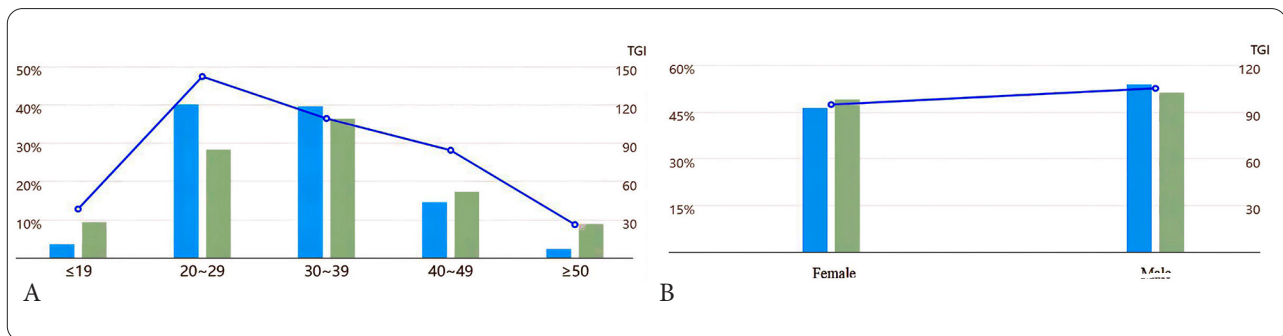
base” with high correlation are also included in the search content and have the highest search frequency (Table 1).

From the geographical distribution of the Baidu Index functional module group portraits, Eastern China and Northern China pay more attention to “knowledge management”, and Beijing’s attention to “knowledge management” ranks first in both provinces and cities (Fig. 3). From the crowd attributes in the crowd portraits of the Baidu Index function module, it was established that the age 20-29 (40.07%) and men (53.78%) are the main sources of people who search for “knowledge management” related content (Fig. 4). Meanwhile, search trends for “knowledge management system” and “knowledge management” were similar (Fig. 5).



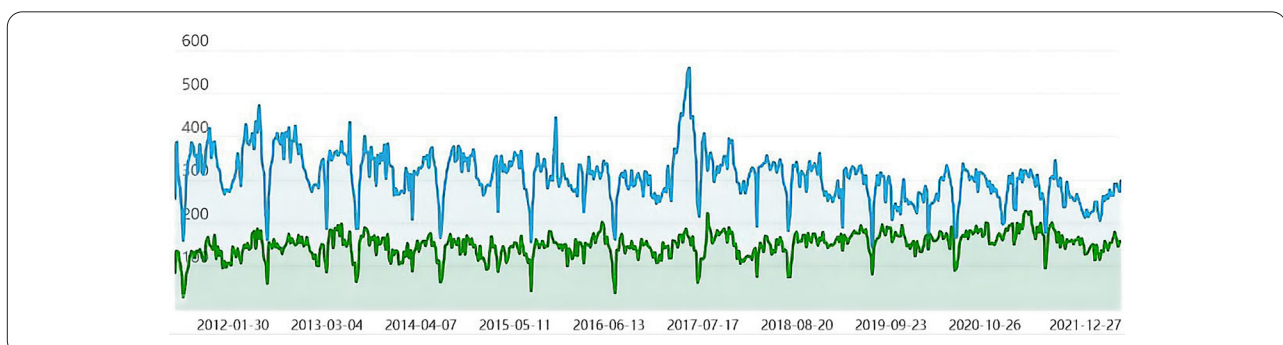
**Figure 3.** Baidu Index maps for “knowledge management”: A – province; B – city

**Source:** authors’ own research



**Figure 4.** Demographic profiles by age (A) and gender (B)

**Source:** authors’ own research



**Figure 5.** Baidu search volume index for “knowledge management” (blue line) vs “knowledge management system” (green line)

**Source:** authors’ own research

Demographic and geographic distribution of the Baidu Index can focus on which regions users come from. Geographical distribution of the data of “knowledge management” has been provided since July 2013. The analysis of the geographical distribution of “knowledge management” shows that the search behaviors of users in the four regions of Beijing, Shanghai, Guangzhou, and Shenzhen are more common (Fig. 4). Both Beijing and Shanghai ranked in the top two in terms of provincial rankings and city rankings. The reason why Beijing ranks first is related to the journal Knowledge Management Forum (ISSN 2095-5472). The journal was founded and published in Beijing. In addition, Beijing and Shanghai are the political and economic centers of China. The comprehensive strength and competitiveness of cities in mainland China are at the most advanced level. Today, knowledge management has been applied to agriculture, industrial construction, transportation, post and telecommunications, business, education, health, finance, industry, etc. Beijing and Shanghai, the first-tier cities with strong comprehensive strength, are bound to practice knowledge management in various industries.

The population attributes can be used to understand the gender and age distribution of users who follow a certain keyword. As Baidu Index provides the data of population attributes on a monthly basis, this study summarizes the social attention data from January 1, 2021 to January 1, 2022, and analyzes the crowd attributes (Fig. 4). The analysis data shows that the gender ratio of men and women is 53.78% and 46.22% respectively, which shows that men pay more attention to knowledge management. In the age distribution, the 20-39-year-old group pays the most attention to knowledge management, with a total of 79.65%, of which the 20-29-year-old group pays attention to 40.07%, and the 30-39-year-old group pays 39.58% attention. The 20-39-year-old group represents the attention of scientific researchers and company management to knowledge management. Groups aged 40-49 paid less attention (14.51%); those aged less than 19 paid 3.54%; those aged over 50 paid the least attention, only 2.29%. In addition, TGI (Target Group Index) is an index that reflects the strength or weakness of the target group in a specific research scope. TGI index can indicate the preference of users with different characteristics to pay attention to problems. TGI index is greater than 100, which means that some users have more corresponding tendencies or preferences. The larger the value, the stronger the tendencies and preferences. If it is less than 100, it means that this kind of users' relevance tendency is weak (compared with the average); and equal to 100 means at the average level. TGI analysis is a method often used in data analysis, and its calculation method is:  $TGI\ index = \frac{\text{the proportion of groups with certain characteristics in the target group}}{\text{the proportion of groups with the same characteristics in the whole population}} \times \text{the standard number}$  is 100. In the gender distribution, the TGI of women was 94.66 and that of men was 105.1, indicating that the male public is more interested in knowledge management-related information.

The study found similar search trends for “knowledge management” and “knowledge management system” (Fig. 5). However, regarding search index, both the overall value of average daily and the mobile value of daily average of “knowledge management” are higher than those of “knowledge management system”. Knowledge management system refers to the use of an information system to manage organizational knowledge [18]. This definition clarifies the relationship between knowledge management and knowledge management system, in other words, knowledge management system is a tool for knowledge management. Knowledge management systems are used only when the amount and complexity of knowledge accumulation within an organization reaches a certain level. Therefore, the keywords entered by users in Baidu Index are knowledge management first, and only when users have demands on the knowledge management system, they will further understand it.

Since the early 21<sup>st</sup> century, the related research in the field of knowledge management in the world has been rising and continuing. Kavalic et al. put forward a structural model of knowledge management process, which shows the relationship among knowledge generation, knowledge sharing, knowledge storage and knowledge utilization, and its influence on organizational knowledge management performance [19]. It provides empirical support for the core role of knowledge management in enterprise performance. The research by Lei et al. provides theoretical support for knowledge management to improve enterprise efficiency and strengthen enterprise core competitiveness [20]. The study by Zhou et al. shows that enterprise knowledge management plays a positive role in promoting organizational innovation ability and industrial development [21]. It provides direction for the development of enterprise knowledge management and the improvement of innovation ability. Similarly, the results of the presented study showed that the intellectual property management was an essential part of enterprise knowledge management. In addition, it can be suggested that for innovative enterprises and knowledge enterprises, intellectual property management would become the core of enterprise knowledge management. Thus, it can be argued that the findings of this study coincide with the statements of other researchers in this subject area.

## Conclusions

Through the trend search study of “knowledge management”, it was found that the decline of knowledge management search trend was closely related to Chinese traditional holidays, such as Spring Festival and National Day. An analysis of the attributes of the “knowledge management” population proved that there were obvious differences in gender when it came to the attention to “knowledge management”. Men pay more attention to knowledge management than women. Beijing, the most advanced political center in Chinese mainland, pays attention to knowledge management, ranking first in all provinces and cities in China. The search trend of “knowledge management system” related to “knowledge management” is analyzed

in the same period, and it is found that the search trend of “knowledge management system” was consistent with that of “knowledge management”. However, the overall daily average and moving daily average of “knowledge management” are higher than those of “knowledge management system”.

Sorting out and gathering knowledge management data information is helpful to analyze the public's search behavior and psychology, and can greatly promote the development of knowledge management in China. Based on the Baidu Index, it is possible to understand the online attention to knowledge management in different regions and

different genders in China, to analyze the user psychology and needs behind the search behavior. However, a deeper study of knowledge management Baidu index needs to be continuously developed and improved in future.

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## Використання індексу Байду для дослідження просторово-часових характеристик управління знаннями в Китаї

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**Анотація.** В епоху економіки знань знання стали провідником для створення економічної та соціальної цінності. Економіка знань вимагає управління знаннями, а сучасний менеджмент знань – це нова теорія менеджменту та метод управління, що виникають у часи економіки знань, що пояснює актуальність цього дослідження. Байду є найбільшою китайською пошуковою системою у світі, є однією з найважливіших платформ статистичного аналізу в Інтернеті та навіть у всій епосі даних. Метою цієї статті є дослідження просторово-часових характеристик уваги китайської громадськості до управління знаннями за допомогою індексу Байду. Аналіз тексту та відстеження процесу використовуються для пояснення причин просторових і часових характеристик уваги китайської громадськості до управління знаннями. За допомогою пошукової системи індексної мережі Байду у статті аналізується тенденція пошуку, графік попиту, а також демографічний і географічний розподіл. У рукописі вибрано період часу з 1 січня 2011 року до 1 січня 2022 року. Результати дослідження показують, що тенденція пошуку «управління знаннями» за останні 11 років досягла піку в кінці 2016 року, а зниження відбулося близько Весного фестивалю та під час щорічного Національного дня. «Організація, що навчається», «база знань» та «менеджмент інформації» – це слова, які найбільше хвилюють громадськість. Було заявлено, що групи, які стурбовані «управлінням знаннями», були в основному розподілені в Гуандуні, Пекіні та Шанхаї. Серед них переважали чоловіки віком від 20 до 29 років. Фактори, які впливають на зміни в обсязі пошуку «управління знаннями», в основному включають традиційні китайські свята, Свято Весни, Національний день і випуск норм, пов'язаних з управлінням знаннями. Крім того, дослідження виявило подібні пошукові тенденції для «управління знаннями» та «системи управління знаннями». У цьому документі об'єктом дослідження є лише «управління знаннями» в індексі Байду. Необхідно додатково перевірити, чи підходить він для всіх мережевих механізмів

**Ключові слова:** економіка знань, пошукова система, дані веб-пошуку, комп'ютерна соціальна наука