Knowledge Management Postprints in the Data Era

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Date: 2023-10-08T00:00:00+00:00

Abstract

[Purpose / Significance] The data era has brought transformations to all industries and fields of society, while also posing challenges to traditional knowledge management research. To better adapt to the new era environment, knowledge management needs to be re-understood and repositioned, and should embrace new technologies in response to the challenges and transformations it faces. [Method / Process] This study analyzes the role of knowledge management in the big data era, explores the methods and challenges of knowledge management in this context, and proposes development directions for knowledge management in the data era based on practical considerations. [Results / Conclusion] Knowledge management has not disappeared in the data era. The development of big data has driven the transformation of knowledge management processes from traditional to technological approaches. While big data has achieved significant breakthroughs in explicit knowledge management, tacit knowledge management remains an urgent issue to be addressed. Knowledge management in the new era places greater emphasis on technological application and the ability to extract knowledge value from data.

Full Text

Knowledge Management in the Data Age

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Abstract: [Purpose/significance] The data age has brought transformation to all industries and sectors of society, simultaneously challenging traditional knowledge management research. To better adapt to this new environment,

knowledge management must be re-conceptualized and repositioned to meet and embrace new technologies in response to emerging challenges and changes. [Method/process] This paper analyzes the role of knowledge management in the big data era, explores the methods and challenges of knowledge management in this context, and proposes development directions for knowledge management in the data age based on practical considerations. [Result/conclusion] Knowledge management has not disappeared in the data age. The development of big data has driven the transformation of knowledge management processes from traditional to technology-driven approaches. While big data has achieved major breakthroughs in explicit knowledge management, tacit knowledge management remains a critical issue to be addressed. Knowledge management in the new era places greater emphasis on technological application and the ability to extract knowledge value from data.

Keywords: data age; knowledge management; technological change; tacit knowledge

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1 Era Transformation

The transformation of eras refers to the current backdrop we face—the age of big data. Under the combined circumstances of increasingly large data volumes, diverse data types, and decreasing value density, the value of knowledge management has become somewhat ambiguous.

1.1 The Value of Knowledge

Management activities in the knowledge economy era are knowledge-based. Knowledge management involves two main aspects: first, managing knowledge effectively; second, applying critical knowledge to various management functions—in other words, providing knowledge services. As Drucker stated, "In today' s society, knowledge is the foundational resource for individuals and the entire economy. Land, labor, and capital—the traditional production factors that economists refer to—have not disappeared, but have been relegated to secondary importance." Against this broad backdrop, knowledge management emerged because the rise of the knowledge economy made knowledge, as a production or management factor, more important than land, labor, and capital. From a certain perspective, knowledge management is a concept that predates data management. The concept of knowledge management has long existed in various fields, though before the data age it was more commonly referred to as information management or records management.

Since 2012, when Viktor Mayer-Schönberger of Oxford University introduced the concept of big data, the term has been increasingly mentioned to describe and define the massive amounts of data generated in the information explosion era, naming the technological developments and innovations related to it. As a *New York Times* column stated in February 2012, "The age of big data has

arrived. In business, economics, and other fields, decisions will increasingly be based on data and analysis rather than experience and intuition." Harvard sociology professor Gary King noted, "This is a revolution. Huge data resources enable quantification processes to begin in all fields—academia, business, and government." McKinsey has declared that "data has penetrated every industry and business function, becoming an important production factor. The mining and application of massive data 预示着 a new wave of productivity growth and consumer surplus."

In fact, "big data" has existed for some time in fields such as physics, biology, environmental ecology, and industries like military, finance, and communications. Even before the big data era, various sectors already possessed enormous amounts of data. Whether in libraries, archives, or intelligence agencies, although the surface objects of management and research were documents and texts, the actual objects were the data and information carried by these materials, and the volume of this data had already become substantial. Since 2012, the application of internet and information technology has caused fundamental changes in social and application management. In the past, people regarded information technology as a tool, but now government agencies, enterprises, and universities no longer generate excessive paper documents in their business activities. Instead, they have deeply integrated information technology with business operations—not only business data but also large amounts of background data generated by business systems. All business activities are supported by data, which runs through the entire workflow. Without data, business activities cannot function normally.

1.2 What is Knowledge

In the *Modern Chinese Dictionary*, "knowledge" is defined as "the sum of understanding and experience gained by people in the practice of transforming the world." The *Encyclopedia of China (Philosophy Volume)* explains it as "understanding of things obtained by people in daily life, social activities, and scientific research, with reliable components being knowledge."

There are multiple ways to classify knowledge. Michael Polanyi, based on its expression and transmission methods, divided knowledge into explicit knowledge and tacit knowledge. Explicit knowledge refers to knowledge clearly expressed and transmitted through language and symbols, primarily existing in organizational documents (such as books, intelligence, and archives). Tacit knowledge refers to knowledge not expressed through language or symbols, hidden in organizational levels or individual minds (such as corporate culture, ideas, employee skills, and problem-solving approaches).

1.3 Knowledge Management

Carl Frappaolo, one of the founders of Delphi Group, believes that knowledge management is the use of collective wisdom to improve adaptability and innova-

tion capabilities, providing new pathways for organizations to achieve sharing of both explicit and tacit knowledge. With the acceleration of economic globalization and the rapid development of science and technology, knowledge management has increasingly become an important choice for governments, enterprises, and institutions to acquire and maintain competitive advantages in the knowledge economy era. Larry Prusak suggests that knowledge management has two extremes: one end is "acquisition," and the other is "connectivity." Knowledge management focused on "acquisition" drives a series of activities for obtaining, storing, and organizing explicit knowledge, emphasizing the connection between people and documents. Knowledge management focused on "connectivity"drives a series of dialogues, discussions, and exchanges for tacit knowledge, emphasizing connections between people.

In fact, knowledge management is a dynamic process, as shown in Figure 2 [Figure 2: see original paper], comprising four main aspects that continuously evolve. First is knowledge creation—discovering useful information and acquiring knowledge. Second is knowledge organization—classifying existing knowledge and improving individual skills. Third is knowledge transfer—collaborative work and knowledge sharing to improve work efficiency. Finally is knowledge utilization—understanding, accepting, and creating new knowledge.

Meanwhile, with the transformation of eras, particularly in the data age, a profound question worth considering is: Has knowledge management become obsolete or has it matured? On one hand, industry frequently asks why, if knowledge management is so important, its frequency and research activity have declined from the 1990s to the big data era, replaced by new concepts such as big data, artificial intelligence, knowledge graphs, and cloud computing. On the other hand, bibliometric studies of knowledge management literature also show that research topics peaked in 2010 and have been declining since. In reality, the role of knowledge management has not diminished; rather, it may have been replaced by new tools and concepts, or problems that were previously difficult to solve have become easier with new technologies. People have begun studying knowledge management from new perspectives—for example, from an information technology angle in the library, information, and archives fields, and from a software implementation perspective in business management. Therefore, knowledge management has not disappeared but has simply evolved into new concepts.

2 Management Challenges

The big data era has not only brought tremendous societal changes but also posed significant challenges to knowledge management.

2.1 Conceptual Challenges

The data age has brought disruptive transformations to people' s concepts, including the following aspects:

First, it is about using all data rather than random sampling. In the big data era, the data available for analysis is more abundant, sometimes allowing processing of all data related to a particular phenomenon rather than relying on random sampling (previously considered a necessary limitation, but high-performance digital technologies have revealed this to be an artificial constraint).

Second, it is about general direction rather than precision. With so much data available, the obsession with precision diminishes. Previously, when little data was available for analysis, it had to be quantified as accurately as possible. With large-scale data, there is no need to get to the bottom of every phenomenon; grasping the general development direction suffices. Appropriately ignoring micro-level precision provides better macro-level insights.

Third, it is about correlation rather than causation. The search for causal relationships has long been a human habit. In the big data era, there is no longer a need to focus on causal relationships between things; instead, we should seek correlations. Correlations may not accurately explain why something happens, but they can alert us that it is happening.

2.2 Management Model Evolution

In the data age, knowledge management models and methods have undergone important changes, which can be broadly divided into the following stages:

KM1.0 Stage is characterized by three main features: First, knowledge management in traditional pyramid structures follows a linear organizational model. While enterprises recognize the need for a dedicated department, opinions differ on where to position it based on various stakeholders' perspectives. Second, knowledge management primarily focuses on building IT-based knowledge repositories, with breakthroughs in document management, knowledge classification, permission settings, knowledge search, knowledge mapping, and knowledge communities, emphasizing standardized, normalized, and integrated management. Third, early knowledge management was relatively separate from business work, often pursued for its own sake, similar to the library, information, and archives fields, where knowledge created by business departments was managed by knowledge management departments and provided upon request.

KM2.0 Stage is mainly manifested in: First, enterprises began exploring flexible organizational structures based on people-centered concepts, recognizing that knowledge carriers exist not only in information technology systems but more importantly in human capital. Second, knowledge management technology underwent significant changes. After Web 2.0 was first proposed in 2004, research developed rapidly, and various "decentralized" social information systems (such as instant messaging tools, blogs, podcasts, microblogs, encyclopedias, and social networking sites) emerged continuously. The internet completed an upgrade of concepts and ideological systems, creating new models for knowledge creation, exchange, organization, and sharing. Third, enterprises began focusing on business departments' needs for knowledge management, leading to

business-oriented knowledge management. The scope of knowledge management gradually expanded from internal employees to collaborative sharing channels with external customers, partners, and suppliers.

KM3.0 Stage is mainly manifested in: First, innovative capabilities and thinking techniques will replace information technology or human capital as the new focus of knowledge application. The scope of knowledge has expanded from external knowledge within physical enterprises to the synchronous management of virtual and physical knowledge resources. Second, knowledge management technology has undergone significant changes. The emergence of advanced technologies such as mobile internet, cloud computing, big data, and artificial intelligence has made further knowledge management elevation possible. Third, knowledge management has integrated with business activities—for example, Enterprise Resource Planning (ERP) systems already incorporate elements of knowledge management.

2.3 Technological Challenges

Technologies such as big data, internet, cloud computing, data mining, and artificial intelligence emerge endlessly, leaving people overwhelmed. Questions about whether artificial intelligence can replace knowledge management continue to arise. At present, artificial intelligence remains merely an important tool—a significant method that knowledge management can utilize.

Artificial intelligence can address the transformation between tacit and explicit knowledge, such as translating knowledge from one language to another, or facial recognition capturing basic facial features, expressions, or emotions. It can convert employees' proficient experiences into standard work paradigms or processes. However, certain tacit knowledge remains difficult to excavate, replicate, and transform. For example, although people recognize the importance of experts in acquiring knowledge, the first reaction for many is still to "ask around." In the data age, almost all information can be found online, so people no longer need to manually update their materials but can retrieve various documents related to personnel and extract expert information.

The problem of knowledge services remains challenging. While people can search for much relevant data online, some tacit, experiential knowledge cannot be found on the internet, in libraries, or in archives. On the other hand, people can mine tacit knowledge from explicit knowledge to obtain what they need. How to transform experiential tacit knowledge into explicit knowledge and then into one' s own knowledge is a complex process that artificial intelligence cannot solve entirely.

3 Management Transformation

3.1 From Data to Information to Knowledge

Knowledge management encompasses data and information while transcending them. Data, information, and knowledge represent a progressive relationship, reflecting the transformation of human cognition. Generally speaking, data refers to authentic records of objective things or statistical descriptions of events, which can be simple collections of numbers, graphics, text, audio, video, and other symbols. Information is a collection of data organized and sorted in certain ways. Knowledge is the summary of patterns and experiences derived from practice and proven by practice, which at the data level means information and its related context. Data, information, and knowledge are distinct yet closely connected and can be transformed into one another.

Using the report on "Iron Man" Wang Jinxi as an example: In 1964, Japan's economic intelligence department saw a *People's Daily* article titled "Daqing Spirit, Daqing People" and concluded that China's Daqing Oilfield indeed existed. Using this as a clue, they began comprehensively collecting reports about Daqing from Chinese public publications, covering various newspapers and magazines, focusing not only on energy, exploration, and smelting machinery but also including materials seemingly unrelated to petroleum energy such as *China Pictorial*. Through analysis of intelligence on Daqing Oilfield's location, scale, and processing capacity, Japanese decision-making institutions inferred that China would soon feel a shortage of refining equipment, making it entirely possible for Japan to sell its light oil cracking equipment to China. They designed products based on the assumption that China would need equipment capable of refining 10,000 tons per day. Sure enough, shortly thereafter, China's Ministry of Petroleum Industry began purchasing 10,000-ton-per-day refining equipment worldwide, with Japanese equipment being favored for its availability, low price, and suitability for China's actual production capacity, winning the bid. Japanese intelligence experts used a single photograph as data, analyzed three pieces of background information, and finally made a knowledge judgment based on that information, uncovering the secret of Daqing Oilfield.

In the big data era, society is no longer lacking in data and information, but it lacks the ability to refine knowledge from them. As John Naisbitt, author of *Megatrends*, said: "We are drowning in information but starved for knowledge. Large amounts of disordered information are not resources but disasters." Therefore, whether in library, information, and archives fields or in government and enterprise management, what is needed in the future is the ability to cultivate the wisdom of knowledge management—to develop a "third eye"(a knowledge eye or information eye) that enables the elevation from data to knowledge, fulfilling the ultimate purpose of knowledge management.

3.2 Finding Experts

In the data age, although people' s ability to access information has greatly increased, finding experts remains an important theme. Identifying who the experts are within an organization is a key point of knowledge management and an important method for enterprises, governments, and other entities to acquire tacit knowledge. Knowledge management includes both explicit and tacit knowledge. In the data age, technology enables people to search for massive amounts of information online, such as retrieving thousands of web pages, but these are limited to explicit knowledge. Much information cannot be searched for, and much knowledge cannot be stored in documents or databases but exists only in human brains—this is called tacit knowledge. In management processes, problems often arise, such as needing to consult an expert with certain expertise but not knowing who within the organization possesses such expertise. The purpose of finding experts is to seek help, obtain knowledge, and solve problems.

3.3 Embracing New Technologies

Under the big data era, the boundaries of knowledge management have become blurred. The concept of knowledge management existing only within enterprises is insufficient. For enterprises to succeed and industries to maintain prosperity, they must face new challenges, change traditional mindsets, and adopt a more inclusive attitude to confront the impact of new technologies and the transformation of knowledge management methods they bring.

Big data technology applications have been integrated into social life. *The Guardian* used WikiLeaks data to create a map (Figure 3 [Figure 3: see original paper]a), where each red dot represents an allied casualty event in Iraq—390,000 red dots in total. Clicking reveals specific data on time, location, and casualties. The shocking data shifted public opinion, forcing the British government to withdraw troops. European police and MIT researchers went further, using mobile phone data from operators to algorithmically map crime prediction in London (Figure 3 [Figure 3: see original paper]b), a method that can greatly improve police efficiency and reduce deployment costs. In 2013, Microsoft successfully used internet data to predict Oscar winners, accurately forecasting 21 out of 23 categories.

Unlike traditional knowledge management processes, knowledge management in the big data context requires more high-tech tools and software. The use of various practical big data technologies has advanced the transformation of knowledge management processes, thereby elevating knowledge management levels and organizational operational efficiency. On one hand, the widespread application of cloud computing, big data, and artificial intelligence has not only brought changes in management concepts and strategies but also triggered transformations in management methods and means. AI has not only replaced many routine tasks, rapidly improving management efficiency, but also effectively enhanced decision-making quality, providing effective support for decision manage-

ment. For example, applying blockchain technology to enterprise management will subvert many existing models, but its characteristics of decentralization, openness, and immutability will make data more transparent and significantly reducing enterprise management costs.

On the other hand, the rapidly increasing large datasets require more efficient data cleaning tools for knowledge acquisition; massive amounts of semi-structured and unstructured data require huge data warehouse tools for knowledge storage; complex and uneven-quality data require cloud computing tools for knowledge integration; and dynamically increasing raw data require more reasonable visualization tools for data mining to extract knowledge value for use.

4 Conclusion

The arrival of the big data era means that knowledge management will become more precise and knowledge services more intelligent, bringing both challenges and opportunities: systematization, intelligence, and scientification of knowledge management are opportunities in the new era; while conceptual transformation in the data age, management problems arising from the explosive growth of diverse data, basic hardware issues facing knowledge management, and tacit knowledge management problems are challenges in the new period. In summary, the data age represents a gradual enhancement process for knowledge management research from data to information to knowledge. To improve knowledge management efficiency, finding experts remains an important topic in the data age. Meanwhile, to better adapt to era transformation, embracing new technologies will inject continuous vitality into knowledge management research.

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Author Contributions: Zhang Bin was responsible for paper design, specific content, and revision; Xiong Ao was responsible for paper writing and revision.