How knowledge resources drive industrial chain carbon reduction: an analysis from the knowledge management perspective

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Abstract
Purpose – This paper aims to analyze the role and advantages of knowledge resources in the carbon emission reduction of the industrial chain, and how it can be used to promote the carbon emission reduction of the industrial chain, so that the industry can better achieve the saving of energy and the reduction of emission.

Design/methodology/approach – This paper argues that the traditional resource-plundering industrial chain production method can no longer meet the needs of sustainable development of the green and low-carbon industrial chain, and builds the coupling and coordination of knowledge technology innovation drive and industrial chain carbon emission reduction mechanism, in the four dimensions of industrial chain organization, government support, internet support and staff brainstorming, put forward suggestions for knowledge resources to drive carbon emission reduction in the industrial chain.

Findings – This paper holds that the use of knowledge resource advantages can better help industrial chain enterprises to carry out technological innovation, knowledge resource digital platform construction, knowledge resource overflow and transfer, application and management of network information technology, so as to reduce carbon emission in industrial chain.

Originality/value – This paper contributes to the discussion about the high-quality implementation of the revitalization strategy of the industrial chain and also deepens research on the knowledge resource-driven carbon emission reduction of the industrial chain. Further, this paper enriches the role of knowledge resources in the industrial industry, and the theoretical results support the advantages of knowledge resource in the field of chain carbon emission reduction.

Keywords Knowledge resources, Knowledge innovation, Knowledge sharing, Carbon emission reduction, Industrial chain

Paper type Viewpoint

1. Introduction

With the intensification of global climate change, environmental protection and carbon emission reduction have become the common responsibility of the international community. With the continuous acceleration of the industrialization process, China’s economy has ushered in rapid development. Figure 1 shows that the GDP has increased from 8.5tn yuan in 1998 to 114.3tn yuan in 2021, and the contribution rate of the industry to GDP has reached more than 40%. At the same time, the rapid economic development has also brought about a tremendous consumption of energy in the industrial chain. The industrial chain is an industrial enterprise that mines, uses, processes and sells industrial raw materials. To maximize the development of resources at a lower cost, realize a higher value and profitability. The upstream and downstream enterprises in the industrial chain tend to adopt the traditional predatory industrial production method, which is characterized by high mechanization, large-scale production and the pursuit of a single goal. This method often ignores the sustainability of resources, and environmental protection are highly dependent...
on fossil energy, such as coal, oil and natural gas. Figure 2 shows that from 1998 to 2021, the primary energy consumption of China’s industrial industry has increased year by year, reaching 408,000 tons of standard coal in 2021. Energy consumption per 10,000 yuan of GDP in 2021 will be 0.55 tons of standard coal per 10,000 yuan, and the collection, processing, transportation and consumption of these energy will generate a large amount of pollutant. Due to this method of extensive production, excessive reliance on fossil fuels, this has led to massive resource consumption and carbon pollution (Gabriele et al., 2018; Pflugfelder, 2021). The data in Figure 3 shows that from 1998 to 2021, the total carbon emissions of China’s industrial chain increased year by year, from 98,000 tons in 1998 to 327,000 tons in 2021. Although the carbon emission intensity of industrial industries has decreased, the magnitude not much. In 2021, the carbon emission intensity of the industrial industry will still be 0.29 tons per 100 million yuan, and the pressure on carbon emission reduction in the industrial chain is huge.

To solve the problem of carbon emissions in the industrial chain, the establishment of a carbon emission restriction mechanism has become a common choice of many countries and regions. Some countries and regions have introduced strict carbon emission standards, restricting emissions of polluting enterprises, and encouraging enterprises to carry out environmental protection technology transformation and transformation and
upgrading to reduce carbon emissions (Miao et al., 2021). However, whether it is establishing a carbon emission restriction mechanism, adjusting the energy consumption structure, forcing environmental policies and regulations, or upgrading the industrial structure, none of them can meet the high-efficiency, low-pollution and high-quality production goals of industrial chain enterprises.

It is worth noting that previous studies have neglected the knowledge collaboration and the knowledge creation of industrial chain enterprises based on the division of knowledge resources. It is generally believed that environmental policies, energy consumption structure and industrial structure are the main influencing factors for industrial carbon emission reduction, but in fact, while relying solely on environmental policies and industrial policies to control industrial carbon emission reduction, it also leads to insufficient innovation enthusiasm of the industrial chain and weakens the market competitiveness of the industrial chain (Cillo et al., 2019; Del Giudice et al., 2022; Li et al., 2022; Fait et al., 2023). Knowledge resource is known for its relevance in the reduction of carbon emission in the industrial supply chain, however, there is scant research on how knowledge resource can be deployed as an instrument of carbon emission reduction in the industrial chain.

Knowledge management pays more attention to the sustainability of production development and takes the dissemination and application of knowledge technology as a means to achieve efficient, low-carbon and sustainable development. Knowledge management can continuously promote the innovation and application of energy-saving and emission reduction technologies, promote the improvement of production efficiency and the reduction of carbon emission pollution of the industrial chain and contribute to the sustainable development of the industrial chain (Ge and Campopiano, 2021; Khatami et al., 2022; Boffa et al., 2023). Therefore, it is necessary to use knowledge resource management as a theoretical basis (Attour and Barbaroux, 2021; Gomes et al., 2021; Madanaguli et al., 2022; Chin et al., 2023b), comprehensively analyzing the impact of knowledge resources on carbon emission reduction in the industrial chain, overcoming the traditional predatory industrial production methods, and under the influence of new technology conditions, knowledge resources will continue to promote the development of the industrial chain. Evolution, through the innovation, transmission, application and sharing of knowledge resources and technical information, realizes the transition from traditional chains to modern chains (Arfi et al., 2017; Chin et al., 2022b; Chorney et al., 2023) and make modern industrial chains the chain will transform to a sustainable and low-carbon development mode of “two lows and two highs” with low pollution, low energy consumption, high efficiency and high added value. At the same time, through the acquisition, transfer, sharing

![Figure 3: Industrial chain carbon emissions and industrial chain carbon emission intensity](image)

Source: National Bureau of Statistics
and application of the knowledge resources and technical information that they rely on, the market adaptability and innovation capabilities of upstream and downstream enterprises in the industrial chain is improved, and the innovation and value-added of products in the industrial production process is realized, as well as efficient management realizes the win-win situation of market competitive advantage and industrial carbon emission reduction. The research idea of this paper is shown in Figure 4.

2. The role and advantages of knowledge resources in the carbon emission reduction of the industrial chain

As an important asset in the new economic era, knowledge resources play a very important role in promoting carbon emission reduction in the industrial chain. Using the advantages of knowledge resources can better help enterprises in the industrial chain to carry out technological innovation, digital platform construction of knowledge resources, knowledge resource overflow and transfer (Chin et al., 2023a), the application of network information technology facilitates the optimization of production efficiency and the reduction of carbon emissions in industrial chain enterprises. The analytical framework of the role and advantages of knowledge resources in the carbon emission reduction of the industrial chain is shown in Figure 5.

2.1 Knowledge resources for technological innovation in energy saving

Enterprises in the upstream and downstream of the industrial chain can obtain information on competitors, consumers and new products from their peers, and can also obtain correct and complete new knowledge from different channels and gradually develop new ones based on the acquired explicit and implicit knowledge. Content to replace existing knowledge resources. In the upstream and downstream of the industrial chain, knowledge resources are constantly confirmed, expanded, amplified and shared to create new knowledge (Chin et al., 2021). The invisible and explicit components of knowledge resources interact and mutually transform under certain conditions in this process, and the experience sharing of individual enterprises in the industrial chain is transformed into new invisible knowledge resources and create new explicit knowledge. These technology

![Figure 4: Research roadmap](image-url)

Source: This figure is made by authors
knowledge interacts with each other to contribute to industrial carbon reduction (Nemet, 2012; Battistella et al., 2016). Upstream and downstream enterprises in the industrial chain achieve large-scale production through knowledge acquisition and creation of new knowledge resources, and at the same time promote the knowledge creation of energy-saving and emission-reduction technologies (Shujahat et al., 2019; Saumyaranjan et al., 2023). Apply new clean energy technologies in all links of production of industrial chain, improve the efficiency and effectiveness of the use of new clean energy through innovation of knowledge resource and application of technical means, apply carbon emission reduction technology to the entire production process of the industrial chain, strictly control the carbon emissions of upstream and downstream enterprises in the production process of the industrial chain and comprehensively promote the green and low-carbon transformation of the industrial chain.

2.2 Knowledge resource for digital platform

The communication and information exchange between upstream and downstream individual enterprises in the industrial chain drives the transfer of knowledge resources within the industrial chain. With the difference in the perceived value of knowledge resources, knowledge resources spread between individual enterprises and organizations in the industrial chain. With different abilities of acceptance of knowledge, in the network of knowledge resource dissemination and exchange, each individual enterprise in the industrial chain has become a recipient of knowledge resources, constantly accepting the cognition stimulated by external knowledge on the saving of energy and the reduction of emission, and forming its own reserve of knowledge resource, affecting their own energy-saving and emission-reduction behaviors. The content of knowledge resource sharing includes sharing achievements of technological innovation, sharing low-carbon production techniques and designs, sharing chain resources of green supply and sharing platform construction, etc. Industrial enterprises can share digital emission reduction technologies and digital innovation achievements, learn from each other’s experiences and technologies and jointly promote the realization of the low-carbon development goals of the industrial chain (Clarysse et al., 2014). Through the sharing platform among enterprises in the industrial chain, the participation and support of all enterprises in the upstream and
downstream of the industrial chain can be obtained, build and improve big data network, digital technology and blockchain technology to monitor the carbon emission reduction of the industrial chain, collect the carbon emission data of upstream and downstream enterprises in the industrial chain in a centralized and unified way on a digital platform, analyze the digital platform, the results shall be returned to each enterprise, providing guidance for the implementation of carbon emission reduction activities, and a more effective cooperation platform support can be provided for realizing the carbon emission reduction goal of the industrial chain.

2.3 Spillover transfer of knowledge resources

The advantages of knowledge resources play an important role in building competitive advantages and realizing carbon emission reduction for enterprises in the industrial chain. The overflow and transfer of knowledge resources will also have external effects, that is when new technologies and new knowledge are applied in enterprises in the industrial chain, their benefits not only affect the industrial enterprises that apply it but may also benefit other institutions or enterprises in the industrial chain (Huang et al., 2022). Publicize the new resources and technological achievements of industrial enterprises, which can be used for reference and reference by other industrial enterprises, or establish a cooperative mechanism with other enterprises. Strengthen protection, promote knowledge patent transactions, reduce government supervision and control restrictions on the sharing and transfer of knowledge resources and maximize the exchange and cooperation of knowledge resources. To improve the overall environmental protection and carbon reduction level of the industrial chain.

2.4 The application of knowledge resources

The application of knowledge resources has a positive impact on promoting carbon emission reduction in the industrial chain. The optimization of modern technology and information makes the capture, tracking, updating and use of knowledge resources more convenient, and further facilitates the application and integration of knowledge resources (Chin et al., 2022a; Yang et al., 2023). Through the integration and application of knowledge resources, the industrial chain can increase the number of available knowledge memory storage points in the organizational structure, and the ability of communication and coordination in the organization is significantly enhanced. Through the integration and application of energy-saving and emission-reduction knowledge technologies, industrial chain enterprises will rapidly increase the efficiency of production and carbon emission reduction (Duan et al., 2021). In the era of knowledge economy, knowledge resources have become an important strategic resource for enterprises. To achieve market competitiveness and low-carbon development, industrial chain enterprises will spend a lot of money and time on the application and management of knowledge resources. The application of knowledge network and information technology has increased the stock of knowledge resources in the industrial chain, lowered the shared cost of knowledge resources for upstream and downstream enterprises in the industrial chain, accelerated innovation of low-carbon knowledge resources, Carbon emission reduction knowledge is continuously integrated, shared and applied among various subjects in the industrial chain, forming a powerful knowledge ecosystem (Järvi et al., 2018; Öberg and Lundberg, 2022) and improved the production efficiency of enterprises in the industrial chain.

3. Using knowledge resources to promote carbon emission reduction in the industrial chain

Industrial chain organization, government department guidance, internet technology support, staff team cooperation to promote knowledge resources to promote industrial chain carbon reduction than other individual influence has more advantages, organization of industrial chain
guide knowledge innovation, government departments promote knowledge resources sharing and application and internet technology to build a low-carbon knowledge resources service platform. Low-carbon knowledge innovation and exchange are carried out by all employees of the enterprise, and the use of knowledge resources to promote carbon emission reduction in the industrial chain is discussed from the above four aspects.

3.1 The application of low-carbon knowledge resource in technological innovation

Within the organization of industrial chain, it is necessary to actively encourage the creation of knowledge resources, guide knowledge innovation, change the traditional passive learning norms and transform into an active learning organization, so that the power of knowledge innovation can be condensed within the industrial chain, and the individual industry chain can be discarded. Values, accepting the thinking mode of innovation and development, from knowledge resource innovation to knowledge resource sharing. In this process, every enterprise in the upstream and downstream of the industrial industry chain is a creator. Under the constraints of the industrial carbon emission reduction policy, the industrial industry chain enterprises must use innovative development thinking, absorb knowledge achievements and continuously innovate low-carbon technologies and low-carbon emissions. Carbon technology and low-carbon design facilitate the sharing and dissemination of novel low-carbon technologies, processes and designs throughout the industrial chain. Moreover, they foster innovative applications of energy-saving and emission-reduction knowledge and technologies across all stages of industrial chain production. Strengthen the ability of industrial chain enterprises to drive carbon emission reduction by knowledge resources, use knowledge resources to drive enterprises to carry out energy saving and emission reduction innovation, and use emission reduction technologies to promote low-carbon, efficient and sustainable development of enterprises.

3.2 The government actively promotes and guides the sharing and application of knowledge resources

Although the traditional energy-saving and emission reduction policies of industrial chain can help enterprises to reduce carbon emissions to a certain extent, the forced emission reduction policies will seriously affect the innovation enthusiasm of enterprises and ultimately limit the carbon emission reduction effect of enterprises. The government’s emission reduction policy should cooperate with the advantage of knowledge resources to promote the carbon emission reduction of enterprises. The government encourages and supports industrial chain enterprises to innovate, share and apply knowledge resources and formulates targeted knowledge resource policies to promote enterprise knowledge resource innovation and help integrate knowledge resource innovation with low-carbon development of industrial chain enterprises. To create a better environment for intellectual property rights, we should encourage the protection and application of low-carbon intellectual property rights, stimulate the enthusiasm of industrial chain enterprises to develop energy-saving and emission-reduction technologies, guide the sharing and application of low-carbon new technologies and maximize the utility of low-carbon technologies. The government actively guides and explores the development and application of new energy, energy-saving and emission-reduction technologies, encourages industrial enterprises to produce and apply products with new energy, energy-saving and emission-reduction technologies and provides them with corresponding financial support and supporting policies. The government guides consumers to practice green consumption through policies and regulations, actively promotes the knowledge of green production and lifestyle and encourages industrial enterprises to produce green products and provide green services. Government departments actively guide the participation and efforts of industrial enterprises, society and individuals to promote the sharing and transmission of low-carbon knowledge, form consensus and joint efforts and achieve the goal of low-carbon sustainable development.
3.3 Using internet technology to build a low-carbon knowledge resource service platform

With the continuous maturity and development of internet technology, the internet has become an important way for industrial enterprises to obtain information, share and disseminate knowledge, and it also provides a good platform and opportunity for promoting the sharing and transmission of low-carbon knowledge resources (Haseeb et al., 2019). Use Internet technology to build an information technology exchange platform for industrial chain enterprises related to carbon emissions, the saving of energy, the reduction of emission and environmental protection, so that they can share and transfer their own emission reduction experience, technology and data knowledge. Internet technology also provides industrial enterprises with a wide range of low-carbon production information channels. At present, internet technology has changed the way people acquire knowledge resources and learn low-carbon skills. The constraints of time and space make it possible to obtain low-carbon knowledge and skills anytime and anywhere, and the threshold for acquiring knowledge resources becomes lower and the degree of popularity is higher. Industrial enterprises can more efficiently access and absorb knowledge resources related to carbon emissions, the saving of energy, the reduction of emission and low-carbon environmental protection. Industrial enterprises can efficiently obtain detailed low-carbon knowledge resources through search engines and social media. The industrial chain can use big data, digital technology, blockchain and other ways to scientifically manage and control the production and carbon emissions of upstream and downstream enterprises.

3.4 Carry out low-carbon knowledge innovation and exchange among all employees of industrial enterprises

Strengthen the initiative of low-carbon knowledge innovation and exchange among all employees of industrial chain enterprises, encourage employees to innovate, share and apply low-carbon knowledge resources under the leadership of the organization and establish a knowledge resource innovation mechanism for all employees in the industrial chain. Cultivate employees to form low-carbon knowledge resources creation awareness and innovative thinking, provide communication tools and an effective environment for enterprise employees’ knowledge resource innovation in the form of the internet and conference discussions and promote the accumulation of enterprise employees’ low-carbon knowledge resources and the improvement of low-carbon knowledge innovation capabilities, establish a knowledge base for enterprise talent knowledge resource innovation, build a mechanism of knowledge resource sharing and delivery, organize employees to innovate, communicate and share low-carbon knowledge resources through enterprises, integrate low-carbon knowledge resources into the enterprise knowledge base, and internalize low-carbon knowledge resources, to provide strong support for the carbon emission reduction of industrial chain enterprises. The realized path of using knowledge resources to promote carbon emission reduction in the industrial chain is shown in Figure 6.

4. Conclusion and significance

4.1 Conclusion

This study analyzes the traditional predatory industrial production mode of the industrial chain by consuming a large amount of natural resources and energy, while emitting a large amount of pollutant and waste, which has caused great damage and impact on the environment. The traditional resource predatory mode The production mode of the industrial chain can no longer meet the needs of the sustainable development of the green and low-carbon industrial chain. At present, it is generally believed that environmental policies, energy consumption structure and industrial structure are the main influencing factors for industrial carbon emission reduction (Phillipson et al., 2012; Siqueira and Honig, 2019). However, numerous studies have
found that relying solely on environmental policies and industrial policies cannot achieve the carbon emission reduction target well, and at the same time, it will weaken the market competitiveness of the industrial chain and the production enthusiasm. Previous studies have neglected the knowledge collaboration and the creation of knowledge of industrial chain enterprises based on the division of knowledge resources. It is necessary to analyze the carbon emission reduction of the industrial chain from the perspective of knowledge management. This paper discusses the role of knowledge resources in the industrial industry chain from four aspects: using the advantages of knowledge resources to better help enterprises in the industrial industry chain to carry out technological innovation, the construction of a digital platform for knowledge resources, the overflow and transfer of knowledge resources and the application and management of network information technology. The role and advantages of carbon emission reduction, in the four dimensions of industrial chain organization, government support, internet support and employee teamwork, put forward suggestions for knowledge resources to drive carbon emission reduction in industrial chains, industrial chain organizations guide knowledge innovation, government departments promote the sharing and application of knowledge resources, internet technology builds a low-carbon knowledge resource service platform, and enterprises carry out low-carbon knowledge innovation and exchange and efficiently use knowledge resources. Overcoming the impact of the traditional predatory production mode of the industrial chain on production and the environment (Vurro et al., 2009), which will help industrial chain companies improve the efficiency of production, and at the same time, reduce carbon emissions in the production process. We will promote the efficient, low-carbon and sustainable development of the industrial chain.
4.2 Theoretical and practical implications

Carbon emission reduction in the industrial chain is a brand-new proposition. Although the successful experience of industrial structure optimization and foreign industrial chain emission reduction models can be used for reference, if there is no theoretical construction of the coupling and coordination of technological innovation drive and industrial chain carbon emission reduction from a global perspective, it is bound to face the dilemma of systemic deficiency, depth and initiative in carbon emission reduction of the industrial chain in the new era. In particular, the existing literature tends to discuss the issue of carbon emission reduction in the industrial chain from the perspective of pure industrial structure and energy consumption structure, ignoring the drive and mechanism analysis of innovative technologies and emission reduction policies.

Based on the theory of knowledge resources, this paper systematically analyzes the serious harm of the traditional predatory industrial production mode to the environment, explain the limitations of the traditional industrial emission reduction means and draws out the importance of knowledge resources to promote the efficient, low-carbon and sustainable development of the industrial chain, this paper will propose a mechanism analysis framework for knowledge resources to drive carbon emission reduction in industrial chains, and discuss the role and advantages of knowledge resources in carbon emission reduction in industrial chains from various aspects and put forward corresponding proposals. The carbon emission reduction proposals enrich the theoretical research results of knowledge resources in the field of carbon emission reduction in the industrial chain.

The implementation of the industrial chain revitalization strategy plays a crucial role in constructing a new development pattern of dual cycles, with the industrial chain serving as cycle. At the same time, the green and low-carbon development of the industrial chain has an important influence in promoting social and economic development. Research on the green and low-carbon development of the industrial chain has certain practical significance for the implementation of the industrial chain revitalization strategy and sustainable economic growth.

In addition, the theory of knowledge resources is a theoretical innovation to strengthen the green and low-carbon development of the industrial chain, and it has been widely recognized and promoted for the realization of carbon emission reduction in the industrial chain. Therefore, it is necessary to continuously deepen the research on the carbon emission reduction of the industrial chain driven by knowledge resources, which has important practical significance for the high-quality implementation of the revitalization strategy of the industrial chain.

5. Limitations and directions for future research

In sum, our paper also has some limitations that need to be further analyzed in future studies. First, this paper is based on China, and its conclusions may not be generally applicable to other countries or economies. Second, the research only focuses on the carbon emission reduction of the industrial chain, although the contribution rate of the industrial field to carbon emissions is much higher than that of other fields, it is also necessary to further consider other fields such as agriculture, transportation and service industries. Future research will continue to take knowledge management as a perspective to further analyze the carbon emission reduction of other industries in China, as well as those of other countries or economies, and complete a more comprehensive paper on the impact of knowledge management on carbon emission reduction.

References


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