

Literature Review on Digital Innovation

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Abstract: The rapid development of digital technology has changed the traditional innovation model, and digital innovation has become a hot issue in the context of digitalization. This paper first summarizes the conceptual connotation and characteristics of digital innovation through the overall overview of digital innovation research. Secondly, the antecedents and consequences of digital innovation are discussed from the environmental and organizational levels, and an integrated research framework of digital innovation is constructed according to the paradigm of "influencing factors-influencing effects". Finally, combined with the gaps and deficiencies in the current research on digital innovation, this paper proposes that the research on digital innovation in three aspects: object, method and content should be improved in the future. This paper provides ideas and references for subsequent research on digital innovation.

Keywords: Digital innovation; Theoretical analytical framework; Research review.

1. Introduction

The emergence and development of new-generation digital technologies such as big data, cloud computing, the Internet of Things (IoT), and artificial intelligence are gradually reshaping the business environment and innovation processes, prompting companies to accelerate their digital transformation and achieve digital innovation [1]. Digital innovation refers to the process in which digital and physical components of products or services are combined in new ways, leading to the creation of new products, business processes, or business models [2]. Given the important characteristics of digital technologies, such as their derivational, convergent, and heterogeneous nature [4], the implementation of digital innovation faces numerous challenges and requires new organizational logics and management strategies [5]. Furthermore, compared to traditional innovation management theories, the digital innovation process is more loosely structured, with innovation actors often difficult to identify in advance, and the boundaries between the innovation process and its outcomes are more ambiguous [6]. As a result, studying digital innovation is an inevitable requirement for adapting to the digital era and enhancing a company's core competitiveness.

Today, with the rapid development of digital technologies and the vast potential of the market in China, a favorable environment has been created for digital innovation. How to implement digital innovation in line with China's national context, how to drive the further development of digital innovation, and the impacts of digital innovation on social production and life remain important directions for future research. Currently, research on digital innovation exhibits an interdisciplinary approach, with scholars from fields such as information technology, management, public administration, and sociology exploring the phenomenon from various perspectives.

2. Connotation

Narrowly defined, digital innovation refers to technological innovations represented by big data, artificial

intelligence, and blockchain. Broadly defined, digital innovation refers to the process of reconfiguring and optimizing the components of innovation subjects, processes, and elements through the application of digital technologies [7]. The concept of digital innovation can be explained from a comprehensive perspective, considering motivation, process, and outcome. From the perspective of innovation motivation, digital innovation arises from the combined effects of the innovation-driving factors in the software industry, the rapid development of digital technologies, and the widespread digitization of products and services [8][9]. Regarding the innovation process, digital innovation is seen as a contextual innovation process in which organizations use digital technologies to alter original products, services, processes, or business models to achieve value-added novelty [10]. In terms of innovation outcomes, digital innovation can be viewed as market products, business processes, and models created or transformed by digital technologies [6]. Additionally, Huang et al. [11] argued that digital innovation is both a process and an outcome, where digital components are reorganized within a layered modular architecture to create new value for users.

In summary, digital innovation refers to the use of digital technologies to drive environment-driven reforms and value-creation activities, ultimately developing products and services, improving structures and processes, or upgrading technologies. Clearly, this type of innovation emphasizes the utilization of digital technologies and the reconfiguration of both digital and physical components [12]. Therefore, digital innovation can further be defined as the process of combining digital and physical components to create new devices, services, or business models. These components are bundled together to form and deliver market products, and embedded within a broader socio-technical environment, enabling them to spread, operate, and be used [13].

3. Characteristic

Existing literature generally identifies three key characteristics of digital innovation.

Firstly, convergence [14] (Vega et al., 2019) refers to the ability of digital innovation to break through or even disrupt

the boundaries of existing products, organizations, and industries. Innovation actors can transcend geographical limitations to collaborate on digital innovation. For example, smart wearable devices integrate digital technology with traditional physical entities, extending the range of product usage and gradually blurring the boundaries of new digital products [15].

Secondly, generativity [16] highlights the dynamic, extensible, and programmable nature of digital technologies, which enable faster and more efficient updates and improvements, thereby expanding the scope of digital innovation outcomes. For instance, various digital products such as apps can undergo real-time iterative innovation based on user feedback.

Thirdly, platformization [18] refers to the gradual decentralization of digital innovation across multiple actors. Enterprises often innovate through platforms rather than individual products. These platforms can gather various innovation actors and gradually form ecosystems, making them an important vehicle for digital innovation.

4. Research on the Development of Digital Innovation

Digital innovation deeply integrates information technology, products, and services, transforming product and service forms, consumption patterns, and business operations and competition. It surpasses the boundaries of traditional innovation theories and also reshapes the business world. This brings new challenges to the role transformation of governments, such as their regulatory concepts, optimization of public policies, and organizational upgrading [19]. Digital innovation, characterized by digitization, intelligence, and networking, is the most important technological factor influencing global economic and social development today and in the future. The digital revolution will fundamentally drive the reconfiguration of global technological, industrial, and economic power, and has become a shared consensus among policymakers worldwide. Digital innovation has attracted significant academic attention, not only because of its inherent practical importance but also because traditional economic theories cannot adequately explain certain digital innovation phenomena [20], which has led to research across various fields.

4.1. The Influencing Factors of Digital Innovation

Based on the perspective of antecedents of digital innovation, through the collection and organization of literature, it is found that the factors driving digital innovation mainly include the following aspects:

4.1.1. Distributed innovation

With the rapid development of digital technology, the storage and dissemination speed of information and knowledge required for innovation has greatly increased, communication and search costs have significantly decreased, and the focus of innovation has gradually shifted from within organizations to distributed entities that cannot be predefined [21]. In the digital environment, due to the platform, combination, and distribution characteristics of digital innovation, the driving role of distributed innovation in enterprise digital innovation should be more prominent [22]. In practice, more and more companies are adopting distributed innovation strategies for digital innovation, such

as LEGO's "LEGO Ideas" and "Design By Me" platforms, Xiaomi's "Xiaomi Community", and Dell's "Idea Storm" community. The establishment of these distributed participation platforms or communities injects new vitality into the digital innovation of enterprises. Distributed innovation, as an important driving factor for digital innovation, holds a significant position in current research [6].

4.1.2. Open innovation

Open innovation refers to the process of applying and commercializing knowledge through the combination of internal and external sources (Yang Lei & Liu Haibing, 2022). It breaks through the narrow concept of innovation, urging companies to build close collaborative relationships with external organizations, and digital innovation embodies this characteristic.

On one hand, open innovation emphasizes the diversity and heterogeneity of innovation actors, addressing the limitations of internal resources in traditional innovation models. It helps capture opportunities for digital innovation and facilitates a dynamic interaction process among the various participants involved. On the other hand, open innovation highlights the multi-actor, cross-boundary, and user-oriented nature of the development process, which aligns closely with the characteristics of digital innovation. As a result, the digital innovation process needs to be organized based on the principles of open innovation.

In essence, digital innovation, with its emphasis on leveraging external knowledge and fostering collaboration across boundaries, aligns well with the open innovation model. The integration of internal and external ideas, resources, and technologies in an open environment enables organizations to accelerate the development and commercialization of new digital products, services, and business models.

4.1.3. The role of government

The rapid development of digital innovation requires active involvement from the government. Governments need to create a favorable ecosystem and regulatory environment for digital innovation, improve digital infrastructure, and reduce entry costs for innovative startups to support the growth of digital innovation.

The importance of government in the digital innovation process is widely acknowledged. Governments play a key role in areas such as the development of digital infrastructure and the establishment of open standards for digital innovation. The management and strategies employed during the digital innovation process are crucial for its healthy development. Governments also have a fundamental role in leading and supporting the construction and evolution of digital ecosystems, as well as in the emergence of digital innovation. The co-evolution of these two elements stimulates a wealth of digital innovation opportunities and creates competitive advantages [19].

4.1.4. Artificial intelligence

Artificial intelligence (AI) is at the core of digital innovation theory [24], as it forms an integral part of the broader impact of digitalization on innovation and research and development [6], reshaping both organizational structures and innovation management. Specifically, AI enables the acquisition, analysis, and recombination of information related to process performance, product usage, and customer needs in novel ways during the innovation process [25]. AI and machine learning offer cost advantages in information

processing [27], providing higher quality, greater efficiency, and better outcomes than human experts [28]. Additionally, the data flows supported by AI are said to shorten process cycles, thereby reducing the time required to market new innovations [30]. Clearly, AI is a crucial driving force behind digital innovation, enhancing both the speed and efficiency of innovation processes and enabling the development of more advanced and competitive solutions.

4.2. The Impact of Digital Innovation

Based on the perspective of the impact of digital innovation, through the collection and organization of literature, it is found that there are mainly the following aspects of research on the development of digital innovation:

4.2.1. Digital Innovation and High-Quality Economic Development

Scholars have analyzed the logic of how digital innovation promotes high-quality economic development from both micro and macro perspectives. At the micro level, the analysis mainly focuses on innovation diffusion, digital cycles, and enterprise digital innovation. At the macro level, several scholars have explored the internal logic of how innovation development under the digital economy influences high-quality economic development based on endogenous growth theory [7].

Currently, China's economy has shifted from a phase of rapid growth to a stage of high-quality development, and it is in the dynamic process of transitioning from quantity to quality. Therefore, digital innovation, as a new driving force for high-quality economic development, can effectively promote sustainable economic growth [31]. Digital innovation relies on digital resources (such as digital infrastructure, new-generation information technologies, and data resources) to reorganize the elements of innovation, disrupting traditional development models. It changes existing organizational structures, production, and lifestyle patterns, enhances the overall total factor productivity of society, and fosters better coordination of resource elements. This significantly boosts the efficiency of promoting high-quality economic development and elevates China's economic development to a higher level [32].

However, there are several challenges in promoting high-quality economic development through digital innovation in China. These include issues related to innovation, coordination, green growth, openness, and sharing. Furthermore, there is a lack of leading innovative enterprises, insufficient investment in research and development, weak incentives, an incomplete innovation ecosystem, and inadequate collaboration between industry, academia, and research institutes. These challenges hinder the full realization of high-quality economic development [33].

4.2.2. Digital Innovation and Digital Transformation

In the era of the digital economy, traditional innovation theories face significant challenges. Digital innovation, as the dominant innovation paradigm, will be embedded in all aspects of technological innovation activities and various levels of economic and social development, driving the digital transformation of organizations and even society as a whole. Digital innovation is an essential path for enterprises to achieve digital transformation and holds great significance for the survival of businesses and the development of the economy and society. Enterprises often face the challenge of insufficient digital innovation capabilities when undergoing transformation and upgrading. Although scholars emphasize

different aspects of digital transformation, the view that digital innovation drives the digital transformation process has gained unanimous agreement and has been validated in various fields of societal digital transformation.

Research has found that improving the digitalization level of enterprises will greatly enhance their operational innovation performance and market innovation performance, facilitate the transformation of old and new driving forces, drive efficiency reforms, and improve the overall factor productivity of enterprises [34]. Therefore, to improve their level of digitalization and gain a competitive advantage through digital innovation, enterprises can consider two approaches. One approach is to build an innovation ecosystem, which accelerates the development and industrialization of new products by leveraging complementary advantages and resource integration among innovation actors, thus reducing market risks. Another approach is to create digital platforms that reinforce the enterprise's digital innovation capabilities, helping to bridge the digital divide in their transformation process and ensuring a smooth digital transition [36]. Digital innovation brings opportunities for sustainable transformation. By reducing negative impacts and enhancing positive sustainability outcomes, digital innovation can help enterprises reduce their potential social harms [38].

4.2.3. Digital Innovation and Digital Innovation Ecosystem

As the main organizational form of digital innovation, the digital innovation ecosystem has become a key platform for innovation output. A digital innovation ecosystem is a complex adaptive system composed of entities related to digital innovation, oriented towards value creation and connected through competitive and cooperative relationships [39]. By constructing a digital innovation ecosystem, core enterprises and other participants can more easily integrate complementary resources, accelerating the innovation of digital products, services, and business models. The cooperative relationships between ecosystem actors also help enhance market power, enabling them to better cope with intense competition [40].

In order to accelerate the in-depth integration and rapid change of digital and innovation, digital enterprises will gather different innovative subjects to carry out digital innovation, drive entrepreneurial subjects and elements to gather, and construct digital entrepreneurship ecosystem, which is manifested in three aspects: (1) The openness of digital innovation expands the scope of innovation subjects, attracts more innovators to participate in the same digital innovation process, speeds up the construction of multi-subject networks, and forms a collaborative and symbiotic digital entrepreneurship ecosystem [41]. (2) The fusion connection of digital innovation expands the entrepreneurial elements, gathers digital elements in an all-round way, expands the boundaries of innovation activities and processes, and drives the vertical extension and horizontal fission of value networks [42], opening up a new way of ecological innovation. (3) The growth of digital innovation makes the scale and scope of innovation expand continuously with the participation of innovation subjects, strengthens the effectiveness of multi-agent collaborative connection, realizes interactive dynamic innovation process, and drives the sustainable renewal and improvement of digital entrepreneurship ecosystem [41].

Although the academic and practical circles have fully

affirmed the importance and development prospects of digital innovation ecosystem, there are few existing studies on digital innovation ecosystem, which are still in the embryonic stage, especially the research results on its evolution and governance are more rare, which cannot guide specific innovation practice [43].

4.2.4. Digital innovation and organizational performance

Digital technology and resource orchestration drive innovation in digitally enabled business models that can significantly improve operational efficiency [44]. Through the application of digital technology, enterprises can re-integrate and upgrade production processes, optimize business processes and improve operational efficiency [45]. Digital innovation has the function of improving operational efficiency, improving organizational performance and changing competitive landscape [46]. On the basis of improving operational efficiency, digital innovation can help enterprises improve organizational performance and competitive advantage. In the digital economy era, digital innovation of manufacturing enterprises can significantly improve enterprise performance through digital process innovation, digital product innovation and digital service innovation [15]. Yoo points out that digital innovation creates new value for users and improves organizational performance [47]; Teece emphasizes that digital innovation improves the dynamic ability of enterprises, enabling enterprises to flexibly respond to changes in the digital environment and achieve excellent performance [48]. Xiong Zhang emphasizes that digital innovation is the application of digital technology in the innovation process and improves innovation performance [49]. Zhang Zhengang et al. further distinguished the specific impact of innovation performance representing innovation ability and financial performance representing profitability, indicating that digital innovation can play a role in value creation, bringing double improvement effects on innovation performance and financial performance for enterprises, and making the relationship between digital innovation and enterprise performance more detailed and comprehensive [50].

5. Conclusion

This article reviews and sorts out the research in the field of digital innovation, clarifies the conceptual connotation and related characteristics of digital innovation, and constructs a preliminary research framework for digital innovation around the antecedents and outcome variables of digital innovation. Literature research shows that:

Firstly, the theoretical connotation of digital innovation is constantly expanding. Although scholars have different definitions of the connotation of digital innovation, they mainly discuss it from three aspects: motivation, process, and outcome. In addition, due to the dependence of digital innovation on the development and application of digital technology, previous research has defined the characteristics of digital innovation based on the dynamic, scalable, and programmable features of digital technology.

Secondly, the antecedents of factors influencing digital innovation include innovation mechanisms (open innovation, distributed innovation), environmental factors (government role), and digital technology level (artificial intelligence). Discussions on these factors are relatively scattered, and there is a lack of research on the integration of multiple perspectives and the interaction between antecedents,

resulting in a lack of systematicity.

Thirdly, the impact of digital innovation is mainly discussed from four aspects: high-quality economic development, digital transformation of enterprises, construction of innovation ecosystems, and enterprise performance, highlighting the positive effects of digital innovation. Existing research mostly focuses on the direct impact of digital innovation on outcome variables, which is not conducive to a systematic understanding of the effects of digital innovation.

Prospect

Although there have been beneficial explorations of digital innovation in existing literature and significant progress has been made, there are still some shortcomings.

Firstly, in terms of research subjects, most existing literature focuses on enterprises or provinces, while research results on urban level are relatively scarce. In the future, further classification and refinement can be carried out.

Secondly, in terms of research methods, existing literature mainly relies on a single indicator to measure digital innovation, or uses case study methods to explore the digital innovation capabilities of specific enterprises, with little attention paid to the comprehensive measurement and evaluation of digital innovation through the construction of indicator systems, especially the multidimensional measurement of urban digital innovation. Therefore, in the future, a mature scale for digital innovation can be constructed through an indicator system, empirical research can be conducted, and the credibility of digital innovation research findings can be improved.

Thirdly, in terms of research content, existing literature focuses on the conceptual connotation, measurement methods, and driving factors of digital innovation, lacking analysis of the spatiotemporal evolution characteristics of digital innovation. The impact of digital innovation is not static or unchanging, but dynamically evolving. Therefore, in the future, longitudinal research designs can be considered to explore the characteristics of digital innovation presented at different time points and its sustained impact effects.

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