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Impact of Digital Transformation on Innovation in the Context of Epidemic Situation

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Abstract: The COVID-19 has had a huge impact on the world economy. The world economic situation and outlook in 2022 pointed out that after the world economy grew by 5.5% in 2021, the global economy is expected to grow by only 4.0% in 2022, while China's economy is still maintaining a relatively stable growth. China's GDP growth in 2021 will reach about 8.1%, which is closely related to China's strong support for the digital economy and innovation. Digital transformation will change the boundary of enterprises and the traditional innovation mode, so that enterprises can widely obtain external innovation resources, and optimize the organization, management and working mode of innovation activities. Therefore, digital transformation has the potential to help enterprises solve innovation obstacles and improve innovation ability.

1. Introduction

In the digital wave, China actively embraces digital change. In recent years, China has deeply implemented the development strategy of digital economy. Digital technology is booming, and the development of digital economy comes first. With the continuous progress and wide application of digital technology, the added value of China's digital economy core industry will take 7.8% GDP in 2020, and the digital economy has become the main engine leading the high-quality development of China's economy[1]. For enterprises, the main body of high-quality economic development, digital transformation is a new source of future competitive advantages for enterprises. The digital transformation will change the boundaries of enterprises and the traditional innovation model, so that enterprises can widely access external innovation resources, and optimize the organizational management and working methods of innovation activities. Therefore, digital transformation has the potential to help enterprises break down barriers to innovation and improve innovation capabilities.

At the beginning of 2020, the sudden outbreak of COVID-19 has posed a severe test to China's economy and society. In the special period of fighting against the epidemic, the development of digital economy has played an important role in stabilizing the economic and social operation.

The COVID-19 has had a certain negative impact on China's economy, while China's digital economy is growing against the trend. In 2020, China's digital economy will reach 3.92 billion yuan, with a growth rate of 9.7%, more than 3.2 times the nominal growth rate of GDP in the same period. The digital economy has become an important driving force for China's economic stability and growth. In the Fourteenth Five Year Plan, it is pointed out that we should vigorously promote industrial digitalization and transformation, and promote the integration and sharing of innovation elements by promoting the digitalization transformation of industrial parks and industrial clusters, so as to build a regional digitalized development ecology of innovation collaboration[2]. It can be seen that digital transformation has become an important tool for enterprise development and innovation. In recent years, the development of digital technology has had a subversive innovation impact on the production, operation, sales and service modes of traditional industries. The digital economy represented by new technologies has become a new driving force for social development, constantly promoting the digital and intelligent process of China's industrial development. In the era of digital economy, the application of big data, cloud computing and other digital technologies has enriched the innovation models of enterprises. Open innovation platforms/communities based on Internet, big data and other digital technologies are increasingly adopted by enterprises. For example, BMW start-up garage, Haier HOPE platform, Meichuang platform, Zhijiang laboratory, etc., through these platforms, enterprises can achieve strategic coordination, cooperative development, seek diversified innovative knowledge and promote technology commercialization. The rapid rise of the digital economy has accelerated the industrial upgrading. complete the digital transformation is the key to measure whether Chinese industries can seize the major opportunities of the digital economy. It can be seen that the digital transformation is an inevitable requirement to promote the continuous innovation of enterprises to adapt to the development of the times[3], as shown in Figure 1.

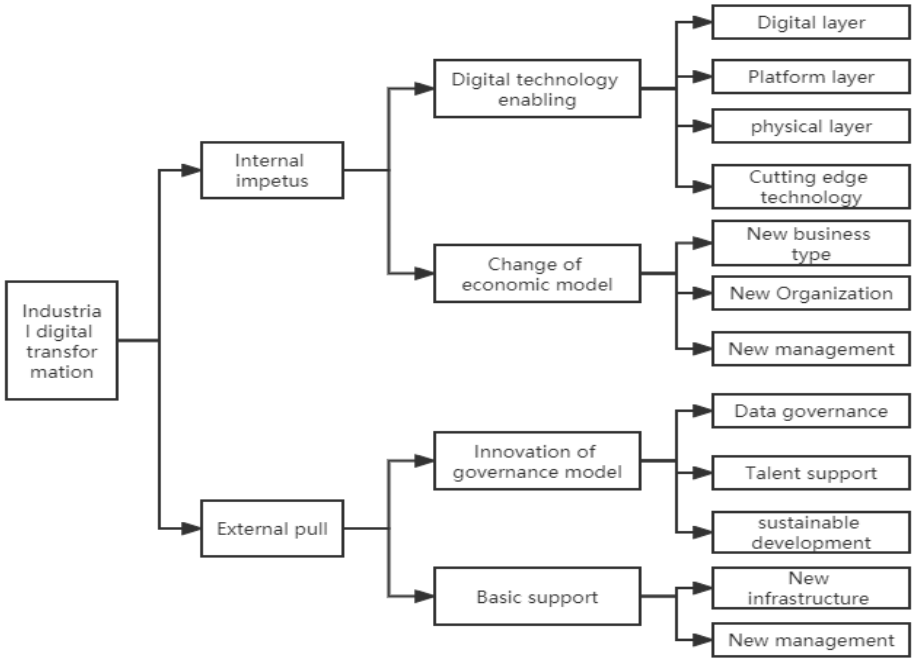

Figure 1. Digital transformation power system

2. Impact Mechanism of Digital Transformation on Innovation

2.1. Open networked Innovation Channel Resources

The basic theory (RBV) holds that the heterogeneous resources owned by different enterprises determine the differences in enterprise performance and competitive advantage, so the amount of innovation resources owned by enterprises will affect the innovation performance of enterprises. Compared with closed innovation, an open innovation mode in which enterprises absorb and utilize external knowledge and achievements and integrate internal and external innovation resources will improve innovation efficiency. And digital transformation can make it easier for enterprises to establish links in the complex network composed of innovation participants, forming a variety of cost savings and innovation driven forms of diversified subjects. Based on this, enterprises can further realize open network innovation, that is, in the complex knowledge network, they can actively search, absorb and utilize external knowledge and achievements by using the new generation of information technology, and introduce external innovation capabilities. First, Internet and digital technology can greatly improve R&D efficiency by reducing the transaction cost of enterprises to obtain external knowledge. For example, the use of the Internet makes it easier for enterprises to obtain various learning resources and related theories from the Internet, view the latest papers, patents and other scientific research achievements, learn knowledge from them and absorb good ideas to promote innovation[4].

Digital transformation can also help enterprises obtain information about market trends and customer needs, and directly absorb consumers' creativity and ideas on product improvement. Generally speaking, data feedback from customers and suppliers can enable enterprises to timely understand changes in consumer demand and market trends, which is conducive to enterprises to grasp the direction of innovation and improve innovation efficiency. Enterprises without digital transformation are difficult to collect and analyze these massive data, and digital technologies such as big data can solve this problem. For example, enterprises can widely collect customer data through big data and use artificial intelligence for data analysis, so as to accurately depict the characteristics of consumer demand at the group and individual levels, and design new products that are more responsive to market trends and closer to the personalized needs of customers.

Digital technology has also reshaped the interaction mode between enterprises and consumers. Consumers will participate in the production process of products, and the difference between consumers and producers is increasingly blurred. For example, consumers can customize products individually or put forward suggestions for improvement of existing products in the user community. In this process, consumers' creativity and ideas will become the source of enterprise innovation. It can be said that in the interconnected cyberspace, "user innovation" in the true sense has been realized, that is, users discover the demand for new products and provide innovative ideas. More importantly, digital transformation can also enable enterprises to integrate external innovation resources in a wider range across borders and achieve open networked innovation. Digital technology provides organizations with a platform for internal and external communication, where enterprises and their stakeholders can exchange ideas and knowledge (Raz Haifeimen et al., 2020)[5]. For example, enterprises can obtain innovative ideas and opinions from external personnel in user communities and enterprise forums, or directly put technical problems on the network platform to external personnel to solve. Enterprises can not only gather a series of external innovation resources through digital technology, but also establish closer ties with the outside world, so that internal and external personnel can work together to better complete innovation. For example, the digital transformation allows R&D to be completed in a "crowdsourcing" way, which allows enterprises to make full use of external resources on the network and hand over R&D to the

most appropriate personnel in the most efficient place (Qi Yudong and Xiao Xu, 2020), while also reducing the risk of enterprises' own R&D investment. For example, both Apple and Google widely use external personnel to develop applications, and the company's main role is to build a digital innovation platform (Raz Haifeimen et al., 2020). Obviously, digital technology weakens the boundaries of enterprises, promotes cooperation between different innovation workers, and promotes the formation of open networked innovation on this basis[6] , as shown in Figure 2.

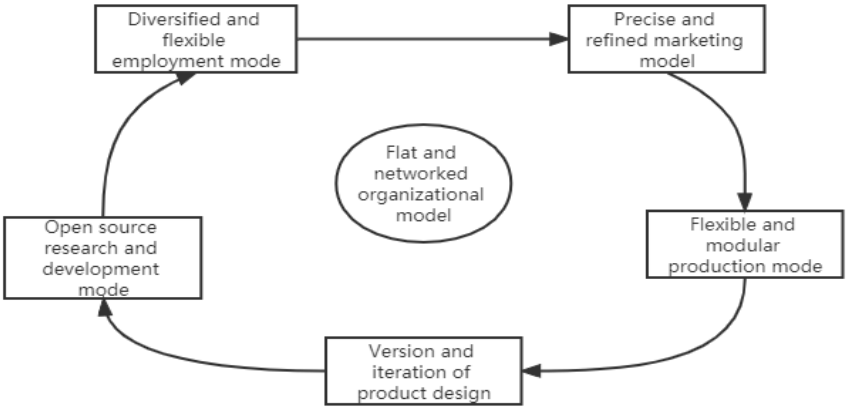

Figure 2. Innovation of enterprise internal management activities

2.2. Organizational and Management Innovation Channels

Digital transformation can also lead to organizational change and management innovation within enterprises, improve the efficiency of organization and management of R&D activities, and thus promote enterprise innovation. While investing in information technology, enterprises often need to innovate in organization and management. This is because not changing the organizational structure will reduce productivity. Enterprises that invest in information technology and also make changes in human capital and management can achieve higher productivity. Specifically, digital transformation can increase the autonomy of grass-roots employees, transform top-down hierarchical management into team based molecular management, and make knowledge work complete in the form of teams. For example, Chrysler created a digital platform development mode based on digital technology. The important decisions of designers do not need to be approved layer by layer, but can be made independently. The platform allows different designer teams to design products in a concurrent design mode, thus greatly improving the R&D efficiency[7].

The digital transformation also makes the organizational structure of enterprises more flat, eliminates intermediate managers, speeds up the transmission of data and information between levels, and builds an agile organization, so that enterprises can quickly detect external changes and seize innovation opportunities. The removal of intermediate links also enables enterprises to focus more on value creation for users and improve innovation efficiency. Digital transformation also further brings about a networked organizational structure, changes the way organizations interact with the outside world, eliminates the boundaries between different organizations, and facilitates enterprises to integrate internal and external innovation resources.

The digital transformation also changes the communication and information transmission within the enterprise from the traditional way to the digital way, so as to improve the efficiency of information transmission within the enterprise and facilitate the collaboration between different departments. A large number of intra enterprise information transmission can be realized through online systems based on digital technology, thus improving communication and coordination

efficiency (Chen Dongmei et al., 2020). The improvement of communication and coordination efficiency in the innovation process will directly lead to the improvement of innovation efficiency. The digital transformation has also broken down the barriers between different departments in the enterprise, enabling the R&D department, manufacturing and sales departments to work together in interaction and improve the R&D efficiency[8].

Digital technology has also expanded the communication and sharing of data and knowledge within the enterprise (Zhao Chenyu et al., 2021), thus creating a public knowledge base within the organization, which is conducive to research and development. For example, different employees may encounter the same problem repeatedly. If the knowledge to solve such problems has been shared in the organization, they do not need to spend time to find a new solution to the problem. Digital transformation has also brought about a new corporate culture, changing the way managers and employees think and work[9]. The Internet spirit encourages enterprises to carry out open innovation cooperation in the network, and encourages the public to share their ideas on the network. The collision of different ideas between internal employees and external personnel will become an important source of innovation. The new corporate culture also encourages the formation of an atmosphere of equality and mutual assistance within the enterprise, breaks the traditional relationship between superiors and subordinates, stimulates the enthusiasm of employees, and trains employees' ability to think independently, which is more conducive to the birth of innovative ideas, as shown in Figure 3.

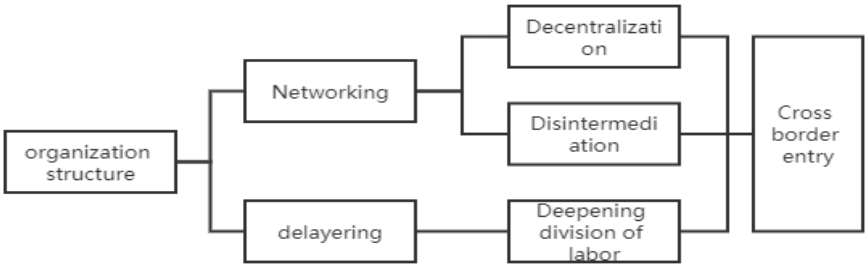

Figure 3. Enterprise organizational structure in digital economy

2.3. Human Capital Channel

Digital transformation can also improve the human capital level of enterprises. On the one hand, the human resources required by enterprises after digital transformation will change. The application of digital technology will cause the work of low skilled labor to be replaced by intelligent devices, while the demand for high-end human resources will increase, which will improve the level of human capital of enterprises. Bresnahan et al; On the other hand, it brings a lot of raw data that needs to be processed and analyzed for decision-making, which leads to the demand for high-end labor. Chen Dongmei and others (2020) also pointed out that digital transformation will change the human resources required by enterprises, and employees who master digital technology will replace existing employees. On the other hand, absorbing high-end human capital and applying digital technology are complementary. In order to make the advantages of IT technology in full use, enterprises generally need to set complementary capabilities such as IT human resource capabilities (Li et al., 2018). Bartel et al. (2007) also found that in order to effectively improve productivity, enterprises need to combine IT technology with highly skilled workers and other elements. Shi Yupeng et al. Enterprises with high-level human capital have more knowledge reserves, stronger ability to generate new ideas, and stronger innovation ability[10].

3. Opportunities for Digital Transformation under the Influence of Epidemic Situation

3.1. Promote Digital Transformation of Government Governance

The establishment of the digital governance platform has played a significant role in the prevention and control of the epidemic for governments at all levels, and the efficiency of government governance has been improved with the help of the new generation of information technology[11]. Next-generation information technologies, such as 5G, big data, cloud computing and artificial intelligence, have played an important role in various aspects of epidemic prevention efforts, including targeting confirmed cases and their close contacts, viewing epidemic information, monitoring the temperature of the flow of people and analyzing epidemic trends. In order to carry out dynamic monitoring and research on epidemic risk, Hangzhou integrated multiple cross-domain big data to establish a high-risk and vulnerable population model.In the process of returning to work, more than 100 cities across the country have adopted health codes to achieve health management for returning to work personnel, accurately and intelligently control the risks of returning to work, and help prevent and control the epidemic and return to work. Contactless digital technology improves government service capability. In this epidemic, the first-line dynamic broadcast of the epidemic based on cloud live broadcast, as well as the epidemic information and policy release based on WeChat, microblog and other new media, have formed an all-round epidemic information open network, effectively improving the credibility of the government. For example, Shanghai released 4570 microblogs and WeChat messages related to the epidemic in January 2020, which effectively enhanced the public's awareness of prevention and control and social confidence[12], as shown in Table 1.

Table 1. Aspects to be improved in emerging industries such as digital enterprises(%)

	Degree of recognition		Degree of recognition		Degree of recognition
High end talent reserve	30.2	Market maturity	18.1	Transformation of scientific and technological achievements	10.2
Industrial Basis	29.3	Financing convenience	18.0	First line skilled workers	7.5
Government guidance and support	26.1	Public infrastructure	15.2	other	2.5
Upstream and downstream supporting facilities of the industrial chain	21.4	Scientific and technological innovation atmosphere	11.5		

3.2. Promoting Industrial Digital Transformation

Offline brick-and-mortar stores have lost money or even closed down due to quarantine measures, so changing the business model is an important way for the brick-and-mortar industry to cope with the crisis. The quarantine situation has accelerated the transformation of consumers' shopping habits, and many new digital industries have developed rapidly during the epidemic, such

as online education and online medical care, while traditional offline industries have been forced to go online. In addition, "contactless logistics" has reached the safety of "the last mile" of logistics, giving birth to "low contact economy" and "home economy". According to Tencent's statistics, during the epidemic period, more than 20000 universities, middle schools and primary schools had nearly 10 million students taking classes live via WeChat. The industrial Internet platform accelerates the empowerment of real industries. The shortage of medical materials exposed the manufacturing industry's deficiencies in industrial chain coordination, supply and demand matching, etc. The integration of the whole industrial chain from supply to distribution enables the upstream and downstream enterprises to meet the market demand[13].

3.3. Helping Social Digital Transformation

In the epidemic situation, digitalization is penetrating into every corner of society at an accelerated pace, taking on the characteristics of diversification and socialization. We will promote the digital transformation of people's lifestyles. According to a market survey, 84 percent of respondents have tried new online services due to the pandemic. Consumption is more diversified in terms of products, groups and regions. Many household consumption and content consumption are also gradually emerging on online platforms, such as online medical care, online education, online office, online reading, online film and television; People who had not participated in online consumption began to do so due to the impact of the epidemic. The transformation of citizen participation into digital mode provides a certain basis for the digital transformation of the whole society[14]. We will promote the digital transformation of community-level units. The epidemic prevention system, with communities, subdistricts, Party organizations, leading groups, trade associations and other grass-roots units as the main body, has closely woven the prevention and control network of the whole society. Digital applications such as online information registration, daily health tracking, and community epidemic clues have opened up information coordination between grassroots governance units and the government[15].

The starting point of various policies is undoubtedly to promote and ensure the steady development of digital transformation, but the implementation level is still not in place. Satisfaction evaluation of various factors related to enterprise digital transformation is shown in the following table 2

Table 2. Satisfaction evaluation of enterprise digital transformation (%)

	Most satisfied	satisfied	commonly	Not very satisfied	Most dissatisfied	score
Digital application of epidemic prevention and control	34.1	33.1	24.1	6.0	2.7	3.90
Digital means of government supervision	30.9	33.4	26.7	6.2	2.8	3.83
Open sharing of government data	30.6	33.2	26.2	6.7	3.3	3.81
Business data trading market	28.0	33.6	28.5	6.9	3.0	3.77
Data collaboration between upstream and downstream enterprises in the industry	26.8	32.2	29.8	7.9	3.3	3.71
Local policies for digital transformation	25.9	32.1	30.4	7.8	3.8	3.68

4. Reflections on Digital Transformation

The COVID-19 has made a great influence of the world economy. The World Economic Situation and Outlook in 2022 pointed out that the global economy is expected to grow by only 4.0% in 2022 after the world economy grows by 5.5% in 2021, while China's economy still maintains a relatively stable growth. In 2021, China's GDP growth rate will reach about 8.1%, which is inseparable from China's strong support for the digital economy and innovation.

Enterprises should conduct a comprehensive digital transformation, rather than just applying a few digital technologies. Utilize the programmable, open, expandable and other characteristics of digital technology to constantly innovate the products or services of the enterprise, realize with users, and constantly improve the innovation ability of the enterprise, so as to maintain its core competitiveness and establish competitive advantage in the competitive market.

The government should actively take measures to promote the digital transformation of enterprises. Digital transformation requires enterprises to pay a large fixed cost, but the benefits need to be realized in the long term, so some enterprises may lack the motivation and ability to transform. The government can adopt corresponding fiscal and tax policies to encourage enterprises to carry out digital transformation. For example, the government can allow enterprises to deduct the pre tax expenditure on purchasing computers, information systems, big data platforms and other digital software and hardware equipment, or give special subsidies for digital transformation. In the process of digital transformation, the government can also build a number of digital transformation promotion centers, cultivate a number of digital solution providers, provide professional digital solutions for enterprises, and guide enterprises to carry out digital transformation. In addition, the government can also implement support policies for industrial clusters to promote the overall transformation of enterprises in the clusters, such as guiding industrial parks to accelerate the construction of digital infrastructure and allowing enterprises in the parks to coordinate transformation. Finally, the government should also provide targeted help according to different types of enterprises.

In addition, the high-end talents trained in China cannot meet the needs of digital transformation of enterprises, which is the key to restricting digital transformation. The government should give full play to relevant capabilities to promote the training of digital composite talents, encourage colleges and universities to open digital-economy-related majors, and establish institutions such as colleges of big data and artificial intelligence.

Finally, although the COVID-19 epidemic is a big impact on the development of enterprises, it can also force enterprises to use more digital technology in production and operation. The government can implement the digital application of epidemic prevention and control, and turn the impact of the epidemic into the power of enterprise digital transformation.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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