

# The Development and Practice of Management of Technology in China under the Context of Digital Economy

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*Received 2 December 2023, Revised 20 December 2023, Accepted 1 January 2024*

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## Abstract

**Purpose** – In recent years, technology management has received widespread attention in academia and industry and has become an important discipline. The competition for comprehensive national power among countries is reflected in the innovation competition.

**Design/Methodology/Approach** – The expansion of the research scope and the deepening of the research level of technology management are inevitably based on its knowledge foundation, and the further improvement of technology management theory should also be based on its intrinsic knowledge foundation. The knowledge base of technology management is the knowledge that has theoretical support and guidance for the development of technology management research and technology management theory, which can reflect the essence of technology management and have relative stability. Based on this understanding, it is of practical significance to explore the knowledge base of technology management.

**Findings** – Innovation is the strategic support for improving comprehensive national power, and the implementation of an innovation-driven development strategy is the key way to realize the Chinese dream of the great rejuvenation of the Chinese nation.

**Research Implications** – Technology management plays an important role in enhancing the core competitiveness and innovation ability of enterprises. In the process of "going out" and "bringing in", Chinese enterprises emphasize technology management and form their competitive advantages. The development of the digital economy brings new development opportunities and challenges for technology management.

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**Keywords:** Technology management; knowledge management; digital economy

**JEL Classifications:** M1, E0

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## **I . Introduction**

In recent years, technology management has received widespread attention in academia and industry and has become an important discipline. The competition for comprehensive national power among countries is reflected in the innovation competition. Innovation is the strategic support for improving comprehensive national power, and the implementation of an innovation-driven development strategy is the key way to realize the Chinese dream of the great rejuvenation of the Chinese nation. Technology management plays an important role in enhancing the core competitiveness and innovation ability of enterprises. In the process of "going out" and "bringing in", Chinese enterprises emphasize technology management and form their competitive advantages. The development of the digital economy brings new development opportunities and challenges for technology management.

## **II . The emergence and development of technology management**

### **1. Definition of the concept of technology management**

Science and technology are highly interrelated and inseparable, but at the same time different. Science is the discovery of the laws that exist in nature, and technology is the invention that transforms the world. It follows that technology is a bridge and a tool between science and practice. In view of the importance of technology, the concept of technology management has gradually gained importance.

The concept of technology management, MOT (Management of Technology), can also be translated as science and technology management, which emerged in the 1980s. Academics began to pay attention to the competitive advantage of technology management for enterprises, represented by the U.S. National Research Council, which released the "Management of Technology: The Hidden Competitive Advantage" related report. The report defines technology management as "technology management is the planning, development, and implementation of technological capabilities to plan and accomplish an organization's strategic and operational goals".

Since then, technology management has received extensive attention from both academia and industry and has gradually formed an independent discipline. In our country, technology management specializes in the study of management activities in the field of technology, which is a cross-discipline between technological science and management science. Technology management is to systematically analyze the development trend and application of technology from the macro level, and to grasp the role mechanism between technology and management at the micro level. In the United States, several colleges and universities have introduced technology management courses. Obviously, the discipline of technology management has become an important discipline. In Korea and Japan, many colleges and universities have also launched the "technology management" program, and the basic idea of its education is to let operators understand technology and let technical experts understand management. In general, technology management is to let those who know technology and those who know management to manage with the latest scientific management methods.

Due to the increasing technical input and complexity, technology management has become one of the most important management activities, for example, the United States Harvard Business School and other technology management have been listed as the 21st century management science and science and technology management. With the development of digital economy, enterprises must also make full use of the opportunity of technological change, seize the opportunity of the times, improve their technology management, and enhance their competitiveness.

## **1.1 The evolution of technology management**

Technology is the means by which mankind transforms the objective world. The activities of human society are inseparable from technical means and methods. In ancient and modern times and at home and abroad, people are familiar with engineering and projects are permeated with the idea of technology management.

Since the Renaissance, mankind has experienced three industrial revolutions, each of which has led to a qualitative leap in productivity. Technology has changed the way people produce and live, and made mass production possible. The upgrading and modification of technology has led to increased productivity, which has revolutionized the economic landscape of the world. Before the industrial revolution took place, there was not much of a breakthrough in the GDP per capita created by the society as a whole. But after the Industrial Revolution, GDP per capita took a quantum leap. In Europe, it increased 50 times in 200 years; in China, it increased more than 10 times in just 40 years. The Industrial Revolution was the result of science driving technology, which in turn was transformed into productivity. This is an important manifestation of science and technology in economic and social life.

Especially in recent years, science and technology have been rapidly and massively transformed into productivity, bringing unprecedented prosperity to human society. Science and technology have played an indispensable role in economic and social development. In 2019, China's per capita GDP reached 10,216 U.S. dollars, and it needs to rely on innovation to cross the middle-income trap. And the foundation of innovation is the development of science and technology.

Looking back to 2020, the new crown virus ravaged the world, becoming the biggest risk for global enterprises and even reshaping the global industrial chain pattern. Engels said, "There is no great historical disaster that is not compensated by historical progress." The epidemic has accelerated the turning point of the times. We are currently in a critical moment in history when the period of the fourth industrial revolution, the digital economy era, the post-epidemic era and the 14th Five-Year Plan period are superimposed, and it is also a period when technological innovations come out of the blue, and with the infiltration of the Internet of Things, Artificial Intelligence, Big Data, Blockchain and other technological systems into people's daily lives, technology management is also changing. Only by constantly updating one's technological knowledge, emphasizing the role of technology in enterprise management, industrial development and national competitiveness, and focusing on fostering the ability to develop and apply technology, can we truly promote technological innovation and, in turn, the development of the national economy.

## **III . Technology management process and important variables**

### **1. Technology management process**

With the deepening development of global economic integration and the accelerated evolution of a new round of scientific and technological revolution, the essence of the competition for comprehensive national power is increasingly reflected in the innovation competition. The implementation of an innovation-driven development strategy is a key way to realize the Chinese dream of great rejuvenation of the Chinese nation. In order to realize the national renaissance, it is necessary to enhance the awareness, level and practical application of technology management at the national, industrial and enterprise levels. Identifying the content and process of technology management can provide more and newer research entry points for technology management research, so as to improve the research system of technology management and enhance the efficiency of technology management. Wu Weiwei et al. (2016) summarized that technology management is a series of management processes about R&D management, innovation management, technology evolution theory, strategic

management, knowledge management, organization theory, and globalization theory, and its core task is to enhance the core competitiveness of the enterprise through a conscious management process, so as to enable the enterprise to achieve sustainable development in a rapidly changing environment.

### **1.1 R&D management**

The enterprise's own R&D management is a micro means to enhance the enterprise's R&D efficiency, and its impact on the efficiency of technological innovation is crucial. R&D management mainly includes product development and innovation, R&D organization and research management, etc. It is an important foundation for the study of technical activities and technical organization in technology management research. The initial focus of technology management is precisely the management of R&D activities, which is later extended to the management of the whole process of new product development. Relying on R&D management, it can truly realize the rational allocation of enterprise resources, further strengthen the utilization rate of enterprise resources, so as to maximize the benefits of the enterprise. For R & D management, as a whole, belongs to a systematic process, usually, can be divided into two aspects, on the one hand, the hard content, such as economic income, R & D institutions, etc., and on the other hand, the soft content, such as the leadership of the innovation consciousness and enterprise system and so on. The setting of R&D system can provide an effective guarantee for the development of the enterprise.

### **1.2 Innovation management**

Innovation management is the combination of management of the innovation process and strain management in a firm, specifically innovation in products, business processes, marketing and organization. Innovation management enables firms to adapt to external or internal opportunities and use their creativity to introduce new ideas, processes or products. Through effective innovation management, it is possible to bring together all the technologies and markets that are needed for the development of the enterprise and to further strengthen its competitive advantage. At the same time, innovation management also includes a wide range of innovative knowledge and plays a very important role in the field of technology management research. Through innovation management, it can further promote the development of technology management theory, for example, open innovation and creative destruction and other phenomena. From this, we can understand that in the process of technology management research, innovation management occupies a very important position, not only can provide a certain knowledge base for technology management, but also a very critical part.

### **1.3 Theory of Technology Evolution**

Technological evolution mainly involves technological laws and technological planning tools. From the perspective of the law of technological development and change, technology has a life cycle, so enterprises need to continuously update technology through a series of innovative activities to maintain the competitive advantage of enterprises. As for the theory of technology evolution, it is mainly used to determine when to update and what kind of technology to update. At the same time, in the process of technological development, must have a set of relatively perfect management methods, and through the theory of technological evolution, can give technology management relatively perfect technology map and management technology and other tools. The use of this series of tools can further strengthen the effect of technology management, can realize the effective distribution of technology resources.

### **1.4 Strategic management**

Strategic management refers to the decision-making and management of the overall and long-term development direction, goals, tasks and policies, as well as resource allocation of the enterprise or organization in a certain period of time. With the progress of society, technology has also gained greater improvement, and in the process of enterprise development, technology occupies an increasingly important position. In the process of development, the strategic issues of technology, such as what technology to get, how to identify the available technology, and collect the resources that are favorable to the enterprise, have all become the key contents in the enterprise's technology management. Through the theory of strategic management, a series of problems in enterprise development can be effectively solved from a holistic perspective.

### **1.5 Knowledge management**

With the development of technology management, technology management research gradually penetrates into the knowledge level. For technical innovation capability, knowledge is the main foundation. In the process of development, enterprises must effectively integrate the knowledge they have to ensure that they can reasonably integrate different parts of technology management, bring more powerful ideas to technological innovation, and thus lay a certain foundation for technology management decisions. For knowledge, in the current stage of development process, has become a strategic asset, and constantly acquire more new knowledge, has become an important factor to break through new technology, innovation and success. Through effective knowledge management, it can ensure that technology is shared to the maximum extent in various organizational cultures, which is very beneficial to the performance of enterprise technology innovation.

### **1.6 Organizational Theory**

Technical organization from the design, power setting to planning and so on this series of processes are related to whether the technical management can be effectively implemented. Guaranteeing the smooth operation of technology management is an important function of organization theory. Many technology management tools also derive from organization theory, such as the organization-technology diagram depicting the co-evolution of organization and technology, which most directly links organization theory with technology theory. The application of organizational theory can promote the smooth operation of technology management, and enterprises can also personalize the technology management system according to the characteristics of their own organizations, thus promoting the improvement of management efficiency.

### **1.7 Theory of globalization**

Conducting technology management requires a globalization perspective. The process of globalization is also an important driving force in promoting technology management, because technology has broken through the boundaries of individual regions or countries, and the integration, spillover and transfer of technology has become a major trend in technological development. More countries are relying on the formation of technology alliances to obtain resources for their own development. Therefore, the context of globalization is an important motivation for promoting technology management.

The characteristics of technology management enable it to safeguard the implementation of enterprise strategies and become an important means for enterprises to gain a competitive advantage.

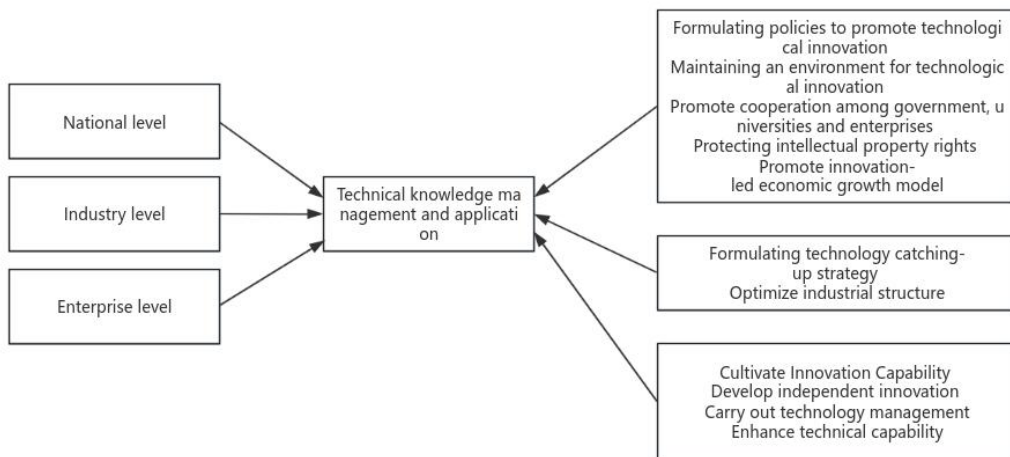
## 2. Important variable in the process of technology management: knowledge management

On the one hand, technology management capability is related to the acquisition, storage, diffusion and utilization of technological knowledge, which can promote the accumulation of knowledge and knowledge integration to enhance technological capability through the operation of the stock of technological knowledge, and then promote the behavior of breakthrough technological innovation. On the other hand, enterprises using technology management capabilities can systematically collect the information needed to implement breakthrough technological innovation, which helps enterprises form a more complete perception of the prospects for breakthrough technological innovation, improves the enterprise's perception of the value of breakthrough technological innovation, and then prompts the generation of radical entrepreneurship to promote the behavior of breakthrough technological innovation.

The expansion of the research scope and deepening of the research level of technology management is inevitably based on its knowledge foundation, and the further improvement of technology management theory should also be based on its intrinsic knowledge foundation. The knowledge base of technology management is the knowledge that has theoretical support and guidance for the development of technology management research and technology management theory, which can reflect the essence of technology management and has relative stability. Based on this understanding, it is of practical significance to explore the knowledge base of technology management.

As shown in Figure 1, the role of knowledge management in technology management and the realization of technological catch-up is explored at three levels:

Fig. 1. : Moderating role of technical knowledge management



### 2.1 Country level

Compared to middle-income countries, high-income countries have higher growth rates of per capita income as well as higher investment ratios. More specifically, among the factors related to the national innovation system, high-income countries tend to have a more balanced distribution of innovations, and higher rates of knowledge creation and diffusion. Among these factors, knowledge localization plays a more pronounced role in achieving technological catch-up. Between 1980 and 2000, the level of knowledge localization tripled in South Korea and Taiwan region, China, which contributed to

more than a threefold increase in their real income per capita.

## **2.2 Industry level**

Since the dominant advantage of the incumbent is likely to be disrupted by the constant emergence of new technologies, technological upgrading is a window of opportunity for latecomers. The relatively backward technology industry to achieve catching up should seize the opportunity to develop and realize technological breakthroughs to achieve the purpose of technological catching up. Such as in the semiconductor chip industry, Japan, South Korea and China Taiwan region has realized the technology to catch up.

## **2.3 Enterprise level**

Research has shown that there is a significant correlation between the localization of knowledge creation and dissemination within the enterprise and enterprise performance. This suggests that enterprises should focus on developing unique knowledge advantages in order to achieve performance growth and maintain their development advantages. The importance of knowledge management is self-evident as Huawei Technologies Ltd. has the highest number of patents in the country in 2020.

# **IV . Technology Management Practices in Chinese Firms**

## **1. National Enterprises "Going Global"**

Under internationalization and the "Belt and Road" initiative, many Chinese enterprises have chosen the road of international operation. In the process of transforming "Made in China" into "Created in China", Chinese enterprises have accumulated a lot of experience in technology management through their own practices, and when they go abroad, they also bring this management style, ideas and culture to other countries.

### **1.1 Technology management helps improve efficiency**

Advanced technology management helps optimize the allocation of personnel and production factors, integrates the organization's operational, technical and internal management capabilities, and promotes the collaboration and capability of the entire organization, which is the key means for enterprises to maintain competitiveness. Excellent Chinese enterprises going abroad not only export capital, but also technology, management and culture, forming a technology and cultural spillover effect, which not only brings local employment opportunities, but also promotes the development of local technology and management, and shapes a positive overseas image of Chinese enterprises. Guided by the demand of overseas market, we join hands with overseas partners to create value together, and walk out of a characteristic road of Chinese enterprises' overseas development.

### **1.2 Technology management empowers enterprise innovation**

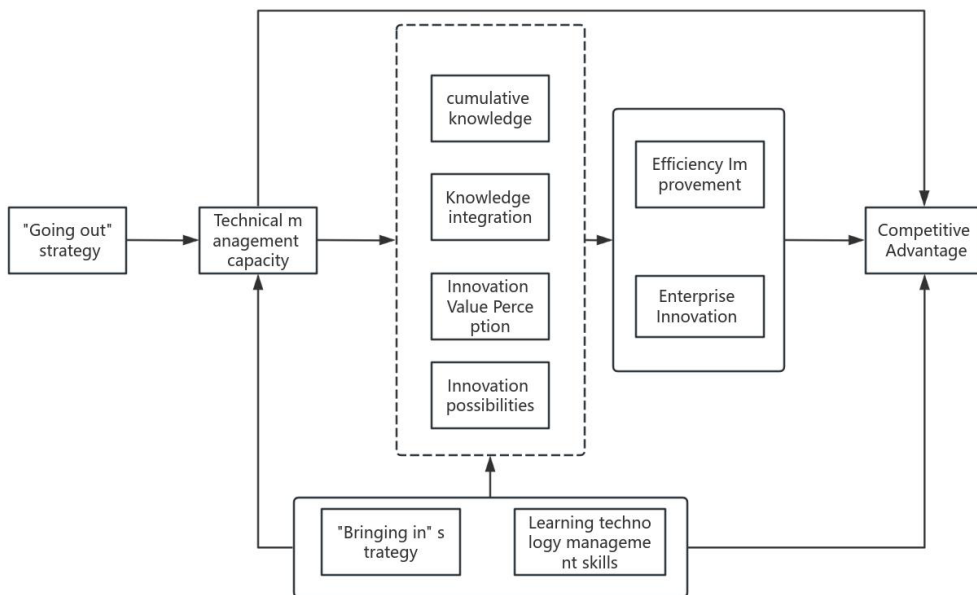
In the process of "going out" of Chinese enterprises, expanding their own advantageous industries to other countries,

in order to maintain the advantageous position, Chinese enterprises need to increase product research and development, increase investment in technology research and development, upgrade the level of technology management, so as to guide and prompt enterprises to carry out the corresponding transformation and upgrading, to enhance the ability to innovate, and to form a global leading edge. Advantage. On the one hand, the improvement of innovation ability can enhance the adaptability of enterprises to the political and market environments of different countries; on the other hand, Chinese enterprises can learn from the experiences of successful enterprises in different countries and apply them to their production and operation activities, so as to push forward the reform and innovation of their own development mode, industrial strategy and business model, and realize a new pattern of double-cycle development that promotes the development of the international and domestic markets.

### 3. "Bringing in" advanced technology management

Through the strategy of "bringing in", the introduction of advanced technology, management concepts and management experience carried by foreign investors can promote the enhancement of the knowledge management capability and innovation capacity of Chinese enterprises. This is crucial for China's enterprises to be embedded in the global industrial chain, value chain and innovation chain. However, it is more important to promote the absorption and digestion of these technological management experiences, transform them into their own core competitiveness, and cultivate new advantages for our enterprises in international cooperation and competition. By utilizing the knowledge overflow from multinational enterprises to promote China's industrial upgrading and transformation, promote the co-construction of value platforms, explore industrial advantages, and form an entrepreneurial and innovative industrial value chain. The above measures will develop and strengthen the competitive advantages of Chinese enterprises, and empower them to better "go global" and further expand the development space of the national economy.

Fig. 1. : Moderating role of technical knowledge management





## V . Opportunities and challenges for technology management in the digital economy

With the continuous development of the times, the global economy has gradually entered the era of digital economy, digital technology occupies a more and more important position, and the world's industries are gradually developing in the direction of digitization and networking. For the digital economy, it is essentially a new economic form, and gradually transformed into a new driving force for social development, which has an essential impact on people's lives and economic growth mode, and also brings new opportunities to the world and human civilization, and contributes to the renewal of the economic and social management system. How to realize the sustainable development and economic growth of the national economy in this context has become a problem that must be solved in the development of China's digital economy.

The development of digital industries represented by the Internet, big data, cloud computing, 5G, artificial intelligence, blockchain, etc. has promoted the accumulation and application of data. Data has become a key production factor after land, labor, capital and technology. The digital economy has become an increasingly mainstream economic form. The key to promoting the development of the digital economy is talent, and it is crucial to cultivate technological management talents with digital literacy. The innovative development of the digital economy makes it even more important to have diversified and forward-looking talents who understand both technology and management, and they are an important source for promoting the development of the digital economy.

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