

Research Article

Resolving Technological Barriers: Development Strategies for Technological Competitive Intelligence of Technology Based Enterprises

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Abstract

In the face of unprecedented global changes, some countries are moving against the trend of globalization, relying on their own technological strength to continuously create technological barriers and disrupt the order of technology enterprises' industrial and supply chains, and have had a serious adverse impact on the recovery of the world economy and the development of high-tech industries. In response to this situation, this article proposes the problems brought about by this situation through literature research, including the need for technology-based enterprises to further strengthen the development of technology competitive intelligence, solve the problems of insufficient technology competitive intelligence institutions, lack of high-level professional talents, and low comprehensive development capabilities of technology competitive intelligence in enterprises. At the same time, this article proposes a practical path to solve the existing problems - by improving the technology competitive intelligence network, establishing technology competitive intelligence agencies, and leveraging the technology competitive intelligence development role of high-tech industrial development zones, the adverse effects of technological barriers on enterprises can be effectively eliminated, and the technological accumulation, research and development, and innovation capabilities of enterprises can be improved. These measures can to some extent alleviate the negative impact of technological barriers and stabilize the industrial and supply chains of high-tech enterprises.

Keywords

Technology Barrier, Technology Enterprises, Competitive Intelligence, Economic Development, Developing Country

1. Introduction

Currently, the world's unprecedented major changes are accelerating. However, some countries frequently politicize normal enterprise technology research and cooperation, establish trade and technology barriers against technology-based enterprises through technological hegemony and

trade and investment protectionism, and arbitrarily use technology export control measures, seriously disrupting the normal industrial and supply chains of technology-based enterprises and affecting their technology research and development efficiency. In recent years, many scholars have

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conducted extensive research on the path and practice of eliminating trade and technological barriers, but mainly from the aspects of legal means, tariff measures, and independent research and development, ignoring the global characteristics of technology-based enterprises and their product industry chains and supply chains, making it difficult to fundamentally solve the problem of technological barriers from the perspective of smooth industrial and supply chains.

In the face of this situation, this study proposes by that legally and systematically capturing domestic and international technological trends in the industry, predicting the trends and directions of technological change, and taking corresponding measures in a timely manner should become an important measure for technology-based enterprises to avoid market risks, seize technological and market opportunities. Meanwhile, this study also points out that during this process, actively conducting research and development on Competitive Technical Intelligence (CTI) to enhance the ability of enterprises to collect, acquire, analyze, and apply their technological competitive intelligence is of great strategic and practical significance for improving the technological competitiveness and innovation management capabilities of technology-based enterprises, as well as reducing risks such as industrial chain breakage and supply chain obstruction. This also highlights the important purpose of this study to promote the breaking of technological barriers, facilitate global economic recovery, and enhance the technological competitiveness of developing countries from a new perspective.

2. The Significance of Technological Competitive Intelligence for Enterprise Development

2.1. The Meaning of Technological Competitive Intelligence

Technical competitive intelligence is an important branch derived from competitive intelligence (CI), and the emergence of CI is related to the process in which the Central

Intelligence Agency and the Defense Intelligence Agency of the United States collect and analyze intelligence of their concern and participate in political decision-making. In 1997, American intelligence expert W. Bradford Ashton and American enterprise technology decision expert Richard A. Kravans collaborated to publish the book " Keeping Abreast of Science and Technology: Technical Intelligence for Business ", which first and systematically expounded the methods for enterprises to collect and analyze relevant technology information and serve their technology strategy, marking the emergence of enterprise technology competitive intelligence.

At present, the academic definition of enterprise technology competitive intelligence is: commercially sensitive information about external technological opportunities, threats, and developments that may affect the competitive position of the enterprise [1]. At present, the definition of enterprise technology competitive intelligence that is widely recognized in the Chinese academic community is: external scientific or technological threats, opportunities, and development information that can have a significant impact on the competitive position of enterprises or organizations, as well as the processes of obtaining, monitoring, analyzing, foresight, and early warning of this information. It is the application of competitive intelligence theory and methods in the field of enterprises [2]. The author believes that this definition includes two levels of meaning: on the one hand, enterprise technology competitive intelligence activities are not the usual "business espionage" behavior, and their basic behavioral norms are to collect and use external competitive technology information through legal and ethical means; On the other hand, enterprise technology competitive intelligence is not simply a collection of information. Literally, "information" mainly refers to raw materials that have not been processed or screened, while "intelligence" emphasizes the analysis and application after completing the collection of "information", which has more reference and guidance value for practical actions than "information".

Generally speaking, the development of enterprise technology competitive intelligence activities includes the following stages:

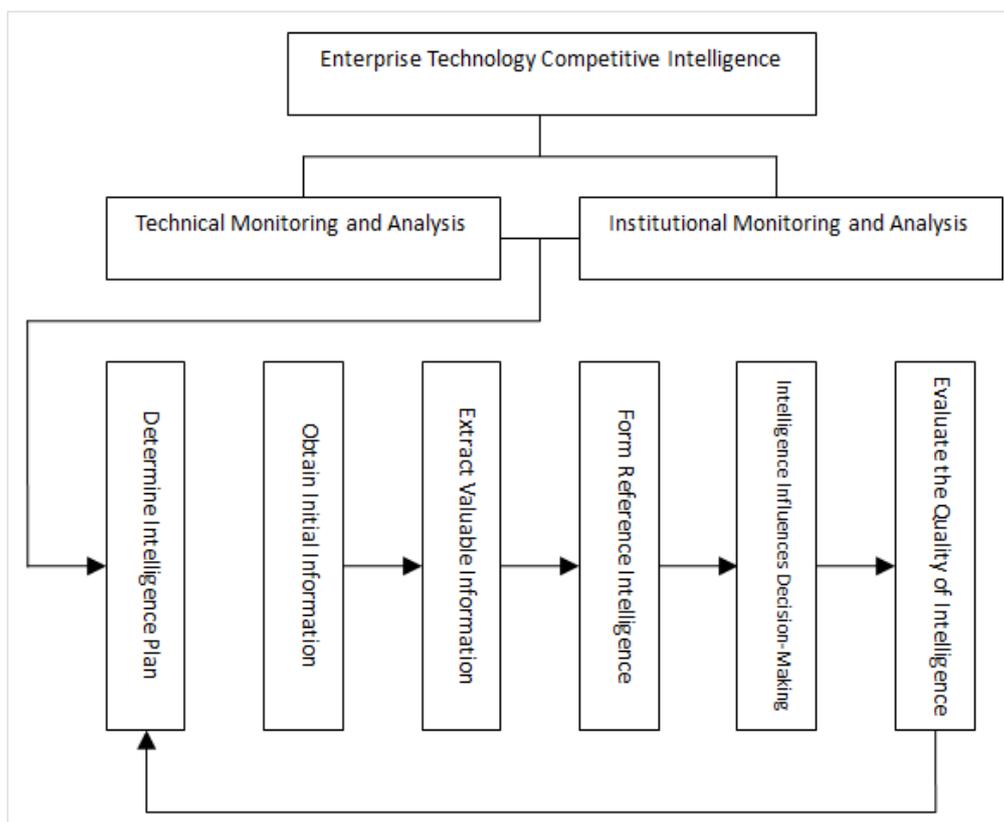


Figure 1. Process of Enterprise Technology Competitive Intelligence Activities.

From Figure 1, it can be seen that enterprise technology competitive intelligence activities have two distinct characteristics: one is clear activity objectives. Before conducting enterprise technology competitive intelligence activities, enterprises have a clear "problem domain", which is a targeted information collection and analysis work, rather than a simple collection of "massive" information. The second is dynamic features. The market is open and free, and enterprises should pay attention to calibrating their targets at any time, making timely judgments on the authenticity and value of intelligence, and striving to avoid erroneous or low value intelligence entering the technical decision-making level [3].

2.2. The Role of Technological Competitive Intelligence in Enterprise Technological Innovation

To a certain extent, enterprise technology competitive intelligence activities are essentially fundamental work serving enterprise technology innovation decision-making, and enterprise technology innovation decision-making can only be based on a comprehensive analysis of the development trend of new technologies and the technology competition strategies of peers in the industry, in order to ensure the smooth implementation of innovation activities and ultimately achieve success in the market [4]. Its importance is reflected in the following three aspects:

2.2.1. Reduce Innovation Costs and Accelerate the Innovation Process

Currently, we emphasize more on improving the original and independent innovation capabilities of enterprises, but in reality, not all technological innovation behaviors must start from scratch. The important task of conducting enterprise technology competitive intelligence activities is to reserve knowledge in the target technology field for the enterprise, provide timely technical support for the problems encountered in the development process of new technologies, reduce the research and development costs of new technologies, and accelerate the productization and commercialization of new technologies.

2.2.2. Grasp Technological Trends and Avoid Innovation Risks

The essential characteristics of technological innovation are creativity and foresight. Therefore, the technological innovation activities of enterprises are high-risk corporate behaviors carried out in situations where technology and market prospects are uncertain. For businesses, a failed technological decision may pose a risk of bankruptcy, especially for small and medium-sized enterprises. The famous disposable imaging camera company Polaroid in the United States invested a lot of manpower, financial resources, and material resources in disposable imaging film technology due to misjudgment of

market and technical information, and showed no concern for the already mature digital imaging technology at that time [5]. So, when peers in the same industry launched digital imaging technology one after another, Polaroid's products were quickly eliminated from the market, not only failing to recover the initial investment cost, but even falling into the dilemma of filing for bankruptcy.

On the contrary, through enterprise technology competitive intelligence activities, scientific analysis and integration of intelligence in the target technology field often reveal the latest trends in the development of the target technology field, help enterprises clarify their technological development goals and bottleneck issues that constrain new technologies, and ensure the enterprises make the right strategic decisions to the greatest extent possible to avoid errors in enterprise technology innovation decisions caused by personal factors of entrepreneurs.

2.2.3. Grasp Market Trends and Enhance Sustained Innovation Capabilities

Under market regulation and feedback mechanisms, different enterprises in the same industry may adjust their technology and market strategies at any time based on product market information. Therefore, if a company wants to keep its products in a leading position in the industry, in addition to obtaining information through technology competitive intelligence activities, it can also use technology competitive intelligence activities during the productization and marketization stages of new technologies to make timely judgments on market product demand, capture market reactions to new products and technological improvement needs, and providing a market foundation for enterprises to improve the technical performance of new products or cultivate new derivative technologies in subsequent products, keeping the enterprise in a leading position in this field [6].

3. The Main Ways for Enterprises to Develop Technological Competitive Intelligence

In recent years, facing increasing technological competition pressure in the industry, enterprises engaged in technology product research and manufacturing have been conducting technology competitive intelligence development through various channels and methods.

3.1. Publicly Published Technical Literature and Materials

Enterprises collect technological competitive intelligence through publicly published literature and materials in their respective technical fields, such as scientific journal articles, theses, industry performance reports, and industry technology

promotional materials. By collecting and analyzing these literature, companies can easily and quickly understand the development trends and research and development trends in related technology fields. However, its drawbacks are also obvious - it is difficult to obtain core technical information and has a certain lag.

3.2. Entrust a Specialized Technical Consulting Company

In recent years, technology consulting companies have developed rapidly, which is related to the increasing pressure of enterprise technology competition and the growing demand for technology. Through professional technical consulting companies, enterprises can obtain targeted solutions or related technological progress for technical problems in their industry, avoiding duplication of investment with peers in the same or already mature technological links, and saving human and financial resources. However, based on the current development situation, enterprises mostly seek help from consulting firms when encountering difficulties in the process of technological productization, and rarely entrust technical consulting agencies to conduct long-term tracking and analysis of a certain technology field. This is unfavorable for enterprises to carry out sustained or continuous technological innovation activities.

3.3. Enterprises Shall Establish Their Own Technology Competitive Intelligence Agencies

This situation is more common in developed countries because setting up a technology competitive intelligence agency independently by enterprises has many advantages: on the one hand, it is conducive to the collection and analysis of specialized or detailed core technology intelligence by enterprises. On the other hand, it is conducive to directly linking intelligence achievements with enterprise research and development or production, and it is not easy to expose the technological "shortcomings" of the enterprise itself, ensuring the relative competitiveness of the enterprise in the current market. However, companies setting up their own technology competitive intelligence agencies to engage in basic research work generally have high requirements for personnel and funding, which small and medium-sized enterprises generally find difficult to afford. In developing countries, often only a few large enterprises such as Huawei and Tencent have established their own technology competitive intelligence agencies.

3.4. Talent Mobility or Employee Job Hopping

In small and medium-sized enterprises, due to operational or management factors, it is common for professional technical personnel to enter other companies in the same industry

to provide services, making it an important way for enterprises to obtain or lose core technical intelligence.

3.5. Official Information Resources

It mainly includes two aspects: one is to track the industrial policies of different countries and clarify the possible development prospects of the technology field, which belongs to the external environment analysis of technological innovation. The second is that national industrial departments actively collect and provide technical intelligence for enterprises, but it is mainly large enterprises that obtain technical intelligence through this channel, which is difficult for general enterprises to obtain.

4. Developing Countries Urgently Need to Strengthen the Development of Technological Competitive Intelligence

4.1. Obtaining Technology Competitive Intelligence Through Government Departments Is Relatively Rare

Technology oriented enterprises will become an important driving force for the economic development of developing countries in the future, but due to the significant investment of funds and personnel required to establish specialized technology competitive intelligence agencies, small and medium-sized enterprises generally find it difficult to afford. At the same time, due to the limited activity space of enterprises in key technical fields related to national economic and security interests, it requires the intervention of government forces [7]. However, due to various reasons, most technical competitive intelligence agencies in developing countries are located in government departments, and the information is generally relatively closed, and the collection and analysis of technical competitive intelligence are not professional, so it is difficult to transmit high-value technical competitive intelligence to enterprises in time.

4.2. Lack of High-level Technical and Competitive Intelligence Professionals

The development of technological competitive intelligence is neither a simple information collection nor a pure academic exploration, but a fundamental technical research work that can only be carried out with the help of professional analysis. The personnel engaged in this work should not only be familiar with the general laws of technology research and development, but also have high economic analysis ability, and certain technical forecasting ability.

In developed countries, most disciplines engaged in the cultivation of technical competitive intelligence talents are

located in business schools and intersect with disciplines such as engineering technology or management science and engineering. The trained personnel are generally able to adapt well to the technical and practical needs of enterprises. However, there are currently few established specialized talent training institutions for technical competitive intelligence in developing countries, and even those engaged in research in this field are mostly in the field of library and information. These institutions lack necessary technical tools to support and have relatively insufficient economic practice experience, making it difficult to directly connect with the technological needs of enterprises.

4.3. The Relevant Legal System Urgently Needs to Be Improved

On the one hand, some research institutions and enterprises are very sensitive to the term "intelligence", often equating obtaining technology competitive intelligence with "commercial espionage" behavior, subjectively rejecting technology competitive intelligence activities, underestimating the information and decision-making suggestions of technology competitive intelligence, resulting in limited technology competitive intelligence information being difficult to play its due role; On the other hand, the use of technological competitive intelligence to engage in technology theft that goes against ethical and legal requirements does exist in countries where it is sent. These situations have to some extent suppressed the growth and development of technology competitive intelligence agencies in developing countries.

4.4. Large Enterprises Have Few Relevant Institutions and a Low Level of Informatization

The economic development practices of developed countries have shown that technology-based enterprises play a very important role in economic layout, and the technological competitiveness of these technology-based enterprises largely depends on the acquisition and use of technological competitive intelligence. According to relevant information, both large Japanese enterprises and multinational corporations currently have specialized technology competitive intelligence departments [8]. In addition, there is France, which has established a competitiveness center system covering the whole country, classified by industrial clusters, and interwoven vertically and horizontally in order to enhance France's international competitiveness. Based on these competitive centers, France has formed several industrial competitive intelligence service systems, providing a comprehensive package of competitive intelligence services for enterprises, especially small and medium-sized enterprises, with a wide range of categories [9].

Compared to developed countries, the proportion of technology competitive intelligence agencies established by large

and medium-sized enterprises in developing countries is relatively low, and the efficiency of intelligence collection and analysis is not high. Relevant achievements are difficult to timely transmit to front-line technology research and development personnel and enterprise technology decision-making levels, resulting in the lag and waste of technology competitive intelligence.

5. Enhance the Technological Competitive Intelligence Development Capability of Enterprises in Developing Countries

Considering that technological competitive intelligence is an important field primarily serving the technological innovation behavior of enterprises, and small and medium-sized enterprises will become an important force in enhancing the technological innovation capabilities of developing countries. Therefore, we should speed up the construction of technological competitive intelligence network in developing countries, promote large and medium-sized enterprises to establish technological competitive intelligence institutions, and support and encourage small and medium-sized enterprises to develop technological competitive intelligence [10], so as to improve the ability and quality of technological competitive intelligence development of enterprises and make it an important part of perfecting the scientific and technological innovation system in developing countries.

5.1. Accelerate the Construction of Technology Competitive Intelligence Network

The possession and analysis level of technological competitive intelligence is not only the basic condition for enterprise technology research and development and industrialization of scientific and technological achievements, but also an important guarantee for maintaining economic security. Currently, technological competitive intelligence has become the core foundation for leading a country's technological self-reliance and self-improvement. Therefore, developing countries should fully leverage the advantages of wide information channels and relatively concentrated professional and technical personnel in government departments. Following the principles of overall coordination, serving the industry, tracking the core, and focusing on key areas, they should accelerate the establishment and improvement of government technology competitive intelligence networks, and carry out strategic technology competitive intelligence activities in a planned and targeted manner. Its main tasks include:

5.1.1. Establish a Technical Trade Barrier and Industry Damage Warning System

Under the framework of relevant WTO rules, by tracking

and dynamically analyzing technological competitive intelligence, timely warnings can be issued for potential technological trade barriers in a certain industry or technology field, helping enterprises adjust their technological routes or market strategies in a timely manner, and avoiding frequent intellectual property or anti-dumping lawsuits when exporting products.

5.1.2. Focus on Tracking the Development Trends in the High-tech Field

Due to the strategic impact that high-tech often has on the development of a country or region. Therefore, the technology competition intelligence agencies established by government departments should closely monitor key technological fields that enhance the country's technological competitiveness and iconic strength.

5.2. Encourage Eligible Enterprises to Establish Technology Competitive Intelligence Agencies

The relatively low proportion of technology competitive intelligence established by enterprises in developing countries is not only due to insufficient funds, but also to the unwillingness of enterprises to invest more resources in basic research under short-term profit goals, as well as insufficient understanding of the role of technology competitive intelligence in enhancing enterprise competitiveness. In this regard, the following measures can be taken as a priority:

5.2.1. Government Technology Departments and Enterprises Carry Out Technology Competitive Intelligence Cooperation Projects

Government technology departments can establish technology competitive intelligence research topics in their annual technology innovation projects by soliciting information on enterprise technology needs, enhancing the demonstration role of technology competitive intelligence in promoting enterprise technology innovation. Beijing has once completed technology competitive intelligence analysis for multiple enterprises through this method, achieving good results, and ultimately making technology competitive intelligence research and construction projects one of the "three major projects" of Beijing's industrial technology innovation and enterprise development plan [11].

5.2.2. Enhance Enterprises' Awareness of the Importance of Technological Competitive Intelligence Through Industry Associations

Industry associations play the role of information liaisons in the development process of enterprises. Industry associations can timely introduce the role of technological competitive intelligence in expanding the market and enhancing de-

cision-making scientificity for enterprises through organizing high-level development forums, market research, exchange visits, and other means, attracting the attention of enterprises and promoting the construction of their technological competitive system.

5.2.3. Promote Advanced Models and Provide Reference for Enterprises to Establish CTI Institutions

At present, a group of Chinese enterprises have explored a technology competitive intelligence development and operation model that is suitable for the actual situation of developing country enterprises. For example, Huawei, a Chinese company, actively builds an integrated model of enterprise supply chain risk management and competitive intelligence, which enables both vertical and horizontal communication and focused extraction of technical competitive intelligence. It can collect and analyze technical intelligence in real time and timely warn of supply chain risks, providing efficient and valuable intelligence basis for enterprise technology decision-making. It has successfully achieved advanced warning and successful response to supply chain interruption risks [12]. Therefore, developing countries can try to optimize the "top-level design" of technology decision-making in large and medium-sized enterprises by conducting pilot work in large enterprises, and play a leading and demonstrative role for other types of enterprises.

5.3. Government Services for Small and Medium-sized Enterprise Technology Competition Intelligence Development

The relatively weak funding and talent foundation of small and medium-sized technology-based enterprises is a practical problem. Therefore, by further optimizing the technology radiation and service functions of high-tech industry development zones, science and technology industry demonstration zones, and other areas for enterprises, a joint technology competitive intelligence agency can be established in conjunction with resident research institutes, universities, and their professional technical personnel [13]. Focusing on the technology needs and fields of enterprises within the regional scope, technology competitive intelligence tracking work can be carried out with emphasis, providing strategic technology decision-making consulting services for enterprises.

For development zones where it is temporarily difficult to establish a joint technology competitive intelligence agency due to funding, personnel, basic conditions, etc., active coordination can be made between enterprises and resident research institutions and universities to promote small and medium-sized enterprises to reach technology competitive intelligence supply and demand agreements with relevant research personnel and institutions through project operation. In addition,

it is also possible to establish technology competitive intelligence agencies in universities, operating according to a project-based approach of "development zones and enterprises sharing funds, enterprises and universities sharing projects, and whoever bears risks benefits". It not only can greatly reduce the cost of conducting technology competitive intelligence activities for development zones and enterprises, but it can also build a strong team of technology competitive intelligence personnel in the host universities, creating conditions for the long-term benefits of small and medium-sized enterprises.

6 Conclusion

In the face of the increasingly severe problems of anti globalization and technological barriers, developing countries can actively address the adverse effects of technological barriers on technology-based enterprises by improving their technological competitive intelligence networks, establishing technological competitive intelligence agencies, and leveraging the role of high-tech industrial development zones in developing technological competitive intelligence. This will enhance the technological accumulation, research and development, and innovation capabilities of developing countries and their enterprises, and stabilize the industrial and supply chains of high-tech enterprises. However, it should also be noted that it is far from enough to achieve the goal of eliminating technological barriers solely through the efforts of one or a few enterprises. It is necessary to use the power of the country to firmly maintain the rule-based global trade order on the international stage and vigorously fight against the forces of anti globalization and the creation of technological barriers. The author believes that this is an important issue that needs to be further explored in future research on the resolution of technological barriers.

Abbreviations

CTI	Competitive Technical Intelligence
CI	Competitive Intelligence

Author Contributions

Li Mengrui: Conceptualization, Data Collection and Analysis, Writing – original draft, Writing – review & editing

Zhai Na: Formal analysis, Writing – review & editing

Zhai Jiankai: Data collection, Writing – review & editing

Conflicts of Interest

The authors declare no conflicts of interest.

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Biography

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Research Field

Li Mengrui: Competitive technical intelligence, philosophy of science and technology, vocational and technical education, cultural construction.

Zhai Na: Enterprise management, enterprise technology competitive intelligence.

Zhai Jiankai: Mechanical and electrical technology, enterprise technology management.