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Strategies and Practices for Integrating Technology Foresight and S&T Information Work

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ABSTRACT

In recent years, with the rapid development of modern technologies such as artificial intelligence and big data, technological innovation has played a core driving role in promoting the sustainable development of the economy and society. Facing the rapidly changing technological transformations, to accurately foresee future technological development trends and seize development opportunities, governments, research institutions, and enterprises should strengthen innovation and continuously move forward. Technology foresight is a new type of strategic management tool dedicated to the integration of science and economic intelligence, optimizing the allocation of various resources, and has been widely used worldwide, becoming increasingly institutionalized and achieving significant performance. S&T information work, as the "eyes and ears" of the information age, plays a crucial role in collecting, organizing, analyzing, and transmitting scientific and technological intelligence. Therefore, in a dynamically changing environment, both technology foresight and intelligence services need to make corresponding adjustments, keep pace with the times, reconstruct service systems, improve service levels overall, and maximize the development and use of intelligence resources to support independent innovation. This paper comprehensively analyzes the necessity and practical paths of integrating technology foresight and S&T information work, achieving their synergistic effect, and advancing the development of science, economy, and society.

KEYWORDS

Technology Foresight; Scientific and Technical Information Work; Integration Strategy.

1. OVERVIEW OF TECHNOLOGY FORESIGHT

1.1. Definition of Technology Foresight

Technology foresight is developed based on technology forecasting, which can be considered the preliminary work of technology foresight. It is generally believed that technology forecasting corresponds to the "trend forecasting" stage in technology foresight activities but has not yet reached the "holistic forecasting" level of technology foresight. There are many similarities between the two, but there are also differences. Technology forecasting is a predictive task primarily focused on accurately predicting future technological development trends. Technology foresight is exploratory; it identifies and integrates uncertainties to research future possibilities, providing decision-makers with decision-making information to promote scientific, technological, economic, environmental, and social coordination and sustainable development. There is no universally accepted definition of technology foresight yet; it is a systematic study of the long-term future development of science, technology, economy, and society, aimed at selecting common technologies that may generate the greatest economic and social benefits.

1.2. Common Methods of Technology Foresight

With the practice of technology foresight, its methods have become increasingly rich and perfected, including brainstorming, bibliometric analysis, and scenario analysis, which are commonly used and have obvious advantages, shown in Figure 1.

Brainstorming, originally a term in psychopathology referring to the wild thoughts of patients during mental disorders, is advantageous because of its simple and practical operation; it allows the thoughts of each participant to be maximally expanded, fostering the generation of more inspiration. It gathers a significant amount of information in a short time, encourages collective wisdom, and allows for objective and continuous analysis of the discussed issues, thus achieving some effective foresight results[1-2]. Therefore, in the selection of project lists or consultation of project foresight in technology foresight, the value of this method has been fully highlighted.

Scenario analysis, also known as foresight description or scripting method, assumes various specific forecast outcomes and considers possible uncertainties, dynamically describing the most likely future scenarios. In technology foresight, this method can describe multiple possibilities for future technological development, integrating various accidental and inevitable factors affecting technology, considering as many future situations and issues as possible, providing decision-makers with rich analytical materials for more comprehensive decision-making.

Bibliometric analysis is a quantitative analysis method based on mathematics and statistics, studying various external features of documents as research subjects, with the entities of document features and data as research objects. The statistical process quantifies document features into mathematical indicators, and the analysis results are presented in intuitive data, which is clear at a glance and has obvious objectivity, quantifiability, and intuitiveness. It is a method suitable for assessing technological achievements.

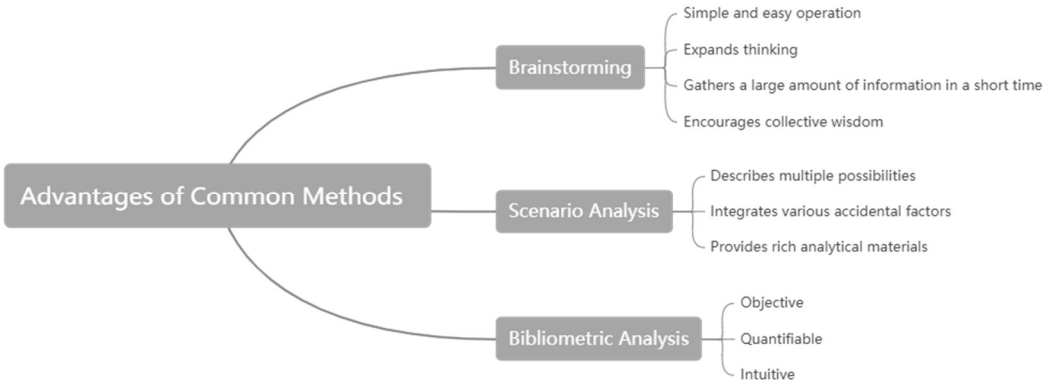

Figure 1. Advantages of Common Methods

1.3. Basic Principles of Technology Foresight

With the emergence of new technologies and business formats bringing new opportunities and challenges to economic and social development, only by grasping the pulse of technological development can we effectively respond to various changes. As a forward-looking strategic planning tool, technology foresight has received widespread attention in recent years and can predict and evaluate important technologies that may emerge in future development courses. However, this technology is not a simple task; it needs to follow a series of principles, shown in Table 1, to ensure the accuracy and feasibility of the forecasts.

Table 1. Basic Principles of Technology Foresight

Principle Name	Description	Meaning
Principles of communication	The government, science and technology, industry, academia and other sectors of society will increase information flow, reach consensus and form synergy	Promoting the integrated development of science, technology, economy and society; We will strengthen information exchange and cooperation across fields and departments
Future-focused principles	Focus attention on medium - and long-term strategic issues with a view to sustainable development of the country as a whole and of the sector in which it is located	Avoid myopia and focus on the possible changes and development of the world in the future; Encourage all sectors of society to divert their attention from urgent and short-term practical problems
Principle of consensus	It is believed that the future world has many possible forms, which is the result of the common choice of rational government and social public	Advocate diverse participation and jointly shape the development landscape of the future world. It emphasizes rational decision-making and formulates medium - and long-term strategic planning based on consensus

First, the principle of communication, which occurs among the government, scientific community, industry, academia, and other sectors of society. Its purpose is to enhance the flow of information between these different sectors and fields, reach a consensus on the integrated development of science, economy, and society, and form a joint force. Second, the focus on the future principle. In an increasingly competitive market environment, internal and external pressures force people to focus on urgent and short-term real issues, without considering what the world might be like in a short time. Conducting technology foresight activities will help by planning to direct the attention of government, industry, academia, economic sectors, and other social sectors to medium- and long-term strategic issues, focusing on sustainable development issues for the entire country and relevant departments. Third, the consensus principle, a basic concept advocated by technology foresight, is that the future world can take many possible forms, and people can shape the future world according to their wishes; it can also be said that the future world's development scenario is a result jointly chosen by rational governments and the public[3-4].

These basic principles together form the cornerstone of technology foresight work, providing strong guarantees for scientifically and reasonably predicting future technological development.

2. OVERVIEW OF S&T INFORMATION WORK

2.1. Definition of S&T Information Work

S&T information work involves the collection, organization, and selection of intelligence information, and accurately and timely reporting and transmitting it to users. This is a task of developing humanity's second resource-social knowledge created by humans, connecting dispersed knowledge across the world, expanding the scope of knowledge use, improving the production efficiency of new knowledge, meeting human information needs, and promoting social progress. The content of S&T information work includes organizing direct exchange activities among people, such as academic conferences, exhibitions, visits, and more; collecting and organizing research literature, selecting knowledge and information for reporting, and transmitting it to users. Because literature can be used

long-term, repeatedly, and by many people, intelligence activities primarily based on literature as the main transmission medium are the main content of S&T information work.

2.2. Development Stages of S&T Information Work

As an important cornerstone supporting technological innovation and social development, the development of S&T information work has experienced a significant evolution from initial cognition to high specialization, shown in Figure 2. From 1982 to 1991, China was still in the exploration stage of economic system reform, and the concept and model of intelligence services had not yet formed. This stage focused more on the management of intelligence, including technical standards, specifications, regulations, and other documents and materials. In 1992, China began to reform its market economic system, and the standard intelligence needs of enterprises gradually increased. Intelligence services existed as "library-style" services, involving the transmission and retrieval of standard documents. In 2001, China joined the World Trade Organization (WTO). The mandatory requirements of WTO/TBT agreement technical documents, the adoption of international standards and certification in international trade and market access, the requirements of intellectual property and patents, and the new information notification system all posed new demands for China's standard intelligence services. The popularization of computers and the internet also facilitated the transformation of China's intelligence services. From 2011 to 2016, as market vitality was further released and big data technology developed, new challenges were brought to intelligence services, further delving into the value of information and transitioning to knowledge services. Since 2017, according to the needs of China's socialist market economy development, the exploration of intelligent knowledge services has further deepened. The application areas of S&T information work will also expand further, injecting new vitality into technological innovation and social development.

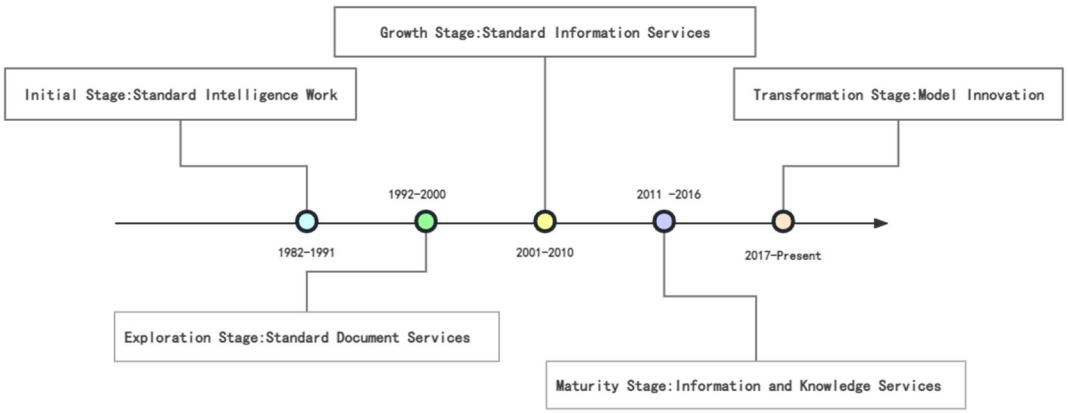

Figure 2. Development Stages of S&T Information Work

3. NECESSITY OF INTEGRATING TECHNOLOGY FORESIGHT AND S&T INFORMATION WORK

3.1. Enhancing Decision-Making Science

To promote rapid economic and social development, the value of technological innovation has been affirmed. Facing the increasingly complex and variable international environment and rapidly iterating technological development trends, decision-makers, to ensure the scientific and effective nature of strategic planning and policy decisions, can integrate technology foresight and S&T information work, combining them with scientific measures[5]. Technology foresight can provide insights into long-term technological development trends, while S&T information work can capture

real-time market dynamics and policy changes. Combining the two can provide comprehensive and accurate information support for decision-makers, helping them avoid blind actions, reduce decision-making errors, and formulate more practical, forward-looking strategic plans and policy decisions.

3.2. Optimizing Resource Allocation

Faced with limited resources and unlimited development needs, to efficiently use various resources and achieve optimal resource allocation, the synergistic role of technology foresight and S&T information work should be leveraged. In specific practices, by deeply analyzing technological development trends, market demands, and policy directions, technology forecasting can play a role in foreseeing the future and clarifying future development directions. The development of S&T information work, on the other hand, can provide real-time feedback on market dynamics and competitive situations. Combining the two can more accurately predict future technology development trends, providing a scientific basis for resource allocation, achieving efficient use of resources, and meeting the needs of sustainable development.

3.3. Promoting Technological Innovation

Technological innovation and industrial upgrading also require the replication of technology foresight and S&T information work. By comprehensively analyzing technological development trends and market demands, technology foresight can capture new technological development directions and potential market opportunities. S&T information work can track global technological dynamics and competitors' strategies in real time, providing strong intelligence support for technological innovation. The combination of the two can help enterprises break through key core technologies, accelerate the transformation and utilization of technological achievements, promote industrial upgrading, and bring more economic and social benefits. From another perspective, it can also enhance national technological innovation capabilities and achieve high-quality economic development.

4. STRATEGIES FOR INTEGRATING TECHNOLOGY FORESIGHT AND S&T INFORMATION WORK

4.1. Establishing a Collaborative Work Mechanism

Whether it is technology foresight or S&T information work, both can promote technological innovation and industrial development. For this reason, it is necessary to first clarify the points of integration between technology foresight and S&T information work, build a collaborative work mechanism, and achieve effective integration of resources, improving work quality and efficiency. In specific practices, it is essential to clearly define the responsibilities of both sides, ensuring that they perform their respective duties and cooperate closely. Through a detailed workflow, key stages such as information collection, analysis, forecasting, and decision-making should be covered. After a series of work, technology foresight and S&T information work can achieve seamless integration at all stages, jointly providing strong support for technological innovation and industrial development, effectively responding to the challenges of the times, and promoting the in-depth development of technology foresight and S&T information work.

4.2. Strengthening Information Sharing and Integration

Ensuring the accuracy and timeliness of information is the foundation for improving the effectiveness of technology foresight and S&T information work. In a rapidly changing technological environment, to enhance the scientific nature and foresight of decision-making, the focus should be placed on information sharing between technology foresight and S&T information work. Thus, the advantages of the information sharing platform can be leveraged to ensure smooth communication between the

two parties[6-7]. On this platform, the latest scientific and technological intelligence, market dynamics, and policy changes can be shared in real time, ensuring that both sides can timely access the most comprehensive and accurate information resources. By sharing and integrating various information, the efficiency of information use can be effectively improved, reducing redundant labor and resource waste, providing more precise data support for technology foresight and S&T information work, and promoting technological innovation and industrial development.

4.3. Enhancing Intelligence Analysis Capability

Faced with a competitive technological environment, improving intelligence analysis capability has become key to technology foresight and decision-making. In a complex market environment, faced with a massive amount of technological information, continuing the existing intelligence analysis methods can no longer meet the established requirements. Combining actual needs, introducing advanced intelligence analysis methods and tools, such as data mining, text analysis, and network analysis, can expand the breadth and depth of intelligence analysis. While applying various tools, it is also possible to more efficiently process and analyze various types of information, revealing the patterns and trends hidden behind the data. To improve the foresight and accuracy of predictions, it is necessary to strengthen the predictive research of future technological development trends, grasp the pulse of technological development, and leverage the potential advantages of various analysis methods.

4.4. Strengthening Professional Talent Training

In today's society, competition is also a competition for talent. In technology foresight and intelligence analysis work, various difficulties are inevitably encountered, and training professional composite talents is fundamental to smoothly solving various problems[8]. With the rapid development of technology, knowledge from a single discipline can no longer meet the needs of technology foresight and S&T information work. It is essential to focus on cultivating interdisciplinary and cross-field composite talents. Once they possess a broad knowledge background and deep professional cultivation, they can more flexibly respond to various emergencies. To achieve work objectives, training sessions, workshops, and other methods can be used to provide a platform for team members to learn and exchange, helping them deepen their understanding and knowledge of technology foresight and S&T information work, enhancing their comprehensive capabilities, and providing strong talent support[9-10].

5. CONCLUSION

In summary, in a rapidly changing social context, to respond to the rapidly changing technological environment, enhance the scientific nature of decision-making, and ensure the development of technological innovation, exploring the integration points between technology foresight and S&T information work and combining them has significant practical importance. However, the integration of the two is a continuous and cumbersome process, requiring the joint efforts of all parties, continuously perfecting mechanisms to meet the requirements of technological innovation development. Therefore, in the course of future development, measures such as adopting a collaborative work mechanism, information sharing and integration, and enhancing intelligence analysis capability should be taken to ensure the maximum rational integration of the two, providing strong support for social development.

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