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Research on Commercialization Strategies for National Strategic Technologies

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Abstract

Purpose: The purpose of this study is to study promotion strategies so that the research results of national strategic technologies can lead to technology commercialization. National strategic technology is being promoted in various fields, but the reality is that review of the commercialization aspect is lacking. In order to lead to commercialization, the strategic goals and direction of the promotion process must be consistent, and a strategic review must be conducted in terms of technology commercialization. **Research design, data and methodology:** In this study, the direction of strategic technology was analyzed and commercialization problems and solutions were presented based on case studies and existing literature research. Although technology commercialization methods have been discussed, research on specific strategies is lacking. **Results:** It is necessary to pursue full-cycle technology commercialization to solve various problems for commercialization of cutting-edge science and technology and advance to the commercialization stage. We will cover topics such as understanding successful commercialization of special strategic technology fields, establishing appropriate commercialization strategies, government-wide cooperation, and investment support. **Conclusions:** Research results showed that discovery of excellent technologies, investment support, and multi-ministerial cooperation support are necessary to commercialize strategic technologies based on cutting-edge science and technology. This study should discuss various promotion strategies for strategic technologies to improve the efficiency of research and development investment.

Keywords : National strategic technology, Technology commercialization, Technology Marketing, Technology startup

JEL Classification Code : L10, M10, M30

1. Introduction

In terms of science and technology innovation policy, the success or failure of technological hegemony lies in fostering and supporting cutting-edge technologies. As the low-market trend of the global economy continues, the role of a catalyst for commercialization utilizing new cutting-edge technologies has become very important. Now, the key for the world is how quickly core technologies such as

semiconductors, artificial intelligence, and advanced bio can be commercialized.

In national research and development projects, establishing various strategic support systems with strategic technologies as the goal is essential in terms of national competitiveness. Accordingly, it is very important to establish how to spread national strategic technologies and support them through commercialization in terms of science and technology policy and to create a support system.

The national strategic technology field is establishing a strategy to intensively support the development of 12

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technologies by the state, and the participation of various stakeholders is essential in the process. In particular, the strategic technology field requires the participation of various stakeholders such as experts, companies, and investors in the commercialization process because the process of linking to commercialization is complex and takes a long time. In addition, the process of establishing a preliminary diagnosis and strategy is important from the perspective that excellent strategic technologies can be linked to the market. The most reasonable policy support direction would be to secure the necessary funds and commercialization investment conditions for establishing such policy strategies.

From a strategic perspective, the diffusion of public research results is now linked to cutting-edge technologies, and the commercialization of excellent cutting-edge technologies requires expansion of strategic technology fields that have not been attempted so far. From this perspective, establishing a system for linking the commercialization of strategic technologies and establishing new competitiveness is seen as creating strategic policies.

In this paper, we will review the plan according to the basic plan for fostering national strategic technologies presented by the government and suggest problems and improvements in the direction of promotion in the process. In the process of reflecting the government's policy proposals in the field, various opinions have been collected, but methods for efficiently promoting commercialization by strategic technology field and improvements have not been made significantly.

Covin and Miles (1999) published research results showing that entrepreneurship plays an important role in competitive advantage. Kwang et al. (2014) studied the success model of technology commercialization of startups and presented an important success model. Park et al. (2015) conducted a study on the success factors and performance improvement of public R&D technology transfer. Han (2016) conducted a study on the technology characteristics and marketing of technology-based startups. Hwang and Suh (2018) studied supplier participation and buyer strategic decisions. This study is considered very important in terms of performance models and growth capabilities in the technology commercialization process.

Lee (2017) studied the relational system of technology commercialization and technology holding companies and presented an important relationship in terms of the technology commercialization operation model of technology holding companies.

Moreau et al. (2001) conducted a study on consumer response to new product services and presented the results of the study on marketing response from the customer perspective, which is very important for entrepreneurs.

In particular, Sin and Sang (2014) presented the importance of actual profit distribution and performance competition through a study on the profit distribution system of technology holding companies.

Suh and Yoon (2017) presented an important relationship between entrepreneurship and marketing activities, and considered this study to be important in that entrepreneurship exerts marketing capabilities in entrepreneurs.

Yoon and Lee (2017) presented a study that found that entrepreneurs' capabilities are important in terms of the performance of entrepreneurship by understanding the entrepreneurs' intentions before starting a business.

Yang and Choi (2010) studied the perspectives of regional R&D performance integration and technology commercialization, and mentioned that it is important to establish a strategy to spread public research results.

In this way, the research results of previous researchers present a very important success model from the perspective of technology commercialization, and it is necessary to find various technology commercialization models for advanced technology commercialization and establish commercialization strategies accordingly.

Therefore, the topic studied in this paper is expected to present implications from the perspective of commercialization of national strategic technologies in the future.

2. Strategic Technology Policy Background

2.1. National Strategic Technology Overview

The government held a special committee on national strategic technology at the National Science and Technology Advisory Council in February 24 and deliberated and approved the agenda for the 12 national strategic technology development roadmaps. The roadmaps for the 12 strategic technology fields set visible tasks to be achieved by 2030 to secure world-class technology and create an ecosystem that matches the key investment directions.

The 12 major fields are semiconductors and displays, secondary batteries, advanced mobility, next-generation nuclear power, advanced bio, aerospace and marine, hydrogen, cybersecurity, artificial intelligence, next-generation communications, advanced robots and manufacturing, and quantum computing. These 12 technologies will be selected as national strategic technologies in the future and will follow the national support system according to the roadmap.

In the case of next-generation nuclear power, as the importance of energy increases to achieve carbon neutrality, it is highly likely that development will focus on small modular reactors, which are next-generation reactors with high cost and safety, rather than large-scale nuclear power plants. Accordingly, competition is intensifying, with the

development of about 80 types of small reactors around the world.

Table 1: Strategic technologies

| Status of 12 strategic technologies | | |
|-------------------------------------|------------------|--------------------------------|
| Semiconductor/display | Advanced bio | Artificial intelligence |
| Secondary battery | Aerospace marine | Advanced robot manufacturing |
| Advanced mobility | Hydrogen | Next generation communications |
| Next generation nuclear energy | Cyber security | Quantum |

Source: Edited by the author

In the aerospace sector, the strategy is to secure technological leadership based on independent technology. With the opening of the Newspace era, this aerospace technology is planned to preempt various markets in the space era through various international cooperation, ecosystem construction, and new market development in the era of advanced space markets. In the case of next-generation communications, the goal is to develop various key technologies such as securing various patents, AI-related technologies, and high-efficiency core components in order to lead the 6G global market in 2030. Based on this securing of technological capabilities, the plan is to expand next-generation communications to various markets.

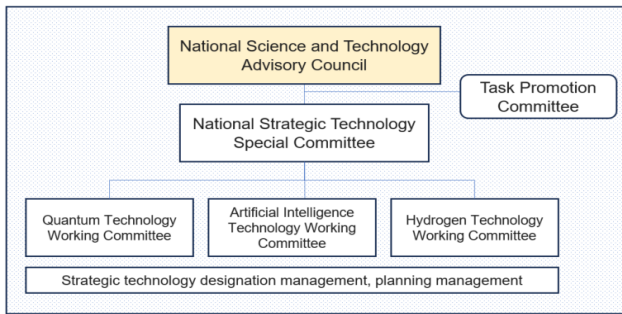


Figure 1: Strategic technology promotion system

2.2. Direction of Fostering National Strategic Technologies

The government plans to establish the first basic plan for fostering national strategic technologies and support key tasks. First, the first key task is to provide full support for rapid commercialization of national strategic technologies in order to secure future growth engines.

First, we will strengthen R&D linked to commercialization. We will pursue support of more than 30 trillion won for 5 years for technologies in 12 fields, focusing on private demand. We will also support innovation hubs and verification support. We plan to sequentially discover and support specialized research institutes for research projects centered on strategic pilot missions, operate specialized education institutions to foster innovative talents, and establish regional technology innovation centers linked to balanced regional development.

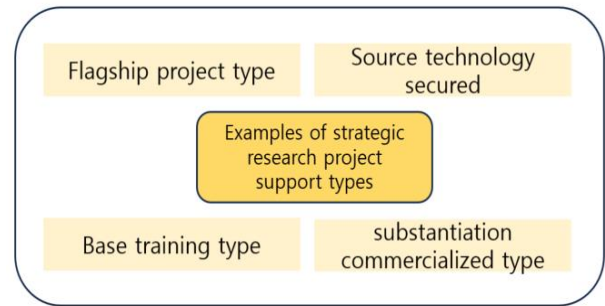


Figure 2: Strategic research project support type

The second key task is to dramatically increase the preemptive response capability of technology security. In terms of technology security, first of all, we should strengthen cooperative relationships between technology security countries. Security cooperation countries such as the United States, Japan, and Europe should strengthen the support system for strategic technologies and create various cooperative strategies.

In addition, we should support the rapid identification, support, and acquisition of strategic technologies that will become a hot topic in the international technology hegemony competition. It is important to secure ultra-gap future materials for national strategic technologies, and from that perspective, we should create a competitive commercialization model from the perspective of securing and utilizing strategic technologies.

The third key task is to establish a mission-oriented research and development promotion system. It is important to focus on mission-oriented research and development for national strategic technologies and to support integrated performance management. In particular, the strategy of creating an integrated performance management system for strategic technologies across ministries is a very important methodological value for performance diffusion.

In addition, the plan is to build an online platform based on industry, academia, and research. This is a plan to establish a policy collaboration system between industry, academia, and research to facilitate early diffusion of national strategic technologies.

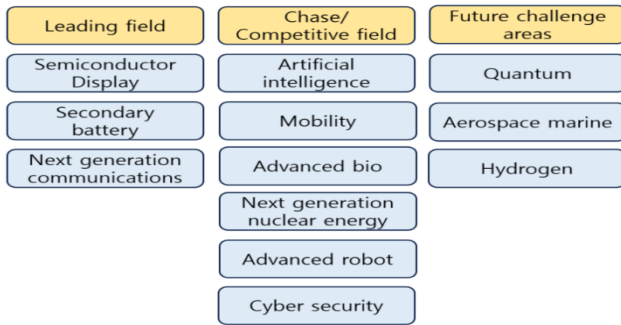


Figure 3: Promotion strategies by sector

2.3 Support for Each National Strategic Technology Field

The government is establishing three strategic support directions for the 12 national strategic technologies to match the areas of leading, pursuing, and future challenges. First, in the case of leading areas, the main business groups in the semiconductor and secondary battery fields aim to take the lead in super-gap technologies and maintain leadership in the international supply chain.

This is a measure for strategic support to expand the technological gap compared to competitors, and it is to secure reasonable results with international connectivity along with public-private joint large-scale research and development. The second is support for pursuing and competing areas.

Artificial intelligence, advanced biotechnology, and next-generation nuclear power are pursuing and competing areas, and we plan to promote early commercialization of strategic technologies.

We plan to strengthen industrial linkage in the direction of commercializing the original technologies of strategic technologies. The third is future challenge areas, with the goal of making a great leap forward in technological capabilities such as aerospace, marine, and hydrogen, and we will support innovative and challenging tasks led by the public sector to simply catch up with the technological gap.

In order to maintain a sustainable advantage and lead in the global market, the aerospace and marine sectors require a cooperative system between industry, academia, and research institutes, as well as large-scale projects for technological leaps.

The industry, academia, and research institute system should establish a linkage system between companies, research institutes, and universities to discover sustainable commercialization idea teams, discover technologies that can be used in industrial fields, and develop them into commercialization.

3. Problems with Commercialization of National Strategic Technologies

3.1. Lack of Commercialization Control Tower

State-led strategic technologies take a long time to commercialize, and government-led commercialization support has many limitations. In particular, strategic technology fields require a long period of market development for securing various markets, verification, and creating demand, and in this respect, I believe that the opportunity to establish a commercialization strategy is important.

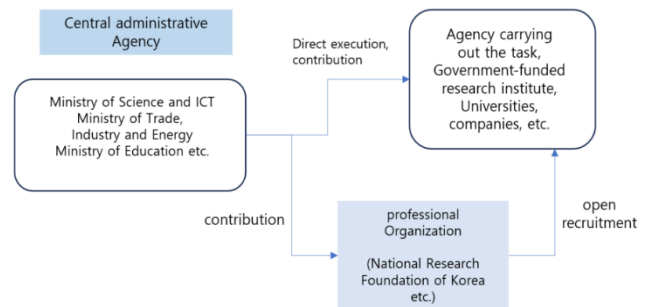


Figure 4: R&D operation management system

The creation of various innovative products and services through a convergence support system between strategic technologies is equally important, and as technology product services are becoming more diverse, networking by field of advanced science and technology is very important. From this perspective, R&D commercialization by various experts, investment companies, and other related organizations is very important, and from a commercialization perspective, operation of various consultative bodies and expert networking are necessary.

From this perspective, the operation of a dedicated organization that professionally operates commercialization is essential, and from a science commercialization perspective, how to connect various platform businesses is an important perspective.

3.2. Lack of Investment Support Linked to Strategic Technology Sectors

In order to commercialize strategic technology fields that do not have an immediate market, a business model differentiated from deep tech technology must be implemented. Market development in the strategic technology field is necessary, and since long-term investment resources are needed after establishment, fund

operation support suitable for the strategic technology field is necessary.

Table 2: Investment amount by type (Unit: KRW 100 million)

| Division | 2022 | 2023 | 2024.7 |
|---------------------------------|--------|--------|--------|
| ICT manufacturing | 2,987 | 4,012 | 2,649 |
| ICT services | 23,518 | 14,595 | 11,186 |
| Electrical/Mechanical/Equipment | 4,108 | 6,239 | 4,476 |
| Chemistry/Materials | 2,871 | 3,375 | 1,986 |
| Bio/Medical | 11,058 | 8,844 | 5,929 |
| Video/Performance/Album | 4,604 | 4,098 | 1,384 |
| game | 1,615 | 1,154 | 719 |
| Distribution/Service | 13,126 | 7,254 | 4,016 |
| etc | 3,753 | 4,407 | 2,169 |
| total | 67,640 | 53,977 | 34,513 |

Source: Korea Venture Capital Association (2024)

From this perspective, the reality is that in the strategic technology field, founders make efforts to secure funds after establishment, but fund execution is insufficient. Securing investment resources is a realistically difficult process because strategic technology has low profitability and the initial investment target company discovery.

A startup support system that links the development of various support projects limited to the strategic technology field and a follow-up support system is needed.

3.3. Lack of Synergy in Corporate-linked Startups

In terms of commercialization, the strategic technology field needs to find and connect markets that are lacking between companies, but there is a lack of a support system that can match them. It is difficult for researchers to find the needs for technologies that companies want, and even if technologies in the strategic technology field are developed, most of them have low marketability or take a long time.

Therefore, the problem of sporadic operation of matching platforms due to the lack of perspectives for matching between companies and researchers must be resolved. Strategic technologies that increase competitiveness in the global market must be selected and discovered, and these strategic technologies must be connected with companies and entrepreneurs in terms of commercialization. In order to commercialize the strategic technology field, it is necessary to first determine whether it is a strategic technology that is needed in the market.

Also, in terms of balanced national development, we should pay attention to ‘entrepreneurship support’ as a new regional development strategy, but there is a lack of a regional-centered entrepreneurship support system linked to the central government in terms of policy. Various business entities are operating in terms of regional technology commercialization, but the linkage between strategic technology policies and regional ecosystems is low. Although business expenses are becoming a central-centered business foundation, they are changing to a regional-based commercialization-centered system, so strategic technologies require regional-led companies and ecosystems.

Many corporate investments are already being made in strategic strongholds such as aerospace, AI, and semiconductors, and strategic industrial complexes are being fostered. From this perspective, it is a reality that strategic technologies linked to national R&D lack regional-led activation policies.

4. Strategic Technology Commercialization Policy Suggestions

4.1. Operation of an Organization that Supports the Commercialization of Strategic Technologies

Strategic technologies require diffusion strategies in various areas of technology commercialization, and in the process, various commercialization support policies need to be established, so the operation of commercialization support organizations is considered important.

The fostering of strategic technologies is a policy-required process, and in order for the policy to be effectively operated in the process, comprehensive support responses for the discovery, commercialization, and commercialization of strategic technology fields are necessary.

Bak and Jeong (2015) mentioned the importance of a successful model for technology commercialization, which means that various evaluation factors are important for commercialization.

Accordingly, a systematic research result diffusion, utilization, and commercialization plan for commercialization in the strategic technology field should be established, and such power technology needs to be systematically performed by a dedicated organization.

In the case of disseminating research results in the strategic technology field, the perspective of commercialization in the technology field is important, but a comprehensive support system based on expertise should be established. Existing national research and development project specialized organizations are operated with a focus on policy support between ministries, but the role of the control tower is insufficient.

Therefore, in order to promote the commercialization of strategic technologies, it is necessary to strengthen the role of the control tower and secure the driving force for strategic commercialization.



Figure 5: Development of business promotion strategy

4.2. Establishing a Multi-Departmental Cooperation Support System

The strategic technology field requires a long-term perspective on commercialization and a direction that comprehensively supports the process. In particular, it is important to strengthen the commercialization discovery system and establish a commercialization plan for excellent technologies through various collaborative projects in terms of multi-ministerial cooperation support.

The multi-ministerial cooperation system is very important. The Ministry of Education and the Ministry of Science and Technology focus on research and development, but in terms of supporting universities, the concepts of education and research are the same. Accordingly, the role of follow-up support from the Ministry of SMEs and Startups and the Ministry of Commerce, Industry and Energy is bound to be that important.

In particular, the Ministry of SMEs and Startups' support for start-ups will need to collaborate with the Ministry of Science and Technology or the Ministry of Education on various programs that can create synergies. In addition, collaboration between projects as well as exchange and cooperation between operational agencies or operators are essential.

In particular, it is necessary to establish a plan to support commercialization by establishing a multi-ministerial cooperation channel such as the Ministry of Education, the Ministry of SMEs and Startups, the Ministry of Science and ICT, the Ministry of Trade, Industry and Energy, and the Ministry of Oceans and Fisheries.

4.3. Providing Excellent Technology Platform Services

It is necessary to implement a matching platform service between excellent technologies and companies and researchers in the strategic technology field. The limitations are that there is a lack of information on analysis and utilization technologies for the results of national research and development projects, and an environment where companies or investors can easily find them is not provided.

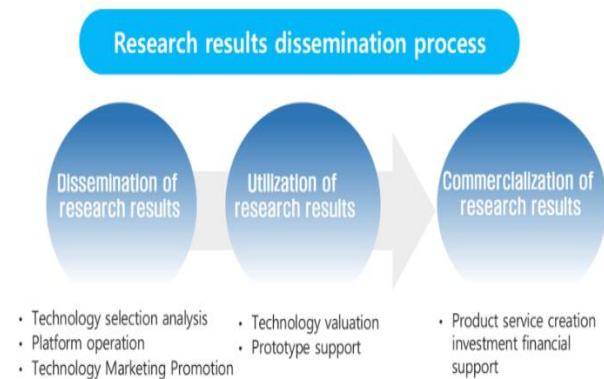


Figure 6: Research results dissemination process

The process of discovering strategic technologies is realistically important for the excellent technology platform. Various strategic technology fields are being invested in, and the process of discovering these excellent technologies and linking them to services can be implemented through the platform.

Accordingly, it is important to create a strategy of creating continuous technology cooperation services along with the process of building an excellent technology platform and linking it to services. In particular, it is necessary to provide services that customers seek out through the establishment of a service platform, rather than limiting it to technology transfer and startups.

4.4. Establishing Investment Linkage Cooperation Plan

From a commercialization perspective, investment is a very important growth engine. In the case of early-stage startups, investors often do not consider them as investment considerations.

Therefore, it is important to have a system that verifies and supports whether the items of early-stage startups are promising for commercialization.

In particular, promising business items should be verified through R&D performance competition or commercialization

competition. Currently, the central government has two fund management organizations.

The fund management organization requires expertise, but there is a lack of performance management and cooperation network among operators. Fund business operation is important not only for managing the fund but also for performance management and developing an operation method that fits the strategic purpose of the fund.

Accordingly, in order to manage funds and expect profitable effects, it is urgent to prepare efficient alternatives for fund operation. In particular, the discovery of public technology start-ups is not only an issue of insufficient funds, but there are also many limitations that prevent operators from directly discovering and acting as coordinators. Accordingly, although the profit effect is important in the aspect of the fund operator, there is a need to expand the scope of the fund operator into the area of a business management professional institution and provide operational support to the mother fund in the area of growth support.

Therefore, it is important to continuously create investment competitions for national-based strategic technologies and establish a cooperative system to enable various networks for each technology. In particular, investment policies for strategic technologies should be accompanied by the operation of a mother fund. The mother fund should be operated as a strategic fund specialized in strategic technologies and supported so that investment policies can be accompanied.

5. Conclusion

Strategic technology is one of the government's important policies that determine future national competitiveness. It is important to systematically support not only the development process of strategic technology but also how to commercialize it, because a lot of research funds are invested in securing strategic technology, and the process of linking excellent research results to commercialization early is important.

Accordingly, this paper examined the direction and policy of fostering strategic technology, diagnosed problems in terms of commercialization during the process, and presented solutions on how to promote it.

This paper states that although there have been many proposals for fostering strategic technology led by the government, there has been no proper research on the system and direction. In addition, there is a lack of research data and papers from the perspective of commercialization, and in terms of systematic fostering and support of national research and development projects so that they can be expanded, utilized, and commercialized through

commercialization, a cooperative system between each ministry is also very important.

The implications of this paper are as follows. First, the part that examines the operating system for national strategic technology that has not been studied so far, diagnoses problems, and contains improvement measures and suggestions is judged to be a study from various angles in terms of commercialization performance. Based on this research, it seems necessary to establish in-depth policies on institutional improvements and supplementary measures to enable advanced science and technology to move into the commercialization process.

Second, in order to expand the commercialization linkage system, comprehensive consulting support that links strategic technologies to startups and even to follow-up support is important. In particular, in the case of strategic technologies, since the level of technical perfection is not high, incubation support for follow-up support is essential.

In particular, customers applicable to the industry should be found by technology field, and technology scale-up should be carried out to meet the product service demanded by the customer. For example, in the case of advanced mobility technology, since the procedures and methods of certification and verification are very important in commercialization, product performance implementation should be carried out to the application stage in the market.

In addition, strategic technologies should have target markets by technology field, and market development is essential.

Although excellent technologies have been recognized, products and services that can apply the technologies to the market are limited. Therefore, a business strategy that can analyze specific fields and develop small markets is necessary. Based on these commercialization strategies, the commercialization of strategic technologies will be promoted.

Third, through this study, we recognized that various support is necessary so that the development of strategic technologies can be expanded from a commercialization perspective.

Also, a system that promotes cooperation between government departments is very important. Technology commercialization requires cooperation between government departments in accordance with the process of discovering excellent technologies, connecting them to startup commercialization, supporting companies, and providing post-finance support.

In particular, the role of each government department should be operated in a way that they cooperate and participate in the process of technology commercialization, and from a public technology perspective, research institutes, companies, and investment companies should cooperate to strengthen the inter-departmental support system. Accordingly, a

comprehensive support agency for technology commercialization, which serves as a control tower for technology commercialization between departments, should also be reviewed.

It is also very important to discover excellent technologies at the national level for the spread, utilization, and commercialization of strategic technologies, foster potential entrepreneurs, and establish programs linked to follow-up investments. Accordingly, we believe that a commercialization strategy that fits advanced science and technology is necessary through selection and concentration of various policy support.

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