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Research towards New Innovation Strategies in Korea via Focused Group Method

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Abstract As the COVID-19 pandemic crisis left developing countries with economic setbacks, it is high time to highlight that innovative technologies lead the digital economy. The big powers including the United States and China are already implementing industrial policies that involve large-scale fiscal expenditures to secure the lives and safety of their people. To prepare for the future up to 2025, this paper reflects opinions of industry-academia-research experts regarding changes in the external environment and industry trends. By reflecting results of focus group interviews and changes in the external environment and industry trends, a new high-level 5X strategy (Digital Transformation, Energy Transformation, Bio Health Transformation, Supply Chain Transformation, and Research Transformation) to solve national tasks required for the existing ten policy demand fields and ten agenda during lower-level policy implementation stages were derived.

Keywords Industrial Technology Innovation, Focus Group Method, New Innovation Strategies, Five Transformations, Ten Agenda

I. Introduction

South Korea (hereafter Korea) is now facing many never-experienced challenges: COVID-19 since 2020, climate change, digital transformation, and the unstable global value chain. COVID-19 and its impacts have been going on for over two years now, so we need no detailed explanation, except for the lockdown of several areas, which stops all international trade from the areas. Digital transformation is a challenge that not only Korea but the whole world is

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experiencing. The 4th industrial revolution theory was pointed out by experts (Ha and Choi, 2015; Schwab, 2016; Moon and Seol, 2017). Korea also experiences climate change: There is an unexpected drought in some areas, and just a few days after the drought, heavy rains of up to 100mm per hour last for several hours a day. The temperature of the seawater is rising, and fish species from the south are appearing.

These big changes are occurring at the same time in a state where it is difficult to overcome COVID-19 itself, and social responses are not easy. These challenges are manifested in several dimensions, and it is difficult for experts in a specific field to grasp the core of the problem and propose more national countermeasures. These difficulties are the same for policymakers, so it is inevitably difficult to find a solution to the overall problem.

Simply speaking, what changes are significantly affecting Korean society? How can the most important changes be organized in order of priority? Furthermore, how to deal with these changes? If we find the key issues, we can respond to the challenges by innovation, which is the tradition of Korea. These questions may become issues of national innovation as a whole and are difficult to deal with in one thesis. Therefore, to overcome these limitations, we briefly recognize the challenges and choose a method to explain them with keywords. In particular, since a new government for five years is starting now, many politicians and policymakers are seeking challenge recognition and solutions. Those kinds of challenge awareness and response methods can help the new government policy establishment.

We use the Focused Group Method through several experts to organize complex issues and response methods simply. We believe that real experts in various fields can not only simplify the issues but also easily derive keywords for the response. Global policy, industrial policy, technology policy, energy policy, ICT policy, and data policy experts with more than 20 years of experience participated in this study.

II. Methodology

Focus Group Interviews (FGI) have been adopted in many fields since the methodological presentation by Stewart and Shamdasani (1990), Morgan (1998), Krueger (1998), and Bloor et al. (2001). The extensive use is because it has the advantage of not only being able to derive collective views but also being able to establish and share common experiences or beliefs (Hyde et al., 2005; Gill et al., 2008; etc.).

Greenwood et al. (2017) show that there are two ways to obtain data even in FGI. Meanwhile, according to Cyr (2015), FGI can also be divided into

participant-centered, group-centered, or interactive types, and each approach has advantages and disadvantages.

If the FGI focuses on the opinions of each individual, it is advantageous to confirm any facts or theories. If the focus is on the group, it is advantageous for the preliminary inspection necessary to derive any facts. On the other hand, interaction has an advantage in the search for unknown facts and common perceptions.

Since individual interviews and group interviews have their strengths, many studies use both individual interviews and FGI in parallel. Gill et al. (2008) compare the interview method and FGI for medical research. Rosenthal (2016) explains when and in what situations to choose the two methods. On the other hand, Laestadius et al. (2019) show the application of several types of FGI methods.

In the present study, FGI was conducted from June to July 2021 with four industries, universities, and research experts who work in the innovation and technology policy fields with 20-30 years of work experience (Table 1). The work consisted of four stages: First, free discussion about the policy issues and directions; second, questionnaires prepared by the research team; and third, panel discussion. The fourth stage was to polish each content discussed by the relevant participants.

Table 1 FGI target information

Division	Participant	Sex	Experience	Affiliation	Major interest
Panel	A	M	30yrs	University	S&T innovation
	B	M	30yrs	Research institute	S&T policy
	C	M	25yrs	Research institute	Global policy
	D	M	20yrs	Industry	Energy policy
Research Team	E	M	35yrs	University	Data Policy
	F	M	20yrs	University	ICT Policy
	G	M	25yrs	Agency	Industrial Policy

As suggested in Park & Kwon (2020), the survey was conducted in the order of Start, Confirmation, Topics of Conversation, Major Questions, and Closing.

Table 2 FGI Questions

Stage	Contents
Start	Introduction of participants
Confirmation	Awareness of changes in industrial technology for new growth strategies
Topics of Conversation	Importance of Industrial Technology Innovation and Industrial Technology Policy after COVID-19 and New Environmental Changes
Major Questions	1. What is the biggest change in COVID-19? 2. What are the big issues to be solved on a national level? 3. What are the new growth strategies needed for the coming future? 4. When a new growth strategy is decided, what are the tasks to be pursued?
Closing	Summary and comments

III. Major Challenges

The major challenges identified are as follows; digital transformation, climate change, bio-health industry, circular economy, fluctuation of the international supply chain, and revitalization of the local economy.

1. Digital transformation

1.1 Current status

Digital transformation is already recognized as the level of civilization change. To this end, the digital transformation of the company is inevitable, but investment in digital infrastructure that goes beyond the level of individual companies is also essential. Digital transformation requires a data center, deregulation, completion of the single digital market, and growth drive through funding for young and energetic companies (OECD, 2019). In addition, data access, technical problems, and diplomatic issues must be resolved. Of course, undermining IT security through excessive government intervention should be prohibited.

1.2 Rationale

There are many reasons for building a digital infrastructure. The first is to directly or indirectly assist companies in their digital transformation, and the second is to support tasks that companies cannot do. We have already experienced the need for such an infrastructure well in the informatization process in the early 1980s. Third, there are reasons to avoid enslavement to other countries in digital transformation. The government's reaction cases to digital

transformation include Industry 4.0 (2011) by the German government and Society 5.0 (2016) by the Japanese government. In the area response, Europe is promoting the Gaia-X project to build a secure data infrastructure under the leadership of the German/French governments to strengthen digital sovereignty and the US on cloud networks. European governments and companies are somewhat less willing to use the cloud system, so there is an inherent possibility that the growth potential of the private and public sectors will not be sufficiently elastic.

2. Climate change

2.1 Current status

The recent climate change is not enough to explain much as academic proof. Summer weather in Korea, which averaged a little over 30 degrees Celsius, is soaring to over 40 degrees Celsius. At the same time, severe droughts are occurring on one side of the globe, and floods are occurring on the other side. Forest fires are common in drought areas, and drinking water, as well as agricultural water, is scarce on the other side. Also, the fish caught in the sea are changing, and the plants grown are also changing. The change is progressing at a much faster pace than what we are discussing.

2.2 International request

In December 2015, the Paris Agreement on Climate Change was adopted as a new framework for responding to climate change, following the Kyoto Protocol. 197 countries, accounting for 95.7% of global greenhouse gas emissions, took part and came into effect in January 2021. In 2001, before the Kyoto Protocol came into force in 2005, the United States withdrew from Kyoto Protocol. In addition, China and India were not included in the Kyoto Protocol under the shadow of developing countries despite their large greenhouse gas emissions. Canada, dissatisfied with the Kyoto Protocol, which does not apply to the United States, China, and India, which account for the largest share of greenhouse gas emission countries, announced its withdrawal from the Kyoto Protocol on December 12, 2011. After that, as Japan and Russia left out in 2012, only 41 countries that accounted for only 15% of the total greenhouse gas were participating.

The main contents of the Paris Agreement on Climate Change are three: First, each country should establish a long-term greenhouse gas emission plan called Long-Term Low Greenhouse Gas Emission Development. Second, countries should submit detailed plans for 2030 to the Commission by 2020 for long-term goals. Third, each country must present the Enhanced Transparency Framework by 2024 that maintains the transparency of efforts.

3. Bio-health industry

3.1 Current status

There have been many difficulties due to COVID-19. In particular, although Korea is evaluated as one of the scoops that responded well to the coronavirus, it suffered from a shortage of vaccines. Therefore, not only the government but also the general public recognizes that it is an essential task to reinforce the ability to respond to infectious diseases. The ability to develop new drugs that can respond to any type of infectious disease is essential.

Korea, on the other hand, has significantly benefited from the export of technology and goods due to COVID-19. A coronavirus diagnostic kit was released for the first time worldwide, and even a therapeutic agent appeared, saving many Korean lives (Seol and Ko, 2020). Fostering it as an industry is also an essential task. Korea has the second largest biopharmaceutical production capacity in the world. It is also the fifth largest exporter of pharmaceuticals in the world.

3.2 Rationale

Due to COVID-19, the United States announced the Bio-Economy Blueprint, the Precision Medicine Initiative, and enacted the 21st Century Healing Act (Joint Ministries, 2019, 2020). Accordingly, three strategies were announced: expansion of R&D investment, promotion of commercialization of research results, and innovative regulatory reform. The UK announced a future industry strategy for the bio-health sector and promoted the establishment of big data for a population of 5 million, the largest in the world.

4. Need for a circular economy

4.1 Current status

According to the World Business Council for Sustainable Development (2021), the Circular Economy market is expected to reach $4.5 trillion by 2030. The Ellen Macarthur Foundation describes Circular Economy as a systematic economic development method designed to benefit businesses, society, and the environment. According to the foundation, changing the cycle of “take, make, and waste” into one centered on reuse, regeneration, and redesign presents new challenges and opportunities. Every year, 90 billion tons of primary products or raw materials are extracted and used worldwide. However, according to the 2019 UN Environment Programme, only 9% of this is recycled.

4.2 Rationale

Global management consulting company Accenture (2020) forecasts $4.5 trillion in 2030 as economic value through the circular economy. Due to the reduction of wasted resources through the introduction of renewable energy and bio-based fuels and chemicals, the economic value will increase by USD 1.7 trillion, including USD 1.1 trillion in the energy sector and USD 500 billion in the material sector.

5. Instability of international supply chain

5.1 Current status

Current global value chain challenges are as follows: the Chinese government's retaliation to the THADD deployment (2016) by the U.S. Army in Korea, the export stop of semiconductor parts and materials by the Japanese government (2017), and further the struggle between the U.S. and China. The United States Innovation and Competition Act of 2021 to contain China, especially in hi-tech areas, make Korea select one side of the chain. In addition, the Russia and Ukraine war (2022) make Korea select one side of the global chain both in import and export.

5.2 Rationale

The visible damage from China's THAAD retaliation alone was estimated to be worth $8 billion (Hyundai Economic Research Institute, 2017). This is a figure that does not account for losses such as Lotte Group's withdrawal from its Chinese business. Therefore, even big countries, the United States and China have already started to build supply chains at the national level. The United States is emphasizing the US-centered 'securing supply chain stability' (Loker, 2020), and China is promoting the establishment of a value chain by linking its 'Technology Rise' (Ra et al., 2019) strategy to the 'Belt and Road Initiative (former One Belt, One Road)' (Ascensao et al., 2018).

6. Regional innovation

6.1 Current status

In Korea, concentration in the Capital area is progressing very quickly. The population is 50.3%, and the economy is 52.5%. The rate of Seoul's economy, the capital area, has increased from 43.7% of 10 years ago (Bureau of Statistics, 2022). The capacity of local governments to respond to these problems is small. This is because Korea is a centralized country where local governments have limited power in authority and budget. There are local governments with a degree of financial independence in the 20% range, and the average is around

50% (Bureau of Statistics, 2022). Therefore, the independent policies of local governments are bound to have limitations.

6.2 Hopeful samples

Leading Germany's IT hub, Berlin has 10,000 IT and telecommunication-related companies having annual sales of 13 billion Euros and 100,000 employees. There was a massive unemployment crisis due to the bankruptcy of East Berlin manufacturers and the lack of budget. However, after the regional innovation, Adlershof has grown into one of the world's top 15 science and technology parks with key companies in the German science and technology industry, generating annual sales of 2.3 billion euros and creating 20,000 jobs (KOTRA, 2019).

After regional innovation, thanks to the Saxony state government, Dresden emerged as a center for the global semiconductor and as the largest semiconductor production base in Europe, with half of the semiconductor chips produced.

IV. New Approaches for the Next Policy: 5X Strategies Having 10 Agendas

1. Vision for Strategies

FGI has drawn up a policy of a new approach to solving the problems, the 5X strategy, and followed 10 agendas, as shown in Table 2; Digital transformation, energy transformation, bio-health transformation, supply-chain transformation, and research transformation. This was published in the report of Park, S.U. and Kim, H.K. (2021). Figure 1 is the simple diagram for the 5X.

Table 3 Vision and Implementation System

Expanded policy demand	5X Strategies	10 major agenda
- Digital transformation - Digital economy - Digital infrastructure	DX (Digital Transformation)	1. Reinforcement of digital infrastructure 2. Realization of a digital innovation system
- Response to climate change - Environmental problems	EX (Energy Transformation)	3. Development of Green Technology 4. Structuring a Green cosystem
- Response to new disease - New industry creation	BX (Biohealth Transformation)	5. Biotechnology for the lab to industry
- Industrial restructuring - Overcoming protectionism	SX (Supply Chain Transformation)	6. Restructuring the global value chain
- Effect of cooperation - Legal obstacle for DX - Social needs for innovation - Low outcome of the region	RX (Research Transformation)	7. Industry-led industry-university- research 8. Upgrade the deregulation of DX 9. Nation-wide social tech. development 10. Promotion of regional policies

Source: Park, S.U. and Kim, H.K. (2021) revised

Source: Park, S. U. and Kim, H.K(2021) revised

Figure 1 New growth strategy through 5X

This agenda can be compared to the 10 policy demands by The Ministry of Trade, Industry and Energy (MTIE); 1) Industrial structure transformation/ nurturing of new technology/industry, 2) digital supply chain/infrastructure, 3) job creation in new industries, 4) regional innovation/talent training, 5) corporate growth (scale-up), 6) DX regulation improvement, 7) protection overcoming trade, 8) response to decarbonization and energy crisis, 9) resolving social and environmental problems, 10) public innovation by national research institutes (Park et al., 2020)

2. Top 10 Agenda

2.1 Reinforcement of digital transformation

First, it is necessary to reorganize the existing institutions for business support and build an infrastructure for digital transformation. The Korea Industrial Complex Corporation is an industrial complex innovation institution that leads corporate growth and local industry promotion. In addition, Technopark is an area that discovers and nurtures small and medium-sized knowledge-based technology companies by establishing an organic cooperative network with regional innovation organizations.

Second, we need to install an industrial digital content distribution center (transaction of correct information at a reasonable price). Even The Framework Act on Data (2020) does not contain this content.

2.2 Realization of a digital innovation system

First, it is necessary to newly install and operate digital factory measures (funds, taxation, technical support). It is necessary to restructure regional industrial complexes through digital innovation-based factory relocation in stages. To this end, government support such as funds, taxation, and technical support is required for new digital factory relocation.

Second, it is necessary to develop a new productivity improvement movement that reverses the decline in productivity. If the industrial revolution in the past mainly contributed to the increase in manufacturing productivity, the new digital revolution centered on artificial intelligence contributes to the improvement of new products. To deepen the polarization of the labor market due to the digital divide, digital safeguards need to be supplemented.

2.3 Development of Green Technology

First, we propose, as a national strategy, that the ‘energy manager’ (materials-parts-equipment) support policy. In response to Japan’s export control started in July 2019, Korea is promoting the ‘Measures to Strengthen the Competitiveness of the 100 Items Material-Parts-Equipment Industry’ to achieve supply

stabilization of 20 items within one year and 80 items within five years. To promote the stabilization of the supply chain without hesitation and to lead the industrial paradigm. In addition to this measure, echo-friendly technology policies are urgently needed as a national strategy.

Second, we also propose a regular strategy meeting of '6K' R&D support organizations; KETEP (Korea Institute of Energy Technology Evaluation and Planning), KIER (Korea Institute of Energy Research), KEA (Korea Energy Agency), KEEI (Korea Energy Economics Institute), KIAT (Korea Institute for Advancement of Technology), KEIT (Korea Evaluation Institute of Industrial Technology). Here, the mission of KETEP is "creating future value through energy technology innovation and industrial development." That of the KIER is "As a research institute leading energy technology, improving the quality of life of mankind and realizing a sustainable future." The KEA is doing "to contribute to the happiness of the people by building a sustainable energy ecosystem." The mission of the Energy Economic Research Institute is the "development of national energy and resource policies that contribute to the improvement of the national economy." The mission of the KIAT is the "realization of a technological powerhouse by establishing industrial technology policies and strengthening the foundation for technological innovation." The mission of the KEIT is "Strengthening national technological competitiveness through transparent and professional industrial technology planning, evaluation, and management." Six organizations organize and operate regular strategic meetings for decarbonizing G7 countries to develop effective policies and technologies.

2.4 Green Ecosystem for Resources and Energy

The importance of environmental issues such as the garbage crisis, fine dust, and plastics has risen sharply. To against this issue, green tech is a technology that considers the balance between environmental conservation and industrial development. It saves energy and resources efficiently and efficiently throughout the entire process of social and economic activities.

First, to meet this need, the government should foster 5 super green technologies; greenhouse gas reduction technology, energy use efficiency technology, clean production technology, resource circulation, and eco-friendly technology. It will secure double-digit global market share and technology specialized for small and medium-sized ventures.

Second, there is a need to prepare a hydrogen technology roadmap like the '2030 hydrogen economy roadmap,' a preliminary draft by the MTIE, which includes both technology and economy. The hydrogen economy is an economy in which hydrogen is used as a major energy source, which causes fundamental changes in the national economy, society, and people's lives. Hydrogen can become a source of economic growth (a new growth engine) and eco-friendly energy.

Third, the export strategy task force needs for re-manufacturing. Re-manufacturing refers to making a product that is in use or at the end of its lifespan but has better performance as a new product through disassembly, cleaning, inspection, repair, adjustment, and reassembly process. It is different from recycling. The biggest feature of re-manufacturing is that compared to new products, the effect of saving resources is very high. The price of re-manufactured products ranges from 50 to 70% of new products.

2.5 Biotechnology from the lab to industry

First, it is necessary to promote customized commercialization support projects in the age of science business, where R&D results are commercialized, and sales are generated immediately in the market. For the success of the science business, we will have to effectively support necessary resources such as funds and manpower by establishing alliances and cooperation systems with external partners.

Second, the most important point is the direction of biotechnology R&D: 1) development of source technology to respond to the emergence of unknown viruses such as the recent coronavirus situation, and 2) development of new drug technology should be pursued.

Third, it is necessary to establish a platform for the bio-health industry in preparation for the '100-100 era' (the world population of 10 billion in 2050, the era of 100 years old) and create an ecosystem that connects small and medium-sized bio ventures and large companies.

Fourth, we suggest a bio-big data platform both for R&D and better treatment technologies. Through this nationwide platform, data from hospitals should be gathered and used under privacy protection. Further, the Ministry of Industry creates an ecosystem that connects small and medium-sized ventures and large companies.

2.6 Restructuring the global value chain

Korea also experienced limited experience in China's anti-THAAD measures in 2017, Japan's ban on semiconductor material exports in 2019, cessation of raw material imports during the Ukraine war in 2022, and Russia-related imports and exports. For this reason, it is necessary to secure at least multiple importers for material parts that are country-dependent. To overcome these kinds of anti-flow, we recommend three steps of measures: First, the identification of the items. Second, the finding out of the alternative import line. Third, if there are no proper alternatives, we should develop with financial and diplomatic efforts.

2.7 Industry-led industry-university-research platform

The industry-academy-research cooperation for technological innovation that exists is not being utilized well in industry because universities or research

institutes are leading it. Therefore, we recommend industry-led technology development cooperation, especially by the economic organization in each group; the Federation of Korean Industries, Chambers of Commerce, Trade Association, Korea Federation of Small and Medium Businesses, etc.

2.8 Upgrade for the deregulation for digital transformation (DX)

Korea already has a regulatory sandbox for deregulation, but these have constraints such as region and time. However, digital transformation has no time and region restrictions and even penetrates the virtual world. Therefore, first, we suggest the construction of a new sandbox that greatly relieves time and space constraints for digital transformation.

In addition, technology development should be promoted for digital transformation. However, SMEs lack these capabilities. Therefore, second, we propose to establish a digital transformation cooperation system that facilitates cooperation between large enterprises and SMEs and between universities and research institutes and SMEs.

Third, all these efforts may be encompassed by a big umbrella, in tentative name, 'Special Act on Promotion of Digital Transformation. This is because, in a legal system such as Korea, supplementing the legal system is of paramount importance.

2.9 Systematization of social technology development

We need to strengthen social technology development, which targets to solve important social issues such as infectious diseases like COVID-19, the polarization of society, and climate change and disasters. By installing a control tower for national R&D projects to solve social problems. In addition, it is necessary not only for R&D but also to connect with technology commercialization and foster social enterprises.

2.10 Promotion of regional policies

First, we will need to strengthen the 'local technical education program' that supports technical education (upskilling and reskilling in cooperation with local universities and companies. With the rapid change in the 4th industrial revolution, the capabilities required in the industrial field change rapidly.

Second, so-called the 'Industry-University-Research Regional Linkage Program' matches regional universities, industrial complexes, and public research institutes to promote regional innovation. The biggest problem with local innovation policies is that the input for innovation itself is small. Therefore, a comprehensive approach from universities, research institutes, and companies is necessary.

V. Conclusion

Due to rising uncertainties such as the COVID-19 pandemic and changes in global value chains, long-term stagnation (low growth, high inflation) and widening gaps are observed in developed economies. In addition, there are big changes represented by digital technologies and biotechnologies. The war between Russia and Ukraine has had a profound impact on the world economy. We must be on riding the wave of change. To meet these challenges, many countries are implementing strong industrial policies. In particular, the United States, which has been a strong critic of 'industrial policy, has changed its stance significantly with several industrial policies, such as the United States Innovation and Competition Act of 2021. Reflecting on these situations, this paper tried to find a new growth strategy to be promoted by the new government of the Republic of Korea starting from 2022 using industrial technology.

Since the task of recognizing the current challenges in Korea and setting the policy direction has become a national task and cannot be solved in one paper, we have chosen a method for simplification. The methodology to identify challenges and find response measures are the Focus Group Method. From this method, we draw out the countermeasures in the form of keywords, deriving detailed tasks belonging to them. From an academic point of view, it is a very large topic, so some topics are omitted from the discussion, while there are inevitably many parts that are also omitted from the description of each topic. Nevertheless, this approach was chosen because we judge that it would be more helpful for policy planners and executives to present challenge recognition and countermeasures through simple keywords that are easy to understand than policy reports in a complex and thick report.

This article suggests the 5X and 10 major tasks for industrial policy, especially from the perspective of technology innovation. Again, this paper has the form of simply keyword-centered problem solving and alternative proposals that support the big picture rather than detailed and precise discussion. It is intended to easily convey a message to politicians and policymakers. Therefore, this article has big shortcomings of no detailed and strict discussion of academic tradition. In addition, this article lacks a detailed discussion of each challenge and response. A detailed discussion can be found in Park and Kim (2021).

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