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A Study on Regulatory and Industrial Policies for the Industrial Paradigm Change

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Abstract

This paper suggests an integrated and comprehensive industrial policy framework reflecting various regulatory and industrial policy issues including new industrial paradigm shift such as the 4th Industrial Revolution. The industrial policy framework should cover all the policy areas including not only the existing industrial policies but also the regulation and innovation strategies from the national economic perspective. In this paper, it is underlined that the regulation and industrial policy should be able to ensure the promotion of industrial innovations by enhancing the interactions among the economic actors. This policy direction must be reinforced by providing the differentiable policy strategies in terms of business scale, type, life cycle, and so on. Furthermore, it is necessary to establish the self-selective optional policy scheme that can encourage creative and autonomous industrial innovations coming from the private sector. This self-selective policy framework can work well over the policy support platform that can allow the economic actors to exchange the information,

technologies, expertise knowledges, consulting, etc, regardless of the positions of policy suppliers and demanders. This policy strategy is the same case in the regulation and industrial policy framework.

Introduction

The aim of this paper is to establish a new approach that seeks after the balance and coordination of the regulation and industrial policy, reflecting the trends of New Emerging Industry(hereafter in this paper referred to as 'NEI') including the 4th Industrial Revolution(hereafter 'FIR'). This way can be expected to enhance the social and economic policy ability to respond to the new paradigm shift resulting from new industrial innovation including the FIR.

These days Korea is facing long-term low economic growths accompanied by rapid industrial paradigm shifts. The new government of Korea is expecting to recover the economic growth by rebuilding industrial powerhouse.

Therefore, my aim in this paper is to establish an analytic approach capable of forecasting industrial structure changes including the economic impacts of the FIR. In accordance with the approach reflecting these industrial changes, it should be also prepared to establish new regulatory and industrial policy

framework and specific implementing strategies.

On the other hand, this paper suggests a new policy framework to deal with the economic and industrial issues associated with the regulation, innovation, and industrial policy. Actually, the other studies make policy suggestions that can be effective in the separate parts of industrial policy, innovation, and regulation. However, the economic situation is more complicate in dealing with the separate policy areas that have impacts on each others. For example, if a new regulation system would be adopted in any industry or market, the other policy areas should be adjusted to it by reflecting its overall effects.

Furthermore, the appearances of NEIs including the FIR can make the policy making and implementation more complicate. This is because the NEIs can cause critical structural changes for the existing industries, apart from their own motivation to evolve further. This means that the policy makers should consider the various policy dimensions including regulatory system, industrial policy, and innovation strategy, in particular in the case where a NEI's appearance is anticipated.

This paper attempts to forecast the converging development patterns of regulation and industrial policy and suggest an integrated policy framework to handle NEI/regulation/innovation/industrial policy, focusing on the industrial structure changes led by the NEIs including the FIR. This implies that the policy areas have to be dealt with in the integrated ways, in the sense that it is necessary to establish a new policy paradigm to manage these policy areas to be connected with core industrial development factors.

II

Industrial Paradigm Change

In this section, I address the concept, distinguished characteristics, and, more importantly, the impacts of NEIs on the existing industries.

The NEIs can be more actively generated in the economic environment where there are higher possibilities to develop cutting-edge technologies. This means that the firms having higher R&D intensities can take higher chances to create NEIs. Hence, it is impossible to exclude R&D policies in generating NEIs more briskly.

On the other hand, let me take a closer look at the dynamic influence paths of NEIs including the FIR, which makes it easier to review varying policy dimensions. The NEIs tend to take an important role to create a virtuous circle that formulates good circulation in the industrial development. They can also offer dynamic motivation for the national industrial development by causing industrial paradigm shift in the overall industries including the existing industries. This means that it is necessary to adopt and adjust new regulation and industrial policy to reflect the development of

NEIs in the overall industrial and economic system.

Focusing on the concept and characteristics of the NEI and FIR, this section shows how the development of the NEI and FIR has impact on the existing industries and what can be anticipated from their impacts in view of policy making.

(1) The NEI and FIR

A NEI is defined as a new industry that is formed by satisfying consumers' needs different from in the traditional market through new product or service. This industry is located at the 'emerging' stage from the perspective of industrial life cycle consisting of 'developing', 'emerging', 'mature', and 'declining'.¹⁾

The NEIs can be more actively created by startups and existing firms having cutting-edge technologies. If they can satisfy market demands for advanced services of goods with the high technologies, the firms would have higher possibilities to set up competitive business models.

Although the FIR is also one of the NEIs, the FIR has much higher levels and degrees in the dimensions of 'scope', 'velocity', and 'impact'. The FIR has a characteristic of broad and deep convergence and integration in terms of technology.²⁾ The FIR causes revolutionary changes in the national economy and society by utilizing cutting-edged technologies in the areas of AI, IoT, Big

1) Refer to PWC(2012).

2) For example, FIR can provide health care service including disease monitoring, diagnosis, therapy, operation, etc. with which AIs deal through Big Data over the IT networks.

Data, Mobile. Intelligent ICT technologies such as AI, IoT, Clouding Computing, Big Data, Mobile would be converged with the incumbent industries and services or be combined with 3D printing, Robot Engineering, Biotechnology, and Nanotechnology. This would make real world goods and services connected and intelligent³⁾, which makes the existing industries smart and intelligent.

Before going further, let me compare the traditional manufacture, NEI, and FIR, focusing on the economic features such as technology, R&D, and market.

As shown in Table II-1, the NEI and FIR can be differentiated from the traditional manufacture, while, in fact, the NEI and FIR cannot be differentiated easily.

In the views of economic and innovative feature, the NEI and FIR are different from the traditional manufacture. First, in the economic feature, the NEI and FIR tend to show technology conver-

Table II-1. Economic Feature Comparison among the Traditional Manufacture, NEI, and FIR

	Traditional Manufacturing	NEI	FIR
Technology	weak relationship with other areas	convergence and integration	broad and deep convergence & integration
R&D	short-term and intensive investment	long-term and large-scale investment	based on platform and ecosystem
Market	mature competitive market	differentiated monopolistic market at embryonic stage	shift to integrated market

Source: Complemented from KIET(2017a).

3) Definition from IT dictionary of TTA(Telecommunication Technology Association).

gence and integration trend, while the traditional manufacture has weak relationships with other technology areas. In particular, the FIR has broader and deeper technology convergence and integration than other industries.

From the R&D perspective, the traditional manufacture tends to invest in short-term and intensive way, while the NEI and FIR cause R&D investment in the long-term and large-scale way. In particular, the FIR needs R&D investment based on the industrial ecosystems working over multi-purpose platforms.

The platform and ecosystem are core concepts needed in explaining the FIR. First, the platforms can be bases for the provision of the FIR goods and services. Over the ICT platforms, the FIR services can be provided, having the characteristics of ‘hyperconnectivity’ and ‘superintelligence’ that are shown in the FIR industries like AI, IoT, Clouding Computing, Big Data, Mobile, etc.

In addition, in the FIR industries, varying industrial ecosystems can be formed, based on the ICT ecosystems. First, in the view of information technology, it is important to collect informations and add values to the informations by analyzing and reallocating the informations in the FIR industries. This means that there can be varying layers where the informations are dealt with and managed. These layers can be extended to the hardware areas where networks, facilities, equipments, etc. can be provided. Furthermore, these FIR related industries and technologies can be connected with 3D printing, Robot Engineering, Biotechnology, and Nanotechnology, which leads to the establishment of varying industrial ecosystems.

(2) New Industrial Structure Changes

New economic trends from the NEI and FIR can cause the paradigm shift of the existing industries as well.

First, it is noticeable that the NEI and FIR can have fundamental impacts on the citizens' lives, which can be easily recognized by considering more closely the functions and contents of the NEI and especially FIR. The NEI and FIR can make the qualities of life higher in various ways. For example, the AI can make our life more intelligent and thereby comfortable and especially healthier (by being connected with medical services such as disease monitoring, diagnosis, therapy, operation, etc.). This can cause the substitution of the NEI and FIR for the products of the existing industries with high quality services.

Second, the NEI and FIR can enhance the effectiveness and efficiency in the manufacturing process of the existing industries. For example, automatic manufacturing using the robot engineering and AI can create intelligent factories like the smart factory that can enhance the productivity, product quality, and thereby satisfy consumers' advanced demands. This can change the overall production system of the existing industries, which can create new industries providing with smart and intelligent facilities, equipments, softwares, and manufacture systems.

Third, as mentioned earlier, the NEI and FIR have an important characteristic that is the converging and integration of ideas, technologies, services, products, systems, business models, etc. In many cases, the NEI and FIR can be connected and com-

bined with the existing industries, which can change them into totally different ones or higher upgraded existing industries. In this sense, it is worth considering this trend as a sort of survival strategy of the existing industries.

Fourth, the existing industries can evolve by utilizing the infrastructure of platform and ecosystem that the NEI and FIR has. This means that it is necessary to cooperate with the NEI and FIR by participating in the industrial ecosystem of the NEI and FIR based on the platform for not only government support services but also voluntary interactions within the private sector. The existing industries can entry into the new industrial development areas by participating in a broader NEI or FIR ecosystem that can provide new industrial development mechanisms.

III

Regulatory Policy Framework

(1) Policy Directions for Smart Regulation

First, the smart regulation can respond to the NEI's development pattern, which accordingly can lead to industrial paradigm shift in proper way.

I define the smart regulation as a systemic approach to enhance effectiveness and efficiency for overall regulation elements including regulatory target, principle and standard, implementation, process, etc, in order to conserve social and economic values that the nation pursues.

The smart regulation seeks for the systematic enhancement of the regulation by dealing with regulatory elements in economically efficient way, considering all the regulatory aspects, if possible, to find out a balanced regulatory point.

I suggest several regulatory policy directions as follows: (i) the establishment of smart regulatory system that align with regulatory targets (ii) the implementation of an industry-differentiated

Table III-1. The Elements of Smart Regulation System

Classification		Target of Regulation	Regulation Tool	Implementation Strategy
Society	Risk	Management of Risk	○ Direct Method - Law, Tax, Subsidy, etc. ○ Indirect Method (Social Consensus) - Formation of Public Opinion - Market Incentive Regulation	○ Establishment of Regulation System - Risk Basis, Risk Management - Performance Basis, Performance Management - Enhancement of Responsibility and Transparency - Cooperation of Government Authorities - Enforcement of Regulation Ability
	Environment	Environment Conservation		
	Health	Health Enhancement		
	Security	Safety		
	Life	Enhancement of Life Quality		
	Ethics	Preservation of Social Values		
Economics	HR	Welfare	○ Direct Method - Law, Tax, Subsidy, Clause, License, etc. ○ Indirect (Voluntary) Method - Certification, Standard, Agreement of Private Sector	○ Enhancement of Economic Regulation - Establishment of Regulation System - Equilibrium Searching based on BC Analysis - Converging Strategy of Regulation Tools - Balance and Cooperation among Industries - Dynamic Response (Improvement of Regulation Process and Establishment of Assessment Feedback System) - Simplicity and Clarification of Regulation
	Quality	High Quality		
	Transaction	Fair Trade		
	Price	Proper Pricing		
	Entry	Competition Promotion		
	Market Structure	Market Activation		
	Environment and Society	Sustainable Economic Development		

Source: KIET(2013).

regulatory policy (iii) the implementation of a firm feature-differentiated regulatory policy.

First, regulations can have impacts on industrial performances

resulted from the firms' management activities including production, facility investment, R&D, etc. Therefore, in the introduction and application of regulations, it is important to offer well designed regulations in efficient ways by providing clear regulatory targets and standards, effective compliance methods along with regulatory information notices and related consulting services, etc.

Second, the appearance of the NEI and especially FIR would underline the importance of the social regulations dealing with environment conservation, health, safety, etc, considering social values, purposes, and ethics. This means that it is necessary to strengthen information capabilities to be able to understand the NEI and FIR more perfectly, for example, by providing various information on rapidly evolving science and technologies in the systematic way.

This approach can make it easier for the regulatory policy maker to find out proper regulatory items and apply timely them. Of course, this approach should be accompanied by the analysis of forecasting model, the collection of test data on the regulation related effects, the other evaluation informations, the diversified analysis of well set-up scenarios, etc.

The NEI and especially FIR require comprehensive social agreements on guaranteeing transparency in verifying the effective conservation of social values and ethics. This requirement would cause time consuming due to the lack of regulatory infrastructures. Hence, it is necessary to establish regulatory system to respond to complicate regulatory environments, which can make it possible to reach social agreements efficiently among

Table III-2. Regulatory Policy Directions for Classified Industries

		Traditional Manufacture	Environment Industry	New Technology Industry
Regulation Target	Society	- safety, health, environmental conservation etc.	- pollution protection, environmental conservation, health, safety	- health, environmental conservation, safety * social ethics and values
	Economy	- timely access to diversified consumption - proper price	- sustainable industrial development	- sustainable industrial development * access to new product
Regulation Tool	Direct	- safety, energy efficiency, pollution emission, quality standard	- environment, health, safety standard	- health, safety standard
	Indirect	- certification, standard, private agreement	- test data submission, forecast model analysis, evaluation information, scenario analysis etc.	- test data submission, forecast model analysis, evaluation information, scenario analysis etc.
Propulsion system	Regulatory System	- risk and performance management system - balance and cooperation between industries - dynamic response: regulatory process enhancement and evaluation reflecting system establishment	- risk management : overall review on potential risks in health and environment - balance and cooperation between industries - dynamic response: regulatory process enhancement and evaluation reflecting system establishment	- risk management: in the broader areas with high complexity - balance and cooperation between industries: considering the features of research basis, capital concentration, multidisciplinary cooperation etc. - dynamic response: elimination of law making and information gaps and law/institutional framework upgrade

(Continue)

		Traditional Manufacture	Environment Industry	New Technology Industry
Propulsion system	Propulsion Strategy	<ul style="list-style-type: none"> - balance finding based on BC analysis - mixing strategy of regulatory tools - simplifying and clarifying of regulation 	<ul style="list-style-type: none"> - reinforcement of regulatory abilities: for science and technology information 	<ul style="list-style-type: none"> - reinforcement of regulatory abilities: drawing social agreement guaranteeing transparency
Policy Direction		<ul style="list-style-type: none"> - performance based regulatory implementation and voluntary agreement promotion - utilizing mixing strategy of regulatory tools 	<ul style="list-style-type: none"> - international regulatory cooperation and information sharing system establishment - reflecting the results from utilizing outside expert group 	<ul style="list-style-type: none"> - establishment of flexible law/institutional response system

Source: KIET(2013).

the stake holders including the government, citizen, firms, etc.

Third, from the perspective of the scale and R&D intensity of firms, they tend to show differentiated patterns. For example, as for the regulation with flexible and frequent regulatory revision, the large- and medium-scaled firms take negative position, because they have higher opportunity costs in responding to frequently changed regulations. In general, the large- and medium-scaled firms make higher and long term R&D investment.

Therefore, as for the large- and medium-scaled firms having high R&D intensities, it is necessary to establish a self-selected autonomous regulatory scheme for the regulatory principles, the specific regulatory items, the implementation processes, the penalty rules, so as to access easily to the regulatory system.

(2) Considerations in the Regulatory Policy Framework

In the survey result⁴⁾, when a new regulation is introduced, key features of the industrial areas that the regulator has to consider are suggested by the firms as follows: (i) high investment cost (52.1%) (ii) the uncertainty of future new markets (48.6%) (iii) the importance of market advantage (41.5%) (iv) long periods for R&D (39.6%), etc.

The high priority industrial features preferred by the firms are mainly the management side concerns for the optimization problems of profit maximization or cost minimization. On the contrary, the key concerns that the regulator considers in the adoption of a new regulation are far from those of the firms. For example, spillover effects on the economy (33.0%), the overlapping of regulations due to technology convergence (24.8%), side-effects on environment protection and social ethics (13.2%), contributions to the development of society (10.1%).

Here, it is noticeable that, as for the firms, the adoption of a new regulation can be recognized as a new opportunity to advance forward better market positions. However, it is important to provide certain incentives for the firms to participate more actively in new regulatory system that should be well organized so as to alleviate the mismatch between the interests of the regulator and private sector.

In the survey result, the difficulties the firms experienced in

⁴⁾ The result is based on survey of 500 companies in KIET(2013).

Table III-3. Industrial Characteristics Needed to be Considered in Introducing a New Regulation

Unit: %

Priority	Characteristics	Ratio
1	high investment cost	52.1
2	uncertainty of future new emerging markets	48.6
3	importance of market advantage	41.5
4	long period for R&D	39.6
5	expertise of cutting-edge technologies	36.7
6	spillover effects on the economy	33.0
7	the overlapping of regulations due to technology convergence	24.8
8	side-effects on environment protection and social ethics	13.2
9	contributions to the development of society	10.1

Source: KIET(2013).

regulatory compliance are as follows: (i) too high regulation standards (57.4%) (ii) the difficulty of understanding specific regulation items (50.5%) (iii) insufficient overall information on regulation (45.7%) (iv) differences from other products or industries (35.4%) (v) unclear regulatory targets and objects (33.8%).

As the barriers to regulatory compliances, they mention mainly the contents of the regulation itself rather than the administrative costs and violation penalty burdens associated with the regulatory compliance. In this view, the regulator's efforts need to focus on the establishment of information infrastructure to make the regulated understand easily the regulation contents.

In the result of the survey, as most important regulation policies the following factors are suggested : (i) deregulation for the promotion of firms' activities (76.3%) (ii) realistic complemen-

Table III-4. Barriers to Regulatory Compliance

Unit: %

Priority	Factor	Ratio
1	too high regulation standards	57.4
2	the difficulty of understanding specific regulation items	50.5
3	insufficient overall information on regulation	45.7
4	differences from other products or industries	35.4
5	unclear regulatory targets and objects	33.8
6	non-transparency of other firms' regulation compliance	21.8
7	differences from other countries' regulatory standards	21.1
8	unclear social benefits from regulation compliance	18.2
9	high intensities of violation penalties	10.1
10	high costs of regulation related administration	5.7

Source: KIET(2013).

tary measures for regulatory provisions hard to comply (71.4%) (iii) the efficiency of regulation related administrative procedures (44.8%) (iv) subsidy support for new facility due to regulatory compliance (34.3%) (v) the expansion of financing support for

Table III-5. Most Important Government Policy Related to Regulation

Unit: %

Priority	Policy	Ratio(%)
1	deregulation for the promotion of firms' activities	76.3
2	realistic complementary measures for regulatory provisions hard to comply with	71.4
3	the efficiency of regulation related administrative procedures	44.8
4	subsidy support for new facility due to regulatory compliance	34.3
5	the expansion of financing support for regulation response	32.3
6	listening for on-the-spot difficulties the firms experience	15.4
7	support for autonomous regulatory system by the private sector	12.7
8	the proper implementation of prior 'regulation impact analysis'	12.7

Source: KIET(2013).

regulation response (32.3%).

As the result of the survey, the firms prefer overwhelmingly the deregulation to the support policies for subsidy and financing. They think that it is also more important to complement the regulatory provisions hard to comply with.

(3) Establishment of New Regulation Framework

As mentioned earlier, three points are important for the efficient and effective regulatory system. First, it is necessary to clarify the purpose and target of regulations in carrying out the conservation of social values and the promotion of economic development. By doing this, the firms can understand well the intentions and aims of regulations and finally accept the regulations with less resistance.

Second, the regulatory system should be able to find out the social and economic equilibrium between the private and public sector. This comes from the fact that, in the views of the regulation, there exist clear differences between the private and public sector. For example, the private sector prefers absolutely the deregulation, while the public sector can pay attention to the side effects from the deregulation such as the higher possibilities for the negative impacts on the society, economy, environment, etc.

Third, it is important to recognize that the adoption of new regulation can be a challenging opportunity for the firms to level-up their innovative performances. In particular, the new opportunities for the innovative development have higher potential

and greater spin-off impacts when establishing new regulatory system in the NEI including the FIR. Therefore, it is noticeable that the national innovation system should deal with more actively this innovation issue connected with the regulation policy.

IV

Innovation Strategy and its Implications for Industrial Policies

(1) New Directions for Industrial Policy

In general, industrial policies can be justified for the reason that they can avoid a variety of failures which occurred in the areas of markets, systems, and coordinations.⁵⁾ However, this paper focus on the fact that major roles and functions of the industrial policy are to support the firms' innovative activities by utilizing varying policy instruments of financing, training, networking, regulation, R&D, information and consulting services, etc.⁶⁾

5) The markets can face the failures due to the problems involved in the externality, asymmetric information, or monopoly. On the other hand, the system failure can be also occurred due to the inefficiency accrued from structural or institutional incompleteness. Multi-equilibriums can cause the failures of the coordination between stake holders, which makes the government's policy interventions justified in the various economic areas.

6) Naude(2010), suggests the policy instruments that can be utilized in the seven domains: (i) Economic signals and incentives (ii) Scientific and technological innovation (iii) Learning and improving technological capabilities (iv) Selective industry support (v) Selection mechanisms (vi) Distribution of information (vii) Improving productivity of firms and entrepreneurs.

On the contrary, in considering the side effect from government's intervention, it is noticeable that the policy makers might have also incomplete and asymmetric information on a range of market factors including technologies, costs and prices, and market demand and supply, etc. The information problem tends to make the policy intervention inefficient in the markets.⁷⁾

The other important point is that the industrial policy should be able to reflect peculiar development patterns of new industries like the NEI and FIR by focusing on greater impacts on the industry, economy, and society. This consideration can help to establish an integrated industrial policy framework that should also be able to contain regulatory policy elements as well as innovation strategies. This approach can cause the reinforcements and extensions of the industrial policy. This tendency is an essential prerequisite to the social and economic development in the environment where a wide range of uncertainty becomes higher. In order to cope with this uncertainty from various angles, hence, it is necessary to carry out well organized policy making under the one integrated policy framework.

Again, In this sense, it is so noticeable that the integrated industrial policy framework should consider the peculiar aspects of the NEI and FIR.

Before going further, first, let us compare the NEI and FIR, recognizing that the FIR is a new industry that has never been

7) As a result, the information problem can cause picking winners in the markets, that is, the government can offer the policy benefits to the potential winners who can be more appealed as proper proposers. That makes the government's intervention meaningless, because the markets can pick winners without any policy support.

TableIV-1. Innovation Policy Comparison among the Traditional Manufacture, NEI, and FIR

		Traditional Manufacturing	NEI	FIR
Innovative Feature	Driver	technology supply	demand pull	meeting high-end demand
	Implementation direction	internal technology ability	external cooperation	broader external cooperation
	Direction	efficiency of technology and process	cutting-edge new technology	converging technology
Policy Direction	Information	technology focusing	overall market information	use of privacy and public information
	Regulation	specific	comprehensive (considering social issues, ethics, etc.)	more comprehensive
	Implementation Structure	top-down	bottom-up	creative bottom-up strategic top-down

Source: KIET(2013).

experienced before.

It is the case that the levels of technologies are higher in order of the traditional manufacturing, NEI, and FIR. The NEI and FIR have the same features of demand pull that creates new markets by meeting high-end demand. In general, high-end demand needs the development of converging technologies that are entirely proper for meeting a variety of high-quality demand. From the perspective of innovative strategies for the NEI and FIR, it is desirable to enhance the technical levels and the varieties of applications of the converging technologies. This strategic direction can be carried out well by promoting R&D cooperation with

external organizations.

On the other hand, from an information point of view, it is important to collect and utilize not only overall market information but also individual private and public information specially in the FIR. However, it becomes more important to recognize for what and how to apply individual private information to the market and public policy areas through the proper payment for personal information. This information problem causes higher necessity to establish more comprehensive regulatory framework for the NEI and FIR.

Here, it is noticeable that, in establishing industrial innovative policies, it is necessary to take a holistic approach that considers both the bottom-up and top-down strategies. This holistic approach can make it efficient and effective to carry out the promotion of external cooperation networking, technology convergence, comprehensive regulation implementation, etc.

In fact, the NEI and FIR needs the bottom-up approach for innovative strategies that can help to induce creativity and autonomy from the private sector. On the contrary, they need a strategic top-down approach that can help to secure important social values, coordinate various interests among stake holders, reflect national economy policies, and so on. This is because they can give larger and deeper impacts on the society and economy. In particular, the FIR cannot help causing government intervention in the areas of public health, humanization with intelligency, cyber networked entertainment, brain engineering, informatization of individual private and public data, etc.

(2) Survey Results and Policy Implication⁸⁾

In order to establish industrial policy framework, as mentioned earlier, it is necessary to manage both the bottom-up and top-down approach. First, for boosting creativity and autonomy got from the private sector, the bottom-up approach needs to exhibit a well-organized incentive scheme to induce the economic actors to conduct innovative management activities.

In order to establish this incentive scheme, we need review what management activities and policy contents are preferred by the firms.

1) Preference Priority for Management Activities

First, it is noticeable that the policy maker needs to find out which management activities the firms consider as important ones and thereby he or she has to combine them with industrial policies by utilizing proper policy contents and tools.

The following table shows the management activities preferred by the firms.

In the management activities, the firms' preferences are shown in the order of the self-securement of new technologies (73.5 out of total 100pt), launching new product (68.5), the enhancement of product procedure (67.0), marketing intensification (66.0), and HR management (supply and reassignment of HR) (65.5).

⁸⁾ This paper refers to the results of the survey conducted in KIET(2016) and KIET(2017b).

Table IV-2. Importance Evaluation for Management Activities

Classification	of 5pt.	of 100pt.
① R&D facility	3.51	62.8
② R&D materials	3.40	60.0
③ Self-securement of new tech.	3.94	<u>73.5</u>
④ Introduction of domestic outside tech.	3.06	51.5
⑤ Tech. development cooperation of domestic outside	3.36	59.0
⑥ Introduction of foreign outside tech.	2.60	40.0
⑦ Tech. developing cooperation with foreign outside	2.76	44.0
⑧ HR management(supply and reassignment of HR)	3.62	<u>65.5</u>
⑨ capital financing	3.45	61.3
⑩ enhancement of product procedure	3.68	<u>67.0</u>
⑪ enlargement of facility investment	3.57	64.3
⑫ launching new product	3.74	<u>68.5</u>
⑬ marketing intensification	3.64	<u>66.0</u>
⑭ expansion of sales distribution	3.56	64.0
⑮ marketing and sales alliance with other firms	3.01	50.3

Source: KIET(2017b).

As important management activities, the firms consider non-technology elements such as new product, product procedure, marketing, HR, etc, except for new technology acquisition that is preferred in the highest priority.

2) Entry into the NEIs

A. Barriers to entry into the NEIs

On the other hand, in inducing innovative management activi-

ties in the NEIs, it is necessary to consider which barriers are serious to the firms and which management activities are important to them.

First, the barriers to entry into the NEIs are as follows: ‘the uncertainty of markets’ (59.9 of 100 pt), ‘the difficulty in the collection of information on the NEIs’ (32.4), and ‘the imbalance of HR supply and demand’ (27.6).

By comparison, PM/A (precision machinery/automobile) industries consider ‘a lack of technology capability’ (46.2) as the highest barrier and OTM (Other transport machinery) chooses ‘the imbalance of HR supply and demand’ as the next highest barrier.

From the firm-scale view, on the whole, the firms consider ‘the uncertainty of markets’ the highest barrier factor. By comparison, the small-sized firms consider ‘the difficulty in recovering investment money’ as the next highest barrier, while the large- and medium-sized firms choose ‘the difficulty in the collection of information on the NEIs’ as the next highest one.

These survey results show that strategically incentive options for the firms to choose should be offered in the way where they can be differentiated according to the classification of industries and the firm scales.

B. Importance of management activities in the NEI

Second, let us review the management activities evaluated as important ones by the firms before and after entry into the NEIs.

Before the entry into the NEIs, the firms evaluated ‘self-R&D’

as the highest management activity (85.3 out of 100 pt), ‘new product launching’ as the next highest (84.4), and ‘technology introduction from the outside’ (79.1). By comparison, the management activities that the firms evaluated as higher priorities after the entry into the NEIs are ‘financing’ (91.1.), ‘expansion of distribution network’ (88.8.), and ‘self-R&D’ (85.0).

These results show that the government should differentiate support policies before and after entry into the NEIs. For the

Table IV-3. The Importance Evaluation for Core Management Activities before/after the Entry into NEIs

	Case number	Top 2%	Total 5 pt.	Total 100pt.
Self-R&D	(80/35)	82.5/88.6	4.4/4.4	<u>85.3/85.0</u>
New product launching	(24/32)	83.3/90.6	4.4/4.3	84.4/82
Technology introduction from the outside	(37/18)	78.4/83.3	4.2/4.1	79.1/77.8
Enhancement of production process	(22/31)	63.6/74.2	4.1/4.1	78.4/77.4
R&D(technology) cooperation with outside organizations	(38/18)	73.7/83.3	4.1/4.2	77.6/80.6
Financing	(32/14)	68.8/100.0	4.1/4.6	<u>76.6/91.1</u>
HR management(HR supply and relocation)	(33/24)	69.7/66.7	4.0/4.0	75.0/74.0
Expansion of distribution network	(4/40)	75.0/95.0	4.0/4.6	<u>75.0/88.8</u>
Marketing or sales partnership with other firms	(5/16)	80.0/75.0	4.0/4.1	75.0/76.6
Reinforcement of cooperation with domestic cooperative companies	(7/18)	71.4/88.9	4.0/4.2	75.0/79.2
Reinforcement of marketing	(13/47)	61.5/89.4	3.8/4.4	<u>69.2/84.6</u>
Expansion of equipment investment	(21/23)	57.1/82.6	3.7/4.3	67.9/81.5

Source: KIET(2016).

Note: The first/second numbers indicate the importance evaluation scores for the management activities before/after the entry into NEIs.

firms located before entry into the NEIs, for example, it is more important to support their own R&D, while for the firms located after entry into the NEIs it is more important to support them with the financing and distribution networks.

3) Innovative Strategies for the Firms

To suggest strategic innovation policies supporting for the firms, their preferences on the business support policies should also be considered.

A. Necessity for business support policies

On the question of which policies are necessary, first, the firms answer as follows: The business support policy that the firms consider as the most necessary one is ‘the support for technology development and the promotion of technology trade’. The second and third most necessary policies are ‘the deregulation for disturbing smooth economic activities’ and ‘the expansion of policy financing support’.

In the view of industrial types, all the other type industries prefer ‘support for technology development and the promotion of technology trade’ except for the pharmaceuticals/space and aeronautics that prefer the most ‘the deregulation for disturbing smooth economic activities’.

In the view of firm scale, on the whole, the firms prefer the most ‘the support for technology development and the promo-

tion of technology trade’, while the large-scale firms prefer the second most ‘the deregulation for disturbing smooth economic activities’.

This survey result shows that the firms consistently want to receive policy supports for the technology development, appreciating the importance of deregulation highly.

B. Evaluation for R&D policies

If it is recognized that technology development is very important in conducting innovative activities, it is necessary to review the firms’ importance and satisfaction evaluation on the R&D policies. The following table shows how the firms evaluate the importance and satisfaction for the R&D policies.

The firms evaluate the importance of R&D policies in order of ‘support for self-technology development’, ‘financing support for R&D activities (ex. tax favor)’, ‘expansion of R&D expert training programs’, ‘provision of global market and technology information’.

On the satisfaction of R&D policies, the firms’ evaluations have the same order as the importance evaluation.

In order to suggest which policies are proper to be provided more actively, it is necessary to examine the extent of a gap between the evaluations of importance and satisfaction for any policy. That is, if any policy has a wider extent of the gap than other policies, then it needs to be implemented more positively.

First, it is noticeable that the policies with higher priorities have

Table IV-4. The Importance and Satisfaction Evaluation for the R&D Policies

Policy	(A) Importance		(B) Satisfaction		(A)-(B) (5pt)
	5pt	100pt	5pt	100pt	
① Support for self-technology development	<u>4.32</u>	83.0	<u>3.18</u>	54.5	<u>-1.14</u>
② Support for collaboration with the public sector	3.62	65.5	3.04	51.0	-0.58
③ Support for technology cooperation with the private sector	3.57	64.3	2.96	49.0	-0.61
④ Financing support for R&D activities (ex. tax favor)	<u>4.01</u>	75.3	<u>3.10</u>	52.5	<u>-0.91</u>
⑤ Support for technology commercialization including promotion of technology transfer market	3.62	65.5	2.92	48.0	-0.70
⑥ Deregulation and support for self-imposed regulation by the private sector (such as industry's autonomous certification system)	3.67	66.8	2.74	43.5	<u>-0.93</u>
⑦ Expansion of R&D expert training programs	<u>3.76</u>	69.0	<u>2.90</u>	47.5	<u>-0.86</u>
⑧ Reinforcement of technology cooperation with foreign partners	3.24	56.0	2.62	40.5	-0.62
⑨ Reinforcement of protection system for contracts and IPRs	3.55	63.8	2.88	47.0	-0.67
⑩ Provision of global market and technology information	<u>3.70</u>	67.5	<u>2.80</u>	45.0	<u>-0.90</u>
⑪ Technology-related law consulting services including patents	3.46	61.5	2.87	46.8	-0.59

Source: KIET(2017b).

wider gaps between the importance and satisfaction evaluations, which means that if they place more importance and satisfaction on the policies, then they should be provided more actively.

The other policy that shows a wide gap between the importance and satisfaction evaluation is 'deregulation and support for self-imposed regulation by the private sector (such as autonomous certification system)', which also implies that this policy

Table IV-5. The Extents of Gaps between the Evaluations of Importance and Satisfaction for the R&D Policies

Policy	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	
Total	<u>1.14</u>	0.58	0.61	0.91	0.7	0.93	0.86	0.62	0.67	0.9	0.59	
I	P/S&A	<u>1.28</u>	0.85	1.00	<u>1.18</u>	<u>1.06</u>	<u>1.28</u>	0.99	<u>1.03</u>	0.82	<u>1.02</u>	0.82
	EC/C&BM	<u>1.07</u>	0.34	0.02	0.41	0.23	0.36	0.59	0.23	0.29	0.76	0.29
	ICT & BE/Ch	<u>1.12</u>	0.64	0.63	0.92	0.54	<u>1.03</u>	0.73	0.58	0.62	1.00	0.59
	GM/HEA	<u>1.23</u>	0.31	0.53	0.83	0.7	0.84	0.97	0.59	0.9	0.91	0.76
	PM/A	<u>1.05</u>	0.53	0.64	<u>1.08</u>	0.81	0.91	0.94	0.62	0.71	0.86	0.47
	OTM/Os	<u>1.05</u>	0.75	0.71	0.86	0.79	0.98	0.95	0.57	0.62	0.75	0.58
BS	L	<u>1.29</u>	0.59	0.55	<u>1.01</u>	0.65	0.9	0.87	0.63	0.71	<u>1.02</u>	0.61
	M	<u>1.07</u>	0.57	0.59	0.9	0.7	0.9	0.85	0.62	0.68	0.82	0.61
	S	<u>1.11</u>	0.62	0.82	0.73	0.84	<u>1.04</u>	0.89	0.62	0.58	0.97	0.49

Source: KIET(2017b).

Note: I: industry

P/S&A: pharmaceuticals/space and aeronautics,

EC/C&BM: electronic components/computer and business machine,

ICT & BE/Ch: ICT and broadcasting equipment/chemistry,

GM/HEA: general machinery/household electronic appliance,

PM/A: precision machinery/automobile,

OTM/Os: Other transport machinery/ other industries

BS: business scale

L: large

M: medium

S: small

has a necessity to be provided more positively.

This policy evaluation approach can be differentiated in terms of the business type and scale.

Regardless of the business type and scale, the policy of ‘support for self-technology development’ is the most important to the policy makers.

According to the business type, it is noticeable that the industries of ‘pharmaceuticals/space and aeronautics’ are dissatisfied

with the overall R&D policies. The industries of 'ICT and broadcasting equipment/chemistry', consider as another important policy 'deregulation and support for self-imposed regulation by the private sector (such as autonomous certification system)'. By comparison, the industries of precision machinery/automobile recognize the policy of 'financing support for R&D activities(ex. tax favor)' as another important policy.

In the business scale, the large scale firms consider the policy of 'financing support for R&D activities(ex. tax favor)' as another important policy. By comparison, the small scale firms recognize as another important policy 'deregulation and support for self-imposed regulation by the private sector'.

Directions for Industrial Policy Paradigm Shift

(1) Regulatory Policy Framework

A core idea of the regulatory policy framework is to reinforce interactions between the regulator and the regulated, based on the approach of the smart regulation from the perspective of regulatory management.

First, the smart regulation needs to clarify social and economic purposes and targets so as to enhance the regulatory efficiency and effectiveness. To this end, the regulatory policy maker should collect and analyze not only the social public opinions but also the economic needs from the private sector especially from the firms.

In setting up the purpose and targets of the regulation, it is necessary to allocate roles and functions to the related economic actors. In this sense, as the regulator, the government should determine the regulatory purposes and targets, considering the coverages and depths of regulatory principles and rules. As for the regulated, the private sector should be able to contribute to

the suggestion of regulation-related options that contain specific contents for the regulator to apply as standards, conditions, functions, etc.

Before determining the specific regulatory items and contents, the regulator should consider both the top-down and bottom-up approach at the same time. The top-down approach for making regulatory policies can be applied to the case where the social and economic purposes and targets are comparatively more important and even clearer. On the contrary, the bottom-up approach can be applied to the case where it is even more important to offer economic and industrial opportunities to the private sector.

In doing this, it is important to allow some room for the regulated to adopt an autonomous regulatory scheme that can apply some standards of certification to themselves, for example. Of course, this autonomous approach by the regulated needs to guarantee a willingness to select the regulatory options by themselves under the careful monitoring of the regulatory effects and efficiencies.

1) Reflecting the NEI's Features

From the future-ready perspective, a new regulatory framework should be able to reflect the NEI's features. The NEI has a rapid, complicate, and various pattern of the industrial development involving the large range of stake holder interests. Under the identified purpose of regulation, in this sense, the regulatory framework should consider diversified policy dimensions affected by the NEI

such as social values, economic growth, industrial development, and economic actors' interests, etc.

However, in establishing this regulatory framework, it is very hard to collect and understand various information related to the NEI and FIR. This means that the regulator needs to receive not only the related information but also the assistance for regulatory decision making from the relevant stake holders. The regulated can exhibit their opinions on the specific contents for regulation items including the standards and penalties. In addition, they can contribute to the regulation making by providing feedbacks on, for example, testing data, forecasting the impacts of regulation, and examining potential risks in health, environment, etc.

This kind of assistance from the regulated can contribute to the establishment of a self-selective regulatory system. The self-selective regulatory system should be able to present well organized manus for the regulated to choose for effective regulatory compliance.

In fact, the self-selective regulatory system can induce efficient and effective regulations, because it can alleviate asymmetric information problem between the regulator and regulated. Furthermore, this kind of autonomous scheme can be promoted by allowing the regulated to make out the regulatory options that should be complied by themselves. Of course, in implementing the autonomous regulatory scheme, it is necessary that the regulated should agree with the regulatory targets, principles, rules, and so on that are set up by the regulator.

2) Considerable Factors in the Regulatory System

The differentiated regulatory system for the NEI and FIR assumes that the industries have potential risks in the areas of society, economy, environment etc. For example, AI in the FIR has potential risk meant by the violation on the social ethics, while biotechnologies realized by 3D printing can cause the problem of life ethics. In this sense, it is necessary to take strategic approaches for the risk management.

In order to enhance the efficiency of risk management, it is necessary to do a series of risk management activities as follows: defining risks, setting up priorities among risks, clarifying the responsibilities for the risks, establishing risk monitoring system, and so on.

As in the risk management policy, regulatory framework needs diversified assistances from science, ethics, laws, philosophy, religion, etc. This multidisciplinary approach for the regulatory framework can make it easier to identify the regulatory issues, verify the problems, analyze several scenarios, evaluate the costs and benefits, and so on.

In addition, it is noticeable that this preemptive regulatory framework can be reflected on the industrial innovative policies. It is the case that regulations can place limitations on technology development, business models, production procedures, and so on.

In the regulatory framework, it is also necessary to differentiate the regulatory system from the perspective of business scale. As for the large-scale firms, it is important to participate actively in the establishment of ex ante regulatory schemes. This

is because their technologies and products have much larger impacts on the industry, economy, and society. By comparison, as for the medium- and small-scale firms, it is more important to provide them with regulatory guide information on how to differentiate their regulatory items and contents from those of the large-scale firms.

In the view of business scale, on the other hand, it can be desirable to differentiate the firms by distinguishing the regulations with ex ante and post regulation. As for the large-scale firms, ex ante regulations are proper to suggest superordinate targets, rules, standards, etc. By comparison, as for the medium- and small-scale firms, it is important to coordinate specific regulatory items and contents under the regulatory framework set up by the regulator and the major economic actors including the large-scale firms.

(2) Industrial Policy Framework with Incentive Schemes

As mentioned earlier, an industrial policy and innovation strategy should be able to promote the creativity and autonomy coming from the private sector, reflecting new technical and demand trends that the NEI and FIR have set so far and will set in the future.

1) Differentiating the Industrial Policies

In order to enforce efficient industrial policies, as shown in the survey results, it is necessary to differentiate the policies according to business scales and types. Furthermore, there also can be

other differentiable factors within the same business scale or industry group in the industrial policy. This is because the firms are located at the various positions, for example, they are located at the different stage of industrial life-cycle where there are the stages of start-up, emerging, development, mature, decline, etc. In this view, hence, the differentiated industrial policies can be provided in accordance with the development stages. Another differentiating policy in R&D policy making can be provided by diversifying into the R&D stages including concept, research and development, prototyping, and commercialization. What is more desirable is for the firms to determine the policy differentiable options by themselves, which can make sure to coordinate the connection between the policy supply and demand side.

In order to make efficient industrial policies, on the policy-demand side, it is necessary to offer the self-selective policy options that the firms can choose spontaneously. To this end, it is important for the government to make efforts to develop differentiable policy elements and factors suitable for the potential choosers. For example, the government can offer the R&D support policies that can be preferred by the firms with high R&D intensities, which, of course, should be able to guarantee the enhancement of economic welfare.

The other policy options can be provided according to national policy support projects in which the firms have participated. The national policy support projects can be classified as R&D partnership, financing, tax benefit, consulting, information service, etc. In this case, the effective policy options can be offered to the firms that prefer differentiable policy options.

The self-selective policy options can be suggested as follows: for example, ① Support for self-technology development, ② Support for collaboration with the public sector, ③ Support for technology cooperation with the private sector, ④ Financing support for R&D activities(ex. tax favor), ⑤ Support for technology commercialization including promotion of technology transfer market, ⑥ Deregulation and support for self-imposed regulation by the private sector(such as industry's autonomous certification system), ⑦ Expansion of R&D expert training programs, ⑧ Reinforcement of technology cooperation with foreign partners, ⑨ Reinforcement of protection system for contracts and IPRs, ⑩ Provision of global market and technology information, ⑪ Technology-related law consulting services including patents. These policy options were suggested in the previous section.

Of course, in making the self-selective policy option feasible, it should be guaranteed that the selection for the option can contribute to the enhancement of economic social welfare.

2) Establishment of Policy Support Platform

The self-selective policy framework can be refined by establishing the policy support platform.

The policy support platform can provide a variety of infra structural policy support programmes for the firms. For example, it can provide not only the information on markets, technologies, and IRPs but also the consulting services on laws, institutions, administration strategies, marketing, sales, etc.

In this paper, it is suggested that all the economic actors can participate in the policy support platform by providing the information and services as well as using them. Over the policy platform, not only the policy makers but also the policy users should be able to provide various policy support services. What is different from the other existing platforms is to guarantee monetary rewards for the provision of the information and services over the platform. This can enhance not only the qualities of the information and services but also the willingness to participate in the policy platform.

Here, it is noticeable that the policy support platform can induce the firms' a wide range of innovative activities coming from the interactions with other economic actors. The interactive policy platform can ensure the autonomous and creative participations of the economic actors in the policy system by making them determine which one is proper between the policy supply and demand side.

The other purpose of the policy support platform is to establish the infrastructure bases of industrial ecosystems.

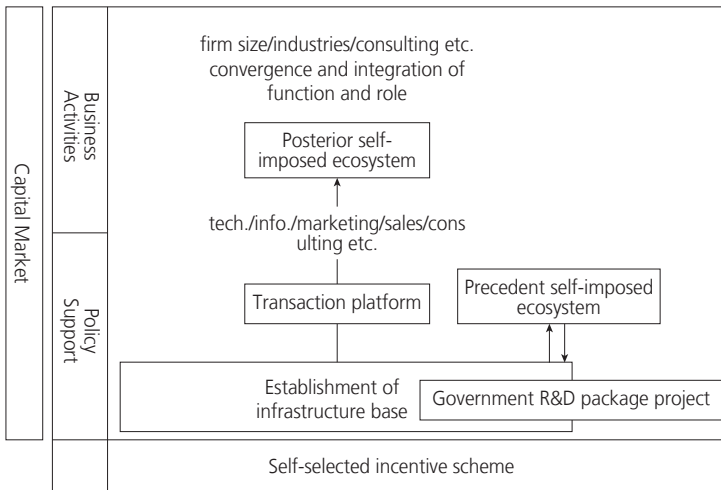
Before going further, it is noticeable that the strong point of industrial ecosystems is to promote innovative activities that can reflect new industrial development trends such as the NEI and FIR. Under an industrial ecosystem, the firm's management activities can be well organized for open innovation. In fact, the open innovation can promote industrial or firm level of development by encouraging the cooperation with external economic actors. The open innovation is proper for the technology convergence by promoting the

technology partnerships with external R&D actors, which becomes a new technology trend coming from especially the NEI and FIR.

As shown in Figure V-1, the framework for policy support platform can be established by creating two tracks of self-imposed ecosystems. One is a precedent self-imposed ecosystem that, from a policy perspective, can be suggested by the firms in the case of applying national programmes and projects, for example, the national R&D projects. The other is a posterior self-imposed ecosystem that can be created naturally as the result of strategic management activities by themselves.

In addition, Figure V-1 shows how the self-selective incentive scheme works in the policy support platform by providing a transaction platform where transactions can occur in dealing with technology, information, marketing, sales, consulting, etc.

Figure V-1. A Policy Framework for Policy Support Platform



Source: KIET(2017b).

(3) Innovation Strategy Reflecting Regulations

In some aspects, as mentioned earlier, regulations can give not only the limitation but also the promotion of industrial innovative activities. In the view of the promotion of innovation from the regulations, innovation policies need to be connected to a variety of regulatory policies. The regulatory policies include the efficient management on permissions and certifications, the facility subsidy support for regulatory compliance, financing support for regulatory response, support for self-regulatory system by the private sector, etc.

The innovation policies reflecting regulatory policy directions also need to reflect a variety of regulatory information on the policy support platform. Of course, the main function of the policy support platform is to offer various infra structural support services and programmes under industrial policy framework.

Over the regulatory policy support platform, opinions, information, Q&A, consulting on a variety of regulatory contents can be exchanged among the interest parties including consumers, firms, private organizations, and public institutes. On the policy supply side, in addition, the regulator can utilize the regulatory policy support platform by offering information on consumer benefit, risk management, regulation impact analysis, notable business success examples, etc. This can allow the enhancement of the efficiency of regulatory implementation and the confidence on regulatory policies.

Conclusion

In this paper, an integrated and comprehensive industrial policy framework is suggested by reflecting new industrial paradigm shift such as the NEI and FIR. The features of the NEI and FIR are presented in terms of policy direction, regulation, and innovation strategy. A main industrial policy implications from the new trends of industrial paradigm shift is the necessity of integrated policy framework. In addition, it is necessary to take an autonomous and creative bottom-up approach so as to ensure innovative industrial development and sustainable regulation.

First, in order to enforce efficient and effective regulation, it is important to promote the interactions between the regulator and regulated and encourage self-imposed regulatory system. And, in terms of the regulatory management, it is also important to utilize the strategic concept of the smart regulation. In enhancing the regulatory efficiency, furthermore, it is necessary to induce the regulated to participate actively in the establishment of a prior regulatory framework by allocating properly diversi-

fied roles and functions to the regulation-related interest parties.

Second, from the perspective of an efficient industrial policy, it is necessary to differentiate the policy strategies from the perspective of the policy supply and demand side. The policy strategies on the policy supply side (by normal classification) can be differentiated according to business scale, industry classification, business life cycle, R&D stages, etc. By comparison, the policy strategies on the policy demand side (new applicable classification) can be differentiated according to R&D intensity, the experience of national policy projects, etc. In view of policy implementation, the other important point is that this policy differentiation should be able to ensure the self-selection of the firms for diversified policy options.

Third, it is also important to take autonomous and creative bottom-up approach for efficient industrial policy framework by providing the policy support platform. The policy support platform should be able to guarantee autonomy from the private sector by allowing the transactions on the information, consulting, etc and encouraging the creation of prior and posterior self-imposed ecosystems. On the other hand, an innovative strategy reflecting the regulatory system also need to establish a policy support platform for a variety of regulatory compliance information.

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