

# Policy Recommendations for SMEs and a Venture-friendly Defense Industry Ecosystem in Korea<sup>1</sup>

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## 1. Introduction

The Moon Jae-In administration first promulgated a policy to support the Korean defense industry in the era of the Fourth Industrial Revolution (4IR) in its 2017 national agenda. In accordance with this, the Korea Defense Acquisition Program Administration (DAPA) announced 2018-2022 Defense Industry Development Master Plan in 2018 which features SME and venture-friendly policies.

The government's policy agenda aims for the establishment of the defense industry ecosystem that enhances both SMEs and venture firms' compatibility and lowers entry barriers for commercial companies with the capability to create 4IR technologies.

However it is difficult to say that industrial ecosystem of the Korean defense industry is healthy. According to the 2017 KIET survey, the production ratio of large defense firms is

almost 80 percent, compared to the 20 percent of SMEs'. This ratio is almost same as it was five years ago. It means that the Korean defense industry mainly relies on a small number of large defense firms that manufacture weapon systems.

If this kind of gap continues in the future, the Korean defense industry will become an unbalanced ecosystem overreliant on a handful of major contractors able to integrate their weapon systems with expensive imported subsystems and parts. To make matters worse, the government is not close to reaching its policy goal of nourishing defense SMEs and venture companies in the near future.

Using the results of the 2019 KIET survey, this paper studies issues in the defense industry through an analysis of the Korean defense industry ecosystem and provides some policy recommendations for building an SMEs and venture-friendly defense industry ecosystem in Korea.

<sup>1</sup> This article draws heavily on "Policy recommendations for SME and Venture-friendly defense industry ecosystem in Korea", *KIET Monthly Industry Economics*, March 2020.

## 2. Concept and Classification

### (1) Concept of the Defense Industry

#### Ecosystem

The concept of a biological ecosystem was first described in Tansley (1935). After Moore (1996) applied the concept to business for the first time, it evolved into a core theory explaining the compatibility of major industries, including IT businesses such as Google, Apple, Naver, YouTube and others.

It is used as a key theoretical basis not only to enhance individual companies' compatibility but also to develop and evolve to respond external environment changes through cooperation with the entire members of the industry ecosystem. The concept of the defense industry ecosystem can be understood as follows. It is defined as a system of co-development and co-evolution that responds to external environment changes via cooperation with all members of the ecosystem functioning as one economic community, including producers (large firms, systems integration [SI] firms), defense SMEs and

ventures (partners), consumers (governments, domestic and abroad) and related stakeholders.

### (2) Classification of the Defense Industry

#### Ecosystem

Members of the ecosystem are classified as thus. Subcontractors or suppliers (Class 1) provide materials, parts, components, subsystems, or software to SI companies. They mainly comprise SMEs and ventures in the defense industry. Leading companies (Class 2) provide systems to customers. They perform the main role of leading the defense industry ecosystem in the use of subcontractors and suppliers.

The government or customer (Class 3) is the end-user of final goods. The customer could be domestic or foreign. The final end user includes MND, DAPA, various forces and foreign governments.

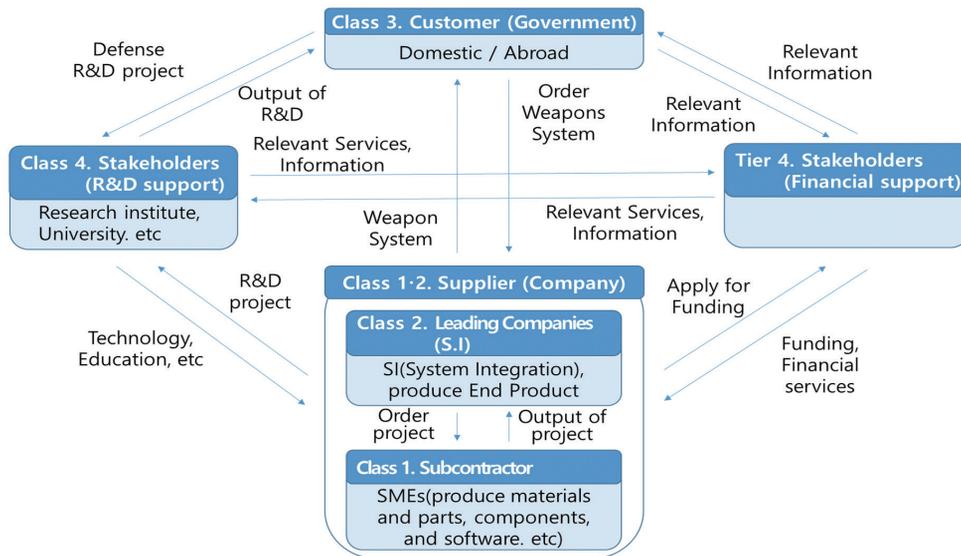
Finance and technical support firms (Class 4) support all the other firms in the industry ecosystem. Compared to a more typical industrial ecosystem, the government plays a major role as both a customer and a provider of infrastruc-

**Table 1. Classification of Defense Industry Ecosystem**

	Classification	Sector	Institution
Class 1	Subcontractor (Supplier 1)	Material/parts/components /subsystem/SW	Subcontractors
Class 2	S.I. (Supplier 2)	End items (weapon system)	S.I. (leading companies)
Class 3	Customer	Government (domestic and abroad)	Domestic agencies (MND, DAPA, other forces) Foreign governments
Class 4	Stakeholders	Infrastructure (Technology, Finance)	ADD, gov. institutes, univ. (Infra 1) policy fund, financial sector, KDIA (Infra 2)

Source: KIET (2019.12).

Figure 1. Conceptual Diagram of Defense Industry Ecosystem



Source: KIET (2019).

ture, technology and finance. A conceptual diagram is shown in Figure 1.

### 3. Structural Problems of the Defense Industry Ecosystem

#### (1) Analysis of Defense Industry Ecosystem Structure in Korea

After analyzing the status of all classes of firms in the Korean defense industry ecosystem, Class 1 firms were found to account for 96 percent of all firms in the ecosystem by number. Revenue at Class 1 firms represented just 31.5 percent of all defense industry revenue from 2015 to 2017. By average revenue per company, Class 1 firms made about 16.9 billion KRW on average. Class 2 firms on average made more than 46 times; the typical firm earned 784.3 billion KRW from

2015 to 2017.

In terms of employment, Class 1 firms employ almost half (49.8 percent) of all workers in the entire defense ecosystem. Sales revenue per capita at Class 1 firms is only 270 million KRW, less than half of that of Class 2, with over 570 million KRW worth of sales per capita.

By business profits, Class 1 firms posted three-year average margins of 4.4 to 5.8 percent. This performance beats Class 2 firms, which recorded average profit margins of around -1.0 to 3.6 percent over the same three-year period. Leading firms' profits have dropped continuously, from 3.6 percent in 2015 to 2.8 percent in 2016. They posted a loss of negative one percent in 2017. Concerning R&D intensity, Class 1 firms stood from 1.4 to 2 percent and Class 2 firms were between 3.4 and 5.2 percent.

There were 284 Class 1 firms and 13 Class 2

**Table 2. Performance of the Defense Industry Ecosystem**

Unit: number, 100 million KRW, persons, times

	Class 1 (A) (subcontractor)	Class 2 (B) (leading company)	Differences (A/B)
Number of companies**	284	13	20.4
Sales revenue**	49,273	91,264	0.54
Sales revenue per company**	169	7,843	0.02
Sales revenue per person**	2.7	5.7	0.47
Business profit ratio**	5.2	2.0	3.2 percent***
R&D intensity**	1.7	4.1	2.4 percent***

Source: KIET, KIET Defense Industry Statistics and Competiveness report, 2019.

Note: \* based on 295 companies (2015), 296 companies (2016), 300 companies (2017) with over 300 million KRW for sales revenue, \*\* based on recent three years (2015~17), \*\*\* A-B.

firms counted in 2015. Domestic sales accounted for 17.3 percent and 3.7 percent of revenue, respectively. Despite the profits to be made, there were nearly the same number of Class 1 and Class 2 firms in 2017. This suggests that the barriers to entry are prohibited new entrants from joining the defense industry ecosystem.

In summary, only 4 percent of companies in the Korean defense industry (Class 2 leading companies) account for 1.9 times more revenue than Class 1 subcontractors, despite those Class 1 subcontractors accounting for 96 percent of all firms and over half of all employees. Those firms rely on the characteristics of the systems integration industry and a large amount of weapon system acquisition programs. In terms of profits, Class 1 firms earn margins 3.2 percent higher than Class 2 firms. This is because the business environment for Class 2 has worsened due to government sanctions, delivery delays and excessive penalties, among other reasons.

The R&D intensity of Class 1 firms is only 1.7

percent, much lesser than the 4.1 percent intensity of Class 2 firms. This is due to the fact that there are a little of R&D incentives in the strict and closed defense acquisition system of Korea. It is necessary to incentivize R&D among Class 1 firms to stimulate R&D investment and pioneer overseas markets in the near future.

In summary, the domestic defense market has high entry barriers and it is prohibited from entering into excellent commercial SME and ventures. It is critical to improve these kinds of regulations.

## (2) Problems in the Korean Defense Industry Ecosystem

There are five main problem in the domestic defense industry ecosystem from the perspective of SMEs and venture firms. First, the Korean defense industry mainly relies on a handful leading companies and there is a lack of cooperation between those firms and SMEs. Main reasons for this include a shortage of cooperation incen-

tives (3.68) and the unfair distribution of performances (3.64). There is less merit even though they are willing to cooperate and exist but distrust each other due to the unfair distribution of co-performances. Moreover, decision-makers prefer to buy parts and components from advanced countries and buy a very limited variety of domestic items due to the defense production cost compensation policy in Korea.

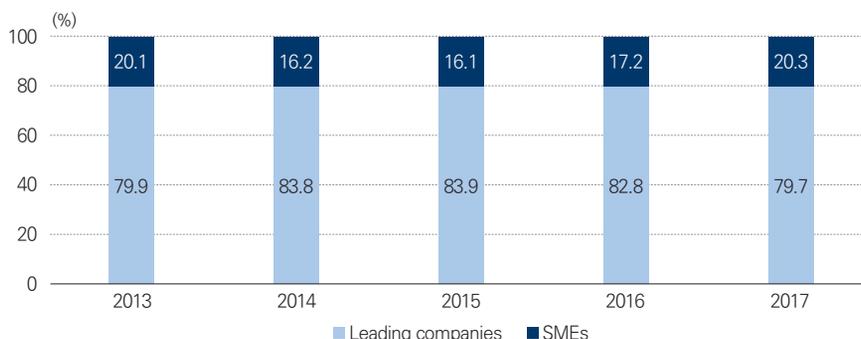
Second, the domestic defense industry has a structural problem. Only about 90 designated defense companies have produced both end-user items and their parts since the 1970s. This shows a lack of openness because the number of companies have remained constant over the last couple of years. In addition, the number of designated defense companies dropped to 91 in 2019. Therefore, it is quite difficult to enter into the defense market as SMEs or venture firms. Even in the case of the parts localization program, which is the sole window of entry into the industry, it is not easy to enter the market due to difficulties in getting

information of imported parts, including lists and blueprints, as well as a lack of supported testing and evaluation. There is also the possibility of incurring cost burdens from required certifications and so on.

Moreover, it is almost impossible to enter into the materials market. This is due to a lack of economic scale, few incentives for development and the difficulty of designating certain defense goods as high-end defense materials at all, including aluminum and ceramics. Therefore, most key materials for defense weapon systems have to be imported from abroad.

Third, from the standpoint of innovation, there is no acquisition system for SMEs and venture firms to deliver high tech products and advanced technologies to armed forces. Nor are there any fast track acquisition systems to upgrade current weapon systems with the use of AI, IoT or other 4IR technologies. The U.S. DoD recently prepared a fast track acquisition system to upgrade weapon systems for the use of the Defense Innovation Unit (DIU) and Air Force

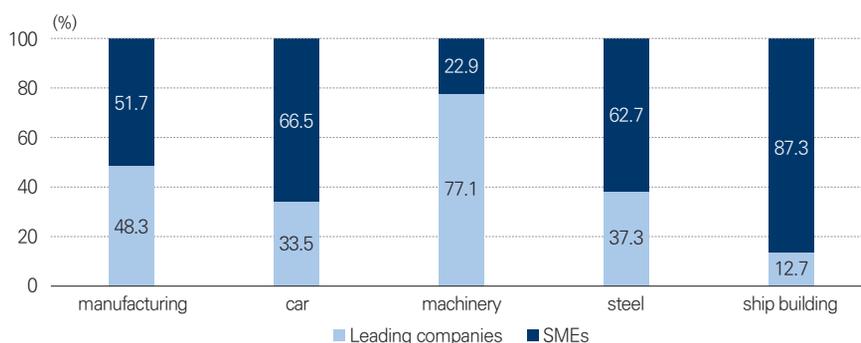
**Figure 2. Defense Industry Production Ratio**



Source: KIET, Defense Industry Stats, 2018.

Note: based on 300 companies with over 3 million KRW in defense sales revenue.

**Figure 3. Major Manufacturing Industry Production Ratio**



Source: KIET, Defense Industry Stats, 2018.

Pitch Day, and others.

Fourth, in terms of completeness, it is hard to narrow the productivity gap between leading companies and SMEs in the domestic defense market. The sales revenue of defense SMEs account for just less than 20 percent of sectoral

sales, a big difference compared to other relevant industries. Sales revenue ratio of SMEs are over 66.5 percent in car manufacturing, 62.7 percent in steel, and 87.3 percent in ship building. In the manufacturing sector as a whole, it is 51.7 percent.

**Table 3. Summary of Problems in the Domestic Defense Industry Ecosystem**

Characteristics	Problems	Contents
Cooperation	· Lack of cooperation between large firms and SMEs	· Shortage of cooperation incentives (3.68) and unfair distribution of performances (3.64). · Preference for imported parts and components from advanced countries · Lack of domestic purchasing due to defense production cost compensation policy in Korea
Openness	· Difficulties for SMEs and ventures entering defense market	· About 90 designated defense companies have to produce both end items and its parts · Not easy to enter market due to difficulties in getting imported parts lists and blueprints, a lack of testing and evaluation support and the possibility of certifications incurring cost burdens
Innovation	· Necessity of innovation capability	· Lack of acquisition system allowing SMEs and ventures to deliver high tech products and advanced technologies to armed forces · No fast track acquisition systems to upgrade current weapons system with the use of AI, IoT
Completeness	· Significant gap between large firms and SMEs production	· Hard to narrow productivity gap between leading companies and SMEs in domestic defense market · Sales revenue of defense SMEs account for less than 20 percent of all sales in industry; major difference compared to SMEs in similar industries
Diversity	· Lack of diversity both main entities and financial support	· The defense R&D program is based on ADD; some leading companies make it difficult for SMEs to apply SME high tech capabilities. · Financial support is restricted to government defense budget. Hindering SMEs burdens defense industry by limiting diversity.

Source: KIET (2019).

Finally, the diversity of main entities including SMEs and ventures in the defense industry ecosystem is also insufficient. The defense R&D program is based on ADD, and some leading companies make it difficult to apply SME’s high-tech capabilities. Also, the source of financial support is restricted to only government defense budgets.

#### 4. Results of Survey of the Domestic Defense Industry Ecosystem

##### (1) Outline

A survey on the domestic defense industry ecosystem was conducted in five areas: interdependence, openness, innovation, completeness, and

diversity, which are characteristics of the industrial ecosystem. The total number of respondents was 175, with 100 experts from government, industry, academia, research and the military, and representatives of 75 defense companies (principally SMEs and venture companies).

##### (2) Results Analysis

The results of the survey showed that overall, interdependence, openness, integrity, and diversity in the domestic defense industry ecosystem were at a low level. Mutual cooperation scored 2.67 out of 5 points, below the average 3.

In terms of openness, the ability of superior private companies to enter the defense sector scored just 2.51 out of 5 points, and 32.4

**Table 4. Survey Items and Overview**

Survey topic		Content	Method of analysis
Survey defense industry ecosystem conditions (33)	Interdependence (2)	· The level of cooperation between large and small businesses and reasons for poor performance	Items ranked first and second selected
	Openness (8)	· Ability of excellent private companies to enter the defense sector, policies for expanding entry, effectiveness of defense venture support policy, policy to enhance effectiveness	Five-point scale, Items ranked first and second selected
	Innovation (6)	· Necessity of establishing a defense core component development project (tentative)	Five-point scale, Items ranked first and second selected, Short answer
	Completeness (7)	· Effectiveness of government’s (Radiation Agency) policy to enhance the capabilities of technological development at small and medium enterprises, policies to enhance its effectiveness, factors that hinder the revitalization of small and medium venture businesses	Five-point scale, Items ranked first and second selected, Short answer
	Diversity (5)	· Reasons necessitating the creation of a fund for defense SMEs, including measures to expand the diversity of innovation entities, measures to expand the diversity of funding sources	Five-point scale, Items ranked first and second selected
	Overall rating (5)	· Policy priorities for fostering small and medium-sized venture companies · Priorities by class for creating a healthy defense ecosystem · Comprehensive assessment (difficulties, suggestions, etc.)	Short answer/essay

Source: KIET (2019).

percent of respondents said that in order to encourage defense start-ups, it is necessary to transfer the ownership of defense technology to research management departments. In order to expand openness, it is necessary to review a plan to establish a core component development business team at the level of weapons systems development (IPT) within DAPA.

In terms of innovation, the need for Fast PIP projects (tentative) that can enable rapid per-

formance improvements by applying new 4IR technologies to existing weapons systems scored highly, at 4.02 points.

In terms of completeness, the need for a full-scale expansion of parts and materials localization efforts was ranked the highest in order to expand sales of SMEs. To increase the defense export of SMEs the need for G to G and offset trade was the highest.

In terms of diversity, 27.7 percent of respon-

**Table 5. Key Findings of Survey of the Domestic Defense Industry Ecosystem**

Survey topic	Subject measured	Score
Interdependence	Level of mutual cooperation	2.67 (Out of 5, same below)
Openness	Ability of superior private companies to enter the defense industry	2.51
	Policies to support start-ups	Transferring ownership of defense technology to the research managing department 32.4 percent
Innovation	Necessity of establishing a defense core component development project (tentative) etc.	4.02
	Necessity of establishing Fast PIP (tentative)	4.02
Completeness	Policies to expand SME sales	Dedication to localizing parts and materials business 24.9 percent
	Policies to grow exports of SMEs	Expand delivery opportunities to global defense companies (GtoG, trade-offs, etc.) 23.5 percent
Diversity	Expand the diversity of funding sources	Allocating budget related to defense technology development to relevant government departments 27.7 percent
	The need for a defense SME fund	3.59

Source: KIET (2019).

dents answered that it is necessary to allocate funding to defense technology development to technology-related government department in terms of expanding the diversity of sources of funds. In addition, the need for a defense SMEs fund scored relatively high, at 3.6 points.

## 5. Policy Tasks for Fostering an SMEs and Ventures-friendly Defense Industry Ecosystem

### (1) Strengthening Mutual Cooperation

#### 1) Activating Mutual Cooperation Between Large and Small Companies

In order to strengthen mutual collaboration in the domestic defense industry, it is necessary to revitalize cooperative endeavors between large enterprises and SMEs. To achieve this, obstacles preventing cooperation need to be removed.

According to the results of the survey, the level of cooperation between leading companies (SI) and participating companies (SMEs) scored less than 3 points in all nine survey items. The main reasons are a lack of incentives for mutual cooperation, the unfair distribution of performance, preferential purchases of parts from advanced countries and mutual reliability.

As a solution to this problem, it is necessary to expand the development of finished products by purchasing parts and components developed by SMEs. And like the mentor-protégé program in the U.S., various incentives need to be ac-

tively reviewed.

In addition, the government needs to actively review the development of first-line parts and introduce a post-system development project implementation system, in which key components are developed and applied to non-critical weapons systems.

#### 2) Guaranteed Participation of SMEs When Purchasing Weapons Abroad

One measure to strengthen mutual cooperation between the government and SMEs is to ensure the participation of domestic companies including SMEs when purchasing weapons abroad. In the case of weapon systems that are not critical to national security, it is necessary to improve the system so that directly introducing foreign systems is last resort.

It is necessary to change the existing approval preferences of the Defense Research Institute (KIDA) and the Defense Agency for Technology and Quality (DTaQ) as follows. Firstly, independent domestic development should be most highly preferred. Then, the priority of preferences is following: joint development and production, technology cooperative production, guaranteed participation of domestic companies for major components and parts (utilizing trade-offs), securing other service capabilities (FACO, etc.) and finally, the direct introduction of weapons.

By benchmarking cases of developed countries, for noncritical weapons system, it is nec-

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essary to establish a system that allows domestic companies (mainly SMEs) to participate in a certain percentage of the total weapon import cost.

## (2) Expanding Openness

### 1) Eliminating Entry Barriers for Excellent Private SMEs and Venture Companies

In order to encourage the entry of excellent private SMEs into the defense sector, it is necessary to promote the establishment of the a Korean Defense Innovation Center (K-DIU), benchmarking the U.S. Defense Innovation Center (DIU). It is necessary to establish an organization within the DAPA can serve as a bridge between the private sector and the military. The facility should be located in high-tech industrial complex such as Pangyo and Daejeon to identify and commercialize high-tech technologies with applications for defense.

In addition, the existing defense product designation system needs to be re-organized to fit in the reality. It is necessary to limit benefits received by designated defense companies that have not innovated for several years or produce products that are significantly inferior to domestic and foreign substitutes. On the other hand, when companies with advanced technology realize remarkable performance improvements or smartization of weapon systems, appropriate incentives need to be given.

### 2) Transfer of Defense Intellectual Property Rights to the Research and Development Supervision Institution

For the past 10 years, there has been a demand for research organizations (including those at private firms) to take ownership of defense technology, but the technology ripple effects stemming from the recognition of joint ownership is still insignificant. It is necessary to consider revisions of the joint ownership rights of defense technology to research institutions including enterprises, granting exclusive licenses to enterprises, or introducing American-style measures (Government: Unlimited Right, Enterprise: Recognition of Ownership).

In addition, it is necessary to review various grant methods, such as holding the government's limited license (with the right to license for a certain period only) based on the share of government-company joint investment, and recognition of intellectual property rights, including SMEs, upon successful technology development.

## (3) Enhancing Innovation

### 1) Establishing a Defense Core Components Development Project for SMEs

The Korean defense industry exhibits a typical structural problem: the import share of core weapon systems components is very high, as large corporations focus on integrated systems

(SI). This structure hinders securing combat capability in case of an emergency, and has limitations such as high purchase costs, supply bottlenecks, high repair costs, limitations in maintenance, and the need for export approval (E/L) in exporting finished products.

The results of the survey emphasized the necessity of establishing a new Defense Core Components Development Project that develops core components applicable to weapon systems. This project could become even more critical depending on factors such as a need for localization of parts owing to reinforcement of Japanese export regulations, the need to improve SME capabilities through core component development projects and continuing trends in increasing defense budgets. To do this, it is necessary to prepare relevant laws and actively review the plan to establish a core component development business team at the same level of the weapons systems development business team within DAPA. In order to expand openness in the future, it is also necessary to actively consider establishing a core component development project team at the level of the IPT within DAPA. Through this, it is necessary to identify and manage key parts that are essential for power enhancement and can be used universally (commonality) in the weapons systems development business.

## 2) Establishing a “Fast PIP” Project

In the case of weapon systems that are expect-

ed to require rapid performance improvement from new development projects, it is necessary to include a clause in the business plan stating that, after a certain period of power conversion, the performance improvement business will be performed through evaluation.

Secondly, it is necessary to expand the current export re-modeling and development project. It is necessary to expand the scope of the project, which was newly established to expand the export of weapon systems in 2014, to include not only export purposes but also domestic demand for performance improvement, and to expand the scope of budget and performance improvement.

Finally, it is necessary to consider the introduction of the plan (as Israel has done) to implement a new development project and a separate performance improvement project through the establishment of separate Fast PIP project. For this, it is expected that a considerable time will be required due to the need for revision of related laws, preparation of promotion procedures, and establishment of budget items.

## (4) Enhancing Completeness

### 1) Expanding Sales and Exports of SMEs and Venture Companies

Firstly, the system needs to be reorganized so that the participation of defense SMEs can be expanded through the offset(industrial cooperation) mechanism. In connection with

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the preliminary value accumulation system and the domestic parts quota system currently being introduced by DAPA, it is necessary to hold a briefing session on the fulfillment of compulsory trade obligations with major countries, and to expand linkages with promising domestic export SMEs. In addition, it is necessary to revise the value multiplier system, from 3 to 5-10 times. It is necessary to widen the scope of recognition of trade to be able to significantly expand the criteria for recognizing trade in line with reality, and allow trade to support domestic SMEs trying to enter global value chains (GVC). In addition, DAPA needs more detailed policy support, such as granting additional points when forming a consortium of large-SMEs, pre-selecting excellent defense SMEs, and including an offset priority list of excellent products in order to expand the trade of SMEs.

Secondly, it is necessary to change the government-to-government (G to G) contracting method, from the passive to active method. In the case of G to G transactions, it is necessary to select promising SMEs in advance through the implementation capability evaluation procedure.

Thirdly, it is necessary to establish a system capable of supplying the military with technology developed by domestic venture firms in the defense sector. It will be necessary to focus on securing additional funding for support from local governments, expanding the labor force, preparing a rapid acquisition system, and expanding the commercialization of development

results in connection with the Defense Innovation Center (K-DIU).

## (5) Expanding Diversity

### 1) Expanding the Diversity of Financing

It is also necessary to diversify the defense R&D system that relies only on the government budget. Firstly, similar to the United States, it is necessary to allocate the budget related to common civil and military technology development to government technology agencies, and to consider how to develop and use those technologies that have both military and civilian purposes.

Secondly, in order to strengthen civil-military technical cooperation, it is necessary to expand the cooperation budget of related ministries. To this end, it is necessary to discover areas where civil-military cooperation is possible, such as aviation and satellites, from the initial stage of the project, and also expand the budget of the Ministry-Linked Cooperation Technology Development Project.

Thirdly, it is necessary to actively introduce a development method that considers exports from the initial planning stage so that large defense companies can participate in their own weapon development projects. It is necessary to shift the current development method, which relies solely government funding through incentive guarantees.

Finally, it is desirable to expand joint development with allies when developing weapon

systems. In the case of large-scale weapon system development projects, it is also necessary to mandate a review of the international joint development method with allies for projects of a certain size (for example, more than one trillion KRW) from the required planning stage.

## 2) Raising a Defense SMEs Fund

In order to strengthen the foundation for the continued growth of defense SMEs, it is necessary to establish a defense fund for defense SMEs. To this end, referring to the case of the Yozma Fund in Israel, it will be necessary to establish a foundation, which may include fostering venture capital and actively attracting foreign capital in the early stages of its creation.

In addition, in order to foster small and medium-sized venture companies in high-val-

ue-added and high-tech fields such as cybersecurity, IT and fields with policy priorities, government support in the initial stages of startup is required by companies.

## 3) Organizing a New Defense Startup Accelerator

In order to strengthen linkages between the private sector and the military and foster private sector growth in the defense market, it is necessary to establish a Defense Startup Accelerator by benchmarking Israel.

Through the establishment of the such a system, it is necessary to provide business development, market information, legal advice and networking services to high-performing SMEs. In addition, it is necessary to strengthen cooperation through the intermediary function between the DAPA, ADD, and DTaQ-SMEs.

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