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Defense Innovation and Industrialization in South Korea

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Summary

South Korea's defense industrial transformation has been impressive by any standard. It was able to satisfy most of its basic weapons needs within a decade after launching its defense industry. Since the late 1990s, South Korea has been elevated from a third-tier arms producer to the second tier by moving from the stage of imitation and assembly to that of creative imitation and indigenization. It now competes with major arms-supplying countries. In addition, the South Korean defense industry has made remarkable progress in RMA-related areas mostly involving command, control, communication, intelligence, reconnaissance, and surveillance. In this policy brief, we first assess South Korea's defense industrial performance by examining the patterns of defense acquisition, rate of localization of defense materiel, and defense exports. We then briefly analyze the evolutionary dynamics of defense industrial upgrades in selected sectors by tracing the stages of innovation. We also delineate a set of institutional and policy arrangements that have contributed to this impressive transformation.

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ASSESSING SOUTH KOREA'S DEFENSE INDUSTRIAL PERFORMANCE

As late as 1968, South Korea was wholly dependent on the United States for the supply of military equipment, from ammunition to basic weapons. Economic and technological backwardness, coupled with U.S. security protection and extensive military assistance, prevented South Korea from seeking any meaningful defense industrialization. A turning point came in the late 1960s, when the United States weakened its security commitment to South Korea. The government of President Park Chung-hee responded by actively pursuing "self-reliant national defense" in which defense industrialization constituted the core.

Procurement Patterns

A list of defense materiel procured through domestic production during the 1970s and 1980s includes small arms, short-range artillery pieces, ammunition, rudimentary communication equipment, Hughes 500MD helicopters, F-5 E/F fighters, small-scale naval vessels, short-and medium-range missiles, and armored vehicles. In the acquisitions mandated by the Defense Reform 2020 plan, emphasis has been placed on improvement of the individual and joint C4ISR capabilities of the armed services. RMA considerations also have become a key factor in determining procurement needs. Defense assets related to sensor, C4ISR, shooters, and networks have increasingly drawn attention from defense planners. South Korea anticipates that by 2020, the year when its defense reform is completed, it will have achieved a considerable level of self-sufficient intelligence collection capabilities, the construction of real time, synchronized networks among all the units involving battle sensor, command/control, and force operation, acquisition of strike forces aimed at strategic targets such as weapons of mass destruction, and overall improvement of combat forces by replacing aging weapons and equipment.

An important trend in procurement patterns since 1999 is that South Korea has been placing an emphasis on the acquisition through domestic

R&D. This can be attributed to not only an assertive government policy that encourages domestic procurement of RMA-related assets, but also to improved industrial capabilities in the areas of information technology, heavy machinery and shipbuilding, mobile vehicles, and aerospace technology.

Rate of Localization

Another important indicator of defense industrial performance is the rate of localization of parts and components. Certain systems reveal a relatively high level of localization, with rates exceeding 80 percent. Aircraft show a lower rate of localization, in which KT-1 (basic training aircraft) and T-50 (advanced training aircraft) accounted for 44 percent and 61 percent in 2007 respectively. Nevertheless, the overall localization rate has been on the rise, implying that domestic supply of parts and components for defense articles has become more active than ever before.

Exports of Defense Industrial Products

In the past South Korea exported military uniforms, ammunition, and small arms, but the composition of its defense exports has changed radically since the late 1990s. ROK military exports rose from \$147 million in 1998 to \$253 million in 2006 and to \$1.03 billion in 2008. In cumulative terms during 2001–2008, exports of military aircraft and related services have accounted for about 32.1 percent of total military exports, followed by ammunition (22.3 percent), off-set based exports (18.3 percent), and artillery and maneuver equipment (18 percent). The \$330 million export contract for technological cooperation on tank development signed with Turkey in 2008 is particularly significant, as it was an export of source technology instead of weapons systems.

South Korea has shown two noticeable trends: 1) export of big-ticket items such as aircraft and naval vessels; and 2) a trend toward Koreanization of defense articles. Having experienced enormous pressure from the United States in terms of third-country arms sales regulation in the 1980s and 1990s, South Korea has been more actively deliberating on the production of defense articles through domestic R&D.

UPGRADING SOUTH KOREA'S DEFENSE INDUSTRY: FROM IMITATION TO INDIGENIZATION

The defense industry usually goes through several stages of industrial upgrades starting from simple assembly, to imitation through reverse engineering, licensed production, creative imitation, and innovation and development and production of indigenous weapons. Our examination of defense industrial upgrades reveals that South Korea increasingly favors defense acquisition through domestic R&D. Such acquisition patterns have proven to be conducive to enhancing technological innovation related to the defense industry. Four examples show the range of stages undergone in the upgrade of South Korea's defense industry.

Maneuver/Firepower: South Korea's force structure reveals the dominance of ground forces; therefore, great emphasis has been placed on the improvement of maneuver equipment and firepower. As with other latecomers, South Korea followed a classic path of defense industrialization in this arena. In the 1970s, South Korea simply assembled imported parts and components, but starting in the late 1980s, it began to develop Korean models. Since the 1990s, indigenization efforts have become further intensified through performance improvement of Korean models, and consequently, South Korea has successfully developed its own models. The performance of these weapons compares favorably with those made in first-tier arms producing countries, but they still depend on overseas sources for development of core components, such as engines, transmissions, and active protection systems.

South Korea lacks core technology for thermal imaging sensors, laser detection sensors, navigation devices, and signal processing, which are essential for future weapons systems. It should also be pointed out that given its limited structural design technologies, it seems necessary for South Korea to benchmark the core technologies of advanced countries. Nevertheless, South Korea has an ambitious plan to produce major maneuver and firepower weapons through domestic R&D. Overall economic conditions and levels of technological sophistication have been conducive to implementing such plans.

Aircraft: South Korea began to assemble the 500 MD with technical support from Hughes in the 1970s, which was followed by co-production of F-5 E/F during 1982–1985. Starting in 2002, South Korea also began to engage in the licensed production of F-16s. Meanwhile, it successfully developed the K-1 trainer through domestic R&D in the late 1990s. The T-50 advanced trainer was also produced through domestic R&D, with technical support from Lockheed Martin.

At present, South Korea is estimated to remain at 60–70 percent of major countries in the plane design/test technologies and 30–50 percent in the core parts/materiel design and production technologies. The rate of localization for plane engines stands at a mere 30 percent.

South Korea still remains at a rudimentary level in core technologies, such as aviation electronics, flight/armament controls, stealth/composite materials, rotor design, and certification technology related to aviation. It could accumulate the relevant technologies by engaging in licensed production. However, licensed production or international joint R&D is likely to result in greater technological dependence on more advanced partner countries. It is not easy to secure core aviation technologies through these methods.

Command/Control/Communications (3C): At present, South Korea remains at the intermediate level for command/control technology, while it has reached the advanced level for tactical communications technology. Looking at the country's level of command/control technology, which forms the core of network-centric warfare, the country is equipped with only the basic capabilities through the operation of the Korea Joint Command & Control System (KJCCS) and most of the weapons systems in this area are developed domestically. South Korea's comparative advantage in information technology has been conducive to indigenous development of 3Cs.

Nevertheless, South Korea still depends heavily on foreign technologies in core areas such as decision support systems and linkage and security technologies. It also falls well behind advanced countries in most command/control systems. However, South Korea has shown impressive progress in its level of tactical communications technology,

as evidenced by its development of a tactical information communications network, owing to its advanced commercial information technology and experience accumulated through the development of the Spider Project.

Surveillance/Reconnaissance: Having relied heavily on U.S. assets, South Korea did not pay attention to this area until recently and has depended on foreign technological sources for payloads and launch vehicles, which are the core components of satellite technology. Its technological level for surveillance/reconnaissance sensory systems seems a little higher than that for satellites, but foreign dependence on core components and system integration technology still remains high. In connection with the scheduled return of wartime operational control from the United States to South Korea in 2015 and the implementation of Defense Reform 2020, South Korea is making concentrated investments in this area through domestic R&D projects. Programs for the development of satellites that can be used for both commercial and military purposes will soon be launched, in concert with joint R&D efforts for application of space science and technology for defense purposes.

INSTITUTIONAL ARRANGEMENTS FOR DEFENSE INNOVATION

Satisfaction of basic weapons needs in a relatively short time span, swift transition to cutting-edge defense industrial items, an increase in defense exports, and most important, constant industrial and technological upgrades through innovation underscore the success story of the South Korean defense industry. The institutional arrangements that have facilitated industrial and technological innovation include the following:

Embeddedness in the commercial sector: Three models of organization were suggested when defense industrialization was initiated in the early 1970s. In the first, benchmarked on China, Israel, and Taiwan, the state is in charge of concept design, prototype development, and manufacturing. The second is the American model, in which a group of specialized defense contractors separat-

ed from the commercial-industrial sector handles the defense industry. The military-industrial complex is a classical example in this regard. The third model, the Japanese model, is based on the commercial industrial complex with greater spin-on effects for the defense sector.

South Korea opted for the Japanese model, selecting and assigning a relatively small number of big business conglomerates (chaebols) to engage in strategic industrial sectors (steel, automobile, ship-building, electronics, special metallurgy) with greater forward and backward linkages with the defense industrial sectors. These chaebols were in turn forced to undertake civil–military dual production. In the 1970s, these firms were by law required to allocate 70 percent of their production capacity for defense, and the remaining 30 percent for commercial production. As demands from the military sector declined throughout the 1980s, they were allowed to adjust the commercial–military production mix in a more flexible manner.

Dependence on big business conglomerates still continues. In 2008, the top 10 defense contractors' sales stood at a total of 5,375.9 billion won or 74 percent of their total sales. Of the top ten defense contractors, nine are subsidiaries of chaebols. Despite risks of economic concentration and monopoly, the institutional arrangement that embedded defense industrial production in the commercial–industrial sector, especially around chaebols, turned out to be rewarding by reducing sunk costs, assuring a flexible production base, and facilitating technological innovation through the synergy of civil and military technologies.

Linking spin-off and spin-on: Although defense production was embedded in the commercial and industrial sectors, synergy effects from both sectors were insignificant. It was only after the introduction of laws concerning the promotion of civil–military dual use in 1999 that more systematic attention was given to the promotion of dual-use technology. The law stipulated that the ministries of national defense, science and technology, industry, resources, and energy, and information and telecommunications form a consortium to undertake joint projects. Although the government invested a total of 260 billion won in 100 projects,

only 25 projects were successful. Though limited, the idea of spin-off is working. Between 1995 and 2008, the military transferred 102 defense technologies to 160 commercial firms.

The Lee Myung-bak government has been more actively pursuing the promotion of dual-use technology by amending the law on the promotion of dual-use technology in 2009 to one that emphasizes the enhancement of civil–military cooperation. At the same time, spin-on efforts have become further strengthened. As part of the Advanced Concept Technology Demonstration (ACTD), the Defense Acquisition Program Administration (DAPA) and the Joint Chiefs of Staff (JCS) invested 1.56 billion won in three projects. DAPA is planning to spend 10 billion won for eight projects, concentrating on portable tactical computers, an unmanned mine destroying vehicle, and a portable unmanned aircraft control system.

Ensuring competition: One of the most complicated institutional arrangements regarding South Korea’s defense industry is industrial organization. Competition is necessary in order to reduce costs and to prevent monopolies and oligopolies, but mandating competition by law could easily lead to excessive competition, duplication, and overlapping facility investment.

Since the early 1980s, South Korea has utilized four policies to promote the defense industry:

1. *The designation of defense materials and defense contractors by law.* A firm designated as a defense contractor is entitled to several benefits such as no-compete bidding and free contracts, mandatory purchases by the government, and guarantees of minimal prime production costs.
2. *Monopoly or oligopoly positions for defense contractors through specialization and departmentalization.* Once firms are designed as “specialized” in the production of a complete weapons system or as “departmentalized” in the manufacturing of a weapons system parts and components, they are given special privileges in terms of access to domestic R&D production and/or licensed production.
3. *Guarantee of production costs by the government.*

4. *Preferential financing through the Fund for the Promotion of the Defense Industry.*

Although these policies facilitate the promotion of the defense industry, their negative repercussions have also been pronounced. The system of specialization and departmentalization has severely undercut competition, and their provisions were responsible for rent creation and moral hazard.

The Lee Myung-bak government has eliminated the system of specialization and departmentalization, and several alternatives are currently being sought regarding contract systems and prime production costs. Competition will be a buzzword for reforming the defense industrial sector in the future.

Streamlining R&D investment and related activities: South Korea’s defense R&D has increased in both absolute amount and relative share of the defense budget. Compared with the past, recent defense R&D expenditures have become much more focused, as evidenced by concentrated investment in technological development designed to secure source/core technologies, reinforcement of cooperation between the private sector and the military, and expansion of civilian participation in defense R&D. Basic research to secure sophisticated basic/source technologies is divided into projects for individual basic research, projects for specialized research centers, and projects for introducing new technologies through international cooperation. Projects for individual basic research are designed for research of basic items by outside institutions, such as universities and research institutes. Projects for specialized research centers are carried out on the basic items required to set the foundation for defense science and technology.

Core technology projects develop technologies that other countries refuse to transfer and that must be secured. In the defense R&D budget, the portion for core technologies rose sharply from 5.6 percent in 2005 to 10 percent in 2009 and will be increased to 12 percent by 2012 and 20 percent by 2020. In systems development, the development of general weapons systems has been shared by the Agency for Defense Development (ADD) and defense contractors, whereas ADD puts priority

on the development of strategic weapons systems. R&D expenditure slated for general weapons systems is gradually being transferred from the ADD to private firms.

The private sector has also been increasing its defense R&D investment from 132.2 billion won (2005), 239.9 billion won (2006), 326.5 billion won (2007), to 410.7 billion won (2008). Leading defense contractors' R&D investment/sales ratio rose remarkably, as revealed by Samsung Thales (16.9 percent), LIG Nex1 (10.6 percent), Hanwha (6.4 percent), and Samsung Techwin (4.3 percent). This seems a positive development that departs from excessive dependence on the government, especially ADD, for defense R&D.

Another interesting development is a reallocation of R&D funds to foster cooperation among industry, academia, and research institutions. R&D funds slated for the industrial academic and research institutions in 2005 was a meager 1 billion won, accounting for 2 percent of the core technology development budget, but the figure has since risen to 56.7 billion won, or 35.2 percent. Along with this, ADD's monopolistic position is being eroded with the establishment of more specialized research centers.

“Buy Korean” policy: Finally, procurement policy favoring domestic defense materiel, as opposed to foreign acquisition, has played an important role in boosting the ROK defense industry. The ratio of domestic to foreign procurement throughout the 1970s was 54 percent (domestic) versus 46 percent (foreign). In the 1990s, the figure changed to 77.5 percent (domestic) versus 22.5 percent (foreign). This trend continued between 2000 and 2007.

RECOMMENDATIONS

Despite mixed assessments, the South Korean defense industry has demonstrated outstanding performance that can be attributed to a combination of the orchestrating role of the government; maximum utilization of the private sector, especially big business; early attention to spin-on and spin-up effects; efforts to ensure competition; effective defense R&D policy; and a wide range of incentives given to defense contractors. However, the con-

tinuing success of South Korea's defense industry cannot be guaranteed. Technological uncertainty, constant trial and error, and built-in vested interests can easily undercut its past achievements.

In order to ensure sustained defense industrial development, South Korea needs to pay attention to the following four issues:

1. *Extend greater efforts to ensuring competition while reducing production costs.* Defense contractors' monopoly and/or oligopoly positions can be harmful to the efficient operation of the defense industrial sector.
2. *Overhaul defense R&D.* Although South Korea has made new efforts to streamline defense R&D, it is far short of enhancing industrial and technological upgrading. South Korea should increase the size of the defense R&D budget, and its allocation should be guided by open competition. Offset arrangements also need to be activated in such a way as to facilitate the transfer of advanced technology to South Korea.
3. *Realign the business environment for defense contractors.* Small- and medium-sized defense industrial firms should be systematically nurtured in order to cope with bottlenecks in the supply of parts and components. Further localization of parts and components should be carried out.
4. *Consider introducing a nation-wide defense technology innovation system.*

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