POLICY SUGGESTION FOR KOREAN DEFENSE GRI - BASED ON COMPARISON WITH ISRAEL, FRANCE AND UK

By

HWANG, Sooyoon

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

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Committee in charge:

Professor Ju-Ho LEE, Supervisor

Professor Changyong CHOI

Professor Taejun LEE

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Abstract

Policy Suggestion for Korean defense GRI

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The purpose of this study is to review the transformation trend of other advanced nations' defense GRIs cases and find some implications that can be applied to the Republic of Korea ("ROK") defense Government Research Institutes ("GRIs"). In order to prepare for future warfare and military tension with military powers and North Korea, the ROK should secure its own core and strategic technology through efficient defense Research and Development ("R&D) policy. Through case study and comparison study between Korea and three advanced nations (France, the UK and Israel), this paper suggests 3 main implications. First of all, a special defense GRI which is in charge of core and strategic defense R&D is required. Secondly, the ROK defense industry should develop their own defense R&D capacity and lead practical R&D for weapon system projects. Government and GRI support are essential to strengthening Korean defense industries' competitiveness. Thirdly, entire governance reform is required for ultimate change. To deal with the current ROK defense R&D issues and conduct consistent defense R&D procedure, some parts of three GRIs(DAPA, ADD and DTAQ) should be merged or relocated under MOD.

Key words: defense R&D policy, defense GRI, defense R&D governance reform

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Chapter 1: Introduction

1.1 Background of Study

Korea is the only divided nation in the world and under an armistice and it should come as no surprise if a war were to break out in this peninsular anytime. The ROK has continuously faced severe threats from North Korea and the threats became more intensified with the 5th nuclear test and long ranged missile launching after Kim Jung-un came into power. Furthermore, traditionally South Korea has experienced severe geopolitical tensions because the nation is surrounded by military powers such as China, Japan, Russia and U.S. An arms race in Northeast Asia region has become severe and uncertainty in world security also becomes intensified due to worldwide nuclear proliferation as well. In this environment, South Korea had to deal with asymmetric threats that come from geopolitical tensions and North Korea. Therefore, naturally South Korea has been required to enhance asymmetric weapon system R&D capacity that specialized for its main adversary. In this context, R&D for weapon systems is very essential for the ROK's national survival. However, South Korea's defense R&D policy has not changed dramatically from past and still Korea's defense R&D is conducted in closed and conservative ways compared to other nations. To deal with urgent pace of change from external environment, South Korea need a new and innovative policy for defense R&D procedure and governance reform.

1.2 Purpose of Study

Basically this research intends to recognize the issues in the current defense GRIs and suggest new policies to improve defense GRI in a more efficient way. The next chapter will introduce an overview of Korean Defense GRI status and point out some issues that should be resolved to

improve the R&D capacity for the national defense. After that, this paper will introduces some advanced nations' defense GRI transformation cases and compare those GRIs with the ROK defense GRI. This paper seeks to define the ROK defense GRI as 3 government organizations (ADD, DAPA, DTAQ) even though DAPA is the independent administration because many other foreign nations' GRIs has same authority as DAPA. In 4th chapter, comparison study will be conducted based on case study in Chapter 3. In conclusion, this paper will introduce result of the comparison study and suggest for Korea's new defense R&D governance policy.

In order to improve South Korea's defense R&D policy, this paper will insist policy reform based on two main pillars, which are strategic defense R&D technology and Efficiency. Firstly, the research on defense R&D state and improvement plan of the National Assembly Budget Office shows the urgent need to develop strategic defense R&D for national defense. The role of the defense R&D has expanded especially in preparation for future warfare, which will include different aspects such as cyber warfare, space warfare or unmanned/robotic warfare. To deal with these kinds of warfare, securing strategic and core technology is essential.[1]For example, the ratio of using precision guided bomb has increased from 7% in Gulf war (1991) to 70% in Iraq war (2008). In addition, advanced nations continuously expand their defense R&D capability and strengthen the control of defense technology. They keep developing state-of-art weapons and core technologies and simultaneously, having a strong control of the technology leakage. In the past, the ROK built its' defense R&D capacity through reverse engineering of advanced nations' weapon systems, but today, technology control is getting severe and reverse engineering is not an appropriate answer anymore. At present, South Korea is more actively seeking to produce

[1] Cited in: Ha Tae Jung, Lee Choon Gun, Park, Mi young. Defense R&D status and way for improvement based on comparison with other areas' national R&D projects. National Assembly Budget Office, 2015

defense materiel based on technologies acquired through its own research and development, therefore, ADD (Agency for Defense Development) is being asked to shift its focus towards R&D activities related to core defense technologies which are considered essential for national security. Also, since South Korea's ambitious goal is to become highly independent in arms development and procurement, ongoing structural changes in South Korea's defense industrial sector are adding increased pressure on the defense industry to conduct independent R&D.

Secondly, efficient defense R&D should be pursued through new defense policy. In the past, as South Korea's defense R&D priorities were national security and battle force maintenance, so we never approached defense R&D in terms of efficiency. It means that South Korea used to invest a lot of money into R&D defense sector in order to strengthen national military forces even though it had to take risks of failure and inefficiency. However, according to the defense R&D innovation plan released in national finance strategy meeting in 2015, defense R&D is currently included as a main part of innovation. It means that now is the time to consider "efficiency" in defense R&D sector. According to the past research about Defense GRI, a bureaucratic power of defense sector in Korea has been transferred from the military to civil servants after creation of DAPA (Defense Acquisition Program Administration) in 2006. It also indicates that defense GRI's main decisions should be made in a more efficient and open way compared to the past.

1.3 Main issues of Study

How the ROK is able to achieve to secure strategic technology for defense R&D in an efficient way? First of all, strategic core technology development should be preceded before system development. It means that the current ROK defense R&D policy is not supportive to develop

core and future technologies if those are not included in planned system development. Lots of employees and budget tend to be concentrated on current and planned projects in Korea. However, for preparing future defense R&D, investment to develop and secure state-of-art technologies is required. In other words, the ROK should concentrate on developing core technologies to diminish critics that Korea is too dependent on foreign components for weapon system development. In the past, we were able to do reverse engineering using advanced nations' weapon systems and also we could learn from other neighbor nations' experiences through international cooperation such as "offset". However, advanced nations' technology control has been strengthened and international cooperation is only possible when both nations have their own strength technologies that would helpful to each nations. Therefore, in the future, the only way to secure core technologies will be strengthen our own defense R&D capacity.

Secondly, Korea defense industries should have their own technological capacity to play a leading part in defense R&D projects. In many advanced nations, defense industries such as Lockheed Martin, Boeing, BAE Systems etc. have great technology capacities and deeply engaged in national defense R&D projects. They cooperate with national defense GRIs and sometimes, they export their own R&D projects to abroad. This paper will elaborate on industries' leading role in foreign defense R&D procedures specifically in Chapter 3.

In summary, this paper will attempt study to draw answers for the 3 research questions as below;

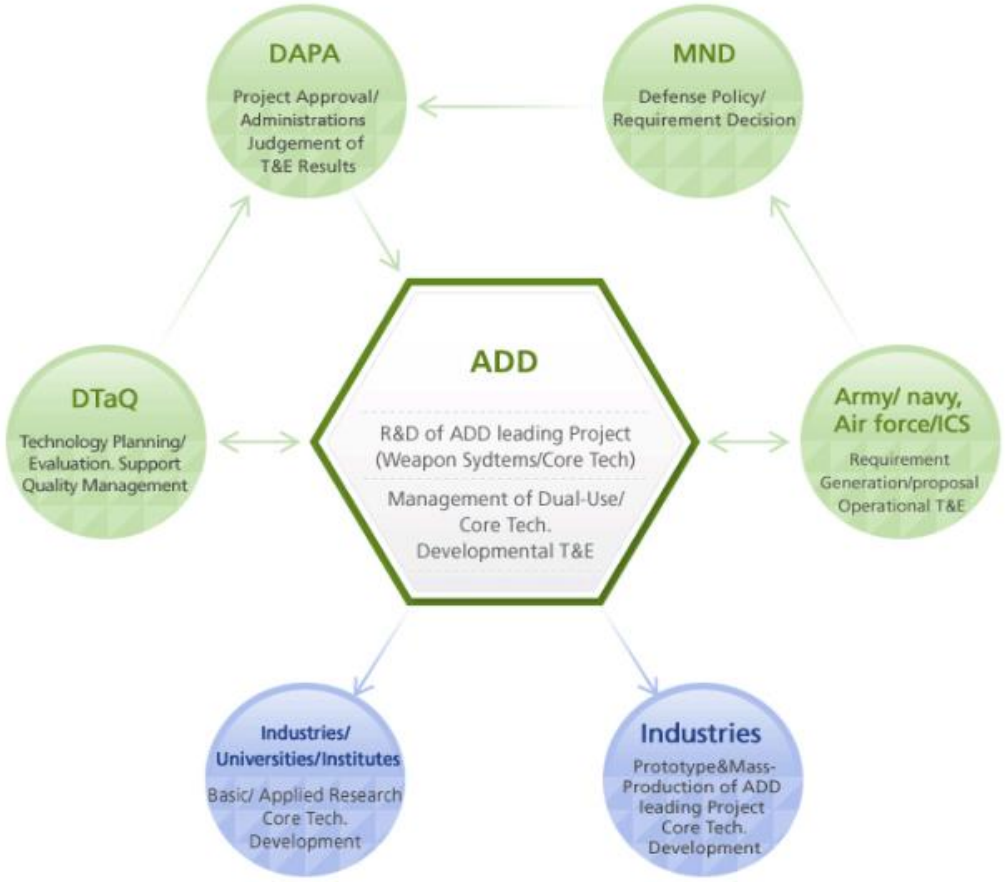
a. How advanced nations' defense GRIs has been transformed so far?
b. How to expand private industries' role in defense R&D process in Korea?
c. Which way would be effective for future Korean defense GRI?

To answer these questions, this study will conduct case study for 3 nations, namely, the UK, Israel, and France on defense GRIs and compare those defense GRIs structure and policies with that of the ROK. Through the case study and comparative study, the main goal of this paper is to find a direction to improve the ROK defense GRI structure in more efficient way and thus, paving a way to a partial solution for the future defense R&D policy reform.

CHAPTER 2: Literature Review

2.1 The ROK defense R&D organizations: ADD, DAPA and DTAQ

The ROK's former president Park, Jung-Hee established ADD (Agency for Defense Development) in 1970 with an aim to realize self-reliant national defense and deal with the Nnorth Korea threats. ADD successfully developed world's 7th surface to surface guided missile "Backgom" in 1978 and ADD has developed 174 core technology systems for the ROK military forces for past 46 years. Main role of ADD is to R&D and Test & evaluation of weapon systems for the ROK military forces. In 2006, as one aspect of the defense acquisition programs' sweeping reform, DAPA was established as an organization to handle whole procurement of weapons, devices and supplies that military forces require and foster defense industries. Also, DTAQ is detached from ADD in 1981 and its' main roles is quality assurance for military supplies and also DTAQ is responsible for defense R&D planning and evaluation of defense science technology. As this paper already mentioned in first chapter, "the ROK defense GRIs" will indicate 3 organizations together since other 3 nations' GRIs that this paper going to explain have similar authority of DAPA, ADD and DTAQ. It is going to be more comparable that considering DAPA, ADD and DTAQ with other nations' defense GRIs and also better to find some lessons from their cases.



[2]Figure 1: The ROK defense R&D process: ADD homepage

2.2 The ROK defense R&D governance

The chart 1 shows the entire defense R&D governance of Korea. This picture describes all defense R&D participants' mission and relationship very well. The reason why ADD is located at center in this governance chart is that the figure is from ADD's website. According to the research from national assembly budget office 2015, the ROK Defense R&D planning system is under defense acquisition system. Defense Acquisition system is including planning management system, requirement planning system and acquisition management system and so on. Defense R&D planning means the procedures carried out in first or second stage of defense

[2] www.add.re.kr

planning system. The main legal agents which participate in defense R&D planning are MOD (Ministry of Defense), tri-service (Army, Navy and Air force), Joint Chief of Staffs and DAPA (Defense Acquisition and Program Administration). MND is in charge of requirement decision and policy. When each military force initially raise requirements on new weapon systems and the Joint Chief of staff decides requirements for certain weapon systems after considering defense policy, security environment and military strategy. Regarding to the required weapon systems, DAPA sets up basic strategy for promoting projects on acquisition after advanced research for R&D possibility, defense science technology level and cost & effect and so on. In terms of defense R&D, domestic development should be an overriding consideration. ADD or other agents (Academia, industry or institutes) lead that R&D projects after DAPA decided to R&D for certain weapon system. Particularly ADD is also responsible for the whole ADD-lead R&D projects including weapon system development/Test and Evaluation and core technology research. Also, ADD is in charge of dual use technology and core technology development management on behalf of government. Since ADD does not have manufacturing facilities, Industry produces prototypes of weapon systems. DTAQ is in charge quality assurance in the weapon development process. For over 40 years, ADD led almost all of weapon system development and industries were usually participated in prototype manufacturing phase and it has been a quite an effective growth model.

Table 1: Missions of DAPA, ADD and DTAQ

	DAPA	ADD	DTAQ
Main Mission	○ Optimal weapon system acquisition ○ Enhancement of defense export ○ Defense Export Support ○ Defense Technology Protection ○ Efficient Management of Project	○ R&D for weapon systems ○ Test and Evaluation of Weapon systems ○ Technology Support for defense R&D ○ Dual-use technology devilment project	○ Defense Technology Planning ○ Defense Quality Management ○ Defense Technology Information

Source: DAPA, ADD and DTAQ's official homepage

According to the table 1, the ROK's authority for defense R&D is distributed to different government organizations. In summary, DAPA has strong authority toward weapon system acquisition and budget approval for ADD's projects. Also, DAPA has a power to control and encourage weapon export as well. ADD is a kind of national expert institute for weapon research and development. Almost all employees (80%) are researchers who have expertise in engineering so practical weapon R&D is carried out in ADD. The defense technology planning is conducted by DTAQ.

2.3 Current status of the ROK defense R&D

The ROK's defense budget is 38 billion dollars in 2016 and among the budget; 11 billion are spending on defense capacity improvement and weapon development. Annual defense R&D budget is about 2.5 billion dollars. Korea currently invested 16.3% of whole government R&D cost to defense R&D and this portion is about 7.1% of whole defense expenditure. This figure is little bit lower comparing with 10% that advanced nations' average defense R&D investment rate. According to the `15~`29 Defense Science Technology Promotion action Plan(draft) from DAPA, as a result of continuous investment, defense R&D capacity in firepower and maneuver

areas have been improved and almost reached advanced nations' technology level. However, technology level of aerospace and surveillance & reconnaissance weapon system field is still lower than advanced nations and continuous investment is required.

The ROK Defense R&D project consists of 5 unit projects based on main agents: Defense technology development, Industry-lead R&D, National policy R&D, ADD-lead R&D and capacity improvement. At the same time, Defense R&D projects can be divided as weapon system R&D and defense technology R&D depending on the project's objective. 60% of whole defense R&D budget is invested to weapon system R&D. According to the Defense Science and Technology Promotion Policy, the ROK's current defense R&D vision is to achieve world level defense science and technology and support to realize "innovative economy". Currently, According to the defense science and technology survey 2013 released by DTAQ, Korea current defense science technology level is tied for 10th with Sweden. U.S., France, Germany, the UK are defined as advanced nations in defense science technology. Specifically, the ROK's technology level in maneuver combat system, Surface combat management system and artillery system have reached in advanced level globally but in case of Satellite SAR, Fixed wing system and Space weapon system, there is a significant gap between the ROK and other advanced nations.

2.4 Current Issue of the ROK defense R&D

The ROK defense R&D achieved remarkable development for a short period of time as Korea did in economy sector. The ROK defense R&D began in earnest on 1970 when ADD established and promoted localized basic weapon systems in 1980s. From 2000s, world-class advanced

weapon system development was promoted and as a result, the ROK endogenously developed personal arms, combat aircraft and submarine and so on. However, there are some issues that the ROK should deal with to leap forward to the future defense R&D power. This paper will deal with 3 main problems that should be resolved to improve current defense R&D policy.

First of all, the ROK defense R&D process is very complicated and takes long times from planning to real acquisition because of "development after verification" policy system. It means that to develop a certain weapon system, there are many steps such as military requirement decision, advanced research, exploratory development and system development so normally developing one weapon system takes at least 7 to 10 years. Therefore, naturally only technologies which are included in planned/permitted system development are researched and developed. It means that core and futuristic technologies which are not related to current system development are difficult to get R&D permission or secure budget. In fact, about 80% of entire defense R&D budget is invested in system development projects and when it comes to DAPA-led defense R&D projects, 35% is applied research projects and 61.5% is development projects. Because average period to secure core technology is roughly 10 years and also it has high risks thus Korea government tends to concentrate its investment on current system development and localizations of advanced technology.

Secondly, since Korea's national defense R&D system is quite rigid and divided distinctly, it is difficult to cooperate with each other seamlessly between government, GRI and industries. Almost all part of whole defense R&D budget is available only after DAPA's permission. DAPA employees consist of half military officers and half government officials. 80% of employees of ADD are engineering experts and ADD is mainly in charge of almost of all R&D projects and

the ROK defense industries are usually working for making prototype and mass production. ADD is suffering from insufficient manpower and lots of projects and research for strategic & advanced technologies tend to be put in the background. Entire innovation for whole 3 participants of defense R&D is essential to secure smooth and efficient cooperation between them. 1. DAPA should have certain portion of officials who have expertise in engineering and they would be in charge of planning and managing government-led core technology and system development tasks. 2. It would be better if ADD has an authority to use some part of defense R&D budget for particular core and strategic technologies for long-term aspect even though that technology is not planning to be applied in weapon system in near future. 3. Industries have to be dominant players in conventional weapon systems and for this; technology transfer from GRIs is needed. Innovation only for one participant will not make big change but if innovative policies are applied for all major participants then remarkable achievement in the Korean defense R&D will be accomplished.

Last but not least, even though the ROK's defense R&D industry infrastructure is considerably well established over time, many industries are still playing a limited role in weapon system development projects comparing to other advanced nations' private defense industries except for only few areas (e.g. Korea Aerospace Industries LTD. (KAI) is the Korean aircraft system integration company). In fact, the ROK could not perfectly break from "ADD conducts R&D and industries carry out production" stance over 40 years. In order to develop industries' capacity, national level of active policy promotions are required such as appointment of core defense R&D areas for each big company to concentrate on developing strength certain technology. Additionally, in terms of conventional weapon systems, technology transfers from GRIs should be preceded to enhance industries' R&D level. .

In next chapter, this paper will conduct case study of 3 nations about their general defense R&D status and characteristics of defense R&D participants. In Chapter 4, this paper seek to compare them with the Korean case and try to figure out some answers or suggestions for the ROK's faced issues.

CHAPTER 3 Case Studies

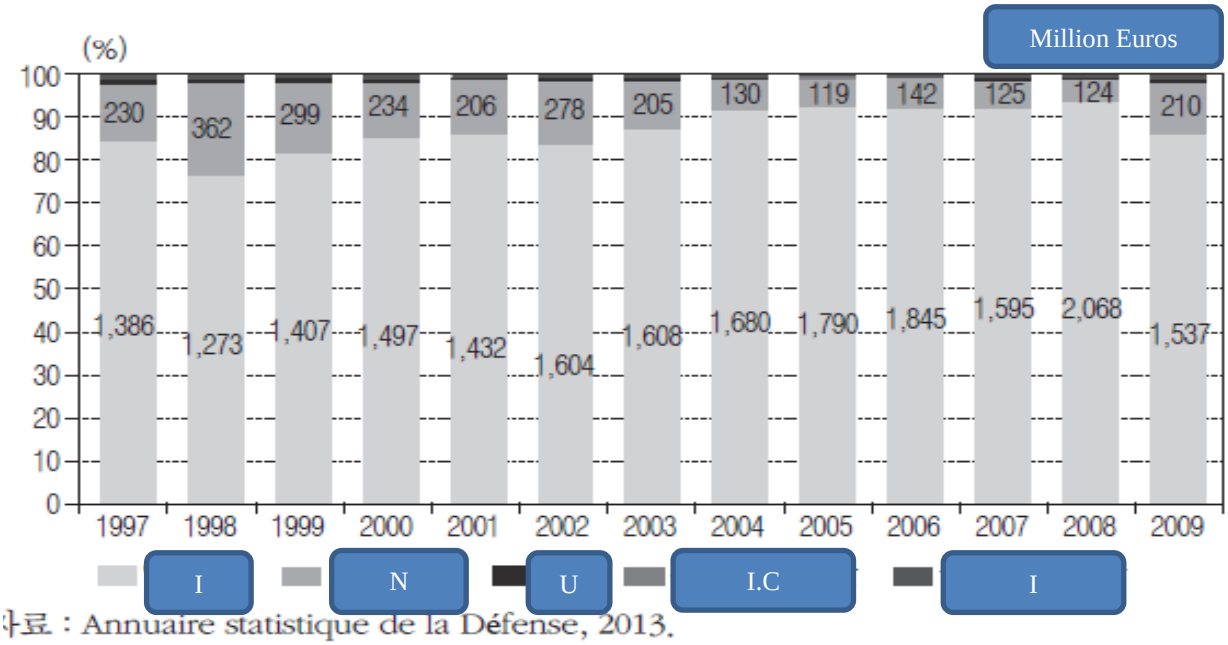
In Chapter 3, this paper will introduce 3 nations' defense R&D policies and GRI, and compare them with that of the ROKs. U.S. is not being mainly mentioned in this paper because its defense budget is very huge and also its defense R&D policy and capacity is not feasible compare to the ROK's status. This paper selected countries that their defense budget is comparable with the ROK and also nations have their own defense GRIs which are evolved over time. France and the UK are famous for their advanced defense R&D level and also their industries have world-class capacities. France has "DGA (Direction Generale de l'Armement)" and the UK used to have "DERA (Defense Evaluation and Research Agency)" and both have similar authority with the ROK's ADD and DAPA. Israel DDR&D (Directorate of Defense Research and Development) is also included in this comparison because Israel has similar external environment and technology level with Korea. Since those 3 nations' defense R&D policy is very different to the ROK's, some lessons from those 3 nations are hopefully found from this case study.

3.1 France

3.1.1 France Defense R&D Overview and DGA

France is the world 6th economic power and one of the Europe's eminent defense technology advanced nations. Approximately 5,000 of industries are participated in defense industry and 5 companies are ranked in top 100 defense R&D companies. In addition, France developed its own weapon system indigenously and has promoted extensive weapon export policy. France ranks fourth in weapon export between 2004~2009 and accounts for 8% of weapon market in the world. France 2015 defense budget is about 39.6 billion Euros. Among them, 3.6billion euro is

allocated in defense research and development. Specifically, for defense studies such as dual research, operational and technical operation and strategic and future-oriented study, 1.587 euros are invested and 864 million euros are allocated to research and technology such as technology demonstrations and franco-german research institute in St. Louis. Also, 739 million euros are invested for contracts concluded with industry and subsidies enable to support innovation on dual matters. France promotes independent defense R&D and at the same time, pursues various ways to acquire weapon systems such as joint production and introduction of technologies. For example, France secures its own R&D capacity independently for main weapon systems such as nuclear weapons and nuclear powered submarine technologies. However, France promotes both joint development and independent development in information-intensive areas such as electronic warfare, information technology and command & communication fields. Regarding to the conventional weapon systems, France prefers technology introduction or joint R&D to independent R&D in order to reduce cost and risk. Traditionally French MOD has directly managed and controlled defense technology but recently, direct management became reduced and promotes marketization of defense technology industry and gradually reduces industries' national control shares. Even though France has some government research centers such as ONERA, Saint Louis, CEA, and so on but DGA will be mainly mentioned in this paper because DGA has comprehensive authority on French entire defense R&D process.



자료 : Annuaire statistique de la Défense, 2013.

☞ I: Industry-led N: Non-defense government department U: University I.C: Cooperation between Industries I: International Cooperation

Figure 2: French outsourcing defense R&D main agent, Annuaire Statistique de la Defense, 2013

According to the Chart 2, 70% of the defense R&D expenditure is outsourcing and among them, 80% of defense R&D outsourcing projects are carried out by defense industries. Additionally, 97% of industry-lead projects are conducted by big companies.

3.1.2 DGA: Reformed from project owner to project manager

DGA is French defense procurement agency under France MOD, established in 1961 and its missions are equipping the armed forces, preparing the future of defense systems and promoting defense equipment exports. Basically DGA managed defense acquisition projects and support defense export. Specifically DGA is located in equal rank with tri-service (army, navy, air force) and responsible for evaluation of technological and economical possibility of military

requirements, planning and drawing up budget, advanced research and R&D, contracting with industries and test and evaluation of developed weapon systems .

However, before 1997, DGA was a project owner rather than procurement agency. In 1961, DMA (Delegation Ministerielle pour L'Amement) was established with aims to secure independent nuclear deterrent and promote advanced defense science technology development. DMA consisted of 4 core research and test directorates related to aircraft, shipbuilding, weapon manufacturing research and ammunitions and 8 support directorates. From 1960 to 1970, after DMA's establishment, France achieved remarkable accomplishments and successfully secured independent nuclear-deterrent capacity. In this period, Strike fighter equipped with nuclear-warhead missile named Mirage IV, Aircraft career Foch and Clemenceau, Combat aircraft Mirage F1, nuclear powered submarine Redoubtable are developed and deployed. In 1977, DMA changed its name to DGA and until early 1990s, DGA mainly designed weapon system projects. In 1997, DRET (Directorate for Research, Studies, and Techniques) is excluded from DGA and DGA reformed as a procurement agency. In 2003, DGA reformed itself again and concentrate more on monitoring and technological control like a project manager. Table 2 and 3 describes well about DGA's role change over time.

Table 2: Changes in DGA's capability, AZARIC Nathalie, MERINDOL Valerie, Rochhia Sylvie. 2010

Changes in DGA's capabilities

Period **Main capabilities**	**Pre-1997**	**1997-2003**	**Post-2003**
Organizational capabilities	Priority to co-design activities ↕ Owner as Project architect	Priority to procurement activities ↕ Procurement agency	Priority to monitoring and technological control ↕ Project manager
Technological capabilities	Upstream approach ↕ R&T management	Downstream approach ↕ Product Management Management of outsourced research	Partnership approach ↕ Management of various networks for maintaining an *externalized absorptive capacity*

Table 3: New role and capabilities for the DGA, AZARIC Nathalie, MERINDOL Valerie, Rochhia Sylvie. 2010

Period **Content of capabilities**	**Before 1997** **Project architect**	**After 2003** **Project manager**
Core capabilities and skills	*Architectural capabilities:* . Integration capabilities . Capabilities to select firms . Skills to translate military needs into technological specifications	*Management capabilities:* . Capabilities to select firms . Contract capabilities . Skills to translate military needs into technological specifications
Main capabilities	Technological/organizational	Organizational /technological
Technological capabilities	Breadth and depth of knowledge	Priority on breadth of knowledge

Currently DGA has 11,298 of personnel and among them, 2,700 are acquisition experts and engineers. DGA currently managed about 80 projects (2012) and budget is about 9 billion euros. 1.3billion euro is invested solely in technology research so DGA is the biggest government investment agency in France. DGA cooperates with military forces and carries out research on weapon systems and maintenance and so son. In addition, DGA supervises national industries and also controls private industries which are participated in weapon system R&D projects. DGA

is also responsible for encouraging or controlling the export of weapon systems. DGA is involved in entire weapon development process such as design, planning, R&D, production, test and evaluation. Among the process, industry mainly leads R&D and production phase and DGA oversees the whole procedure.

3.1.3 Implication

France secures advanced level of defense technology capability and pursues market-oriented policy in defense R&D field. In addition, DGA controls entire defense R&D process as supervisor and industries play a leading role in practical R&D of weapon systems and French defense industries capability is advanced enough to promote independent R&D for weapon system development. "*Smart Defense Acquisition: Learning from French Procurement Reform*" written by Ethan B. Kapstein introduced lessons from French procurement reform. First of all, in France, [3]one single executive agency within the Ministry of Defense, the DGA is responsible for the contracting and management of all weapon systems, from initial inception to delivery, including export sales. DGA has an exclusive authority in defense R&D process and the director general of DGA reports directly to the French defense minister. In order to carry out these important missions, DGA recruits most talented and smartest engineers as their employees to deal with this information asymmetries issue. People who got their engineering degree from "Grandes Ecoles" such as Ecole Polytechnique enter the DGA, then they are able to receive the title of armaments engineer. This recruitment policy shows that how DGA tried to secure expertise in technical knowledge for weapon systems to carry out professional acquisition procedure. Moreover, many of DGA staffs are assigned in defense industries for a while to learn

[3] Cited in: Ethan B. Kapstein, Smart Defense Acquisition: Learning from French Procurement Reform, Center for a New American Security, 2009

practical defense R&D process and also appointed a certain weapon system project for a long time to accumulate their own expertise in this certain weapon systems. They become well known about all the details of their weapon system project and also become more confident to their work through this personnel appointment policy. Secondly, French government found that information asymmetries exist between government and defense industries so it was possible that industry contractors overcharge the government. In order to cope with defense R&D process properly, French government believed that defense industry and defense GRI (DGA) should understand each other more profoundly. Therefore, DGA staffs are able to have opportunities to learn and understand about defense industries and weapon system R&D process thoroughly when they are sent to defense industries and working for practical R&D. It means that even though France DGA reformed and currently is responsible for procurement and project manager rather than actual defense R&D, DGA keep maintaining its employee's expertise in defense science and technology because DGA realized that to oversee entire weapon development phase, the staffs' expertise in engineering is necessary. This point may have important implications for the ROK because Korea's procurement agency DAPA consists of half-government officials and half military officers.

1. DGA once carried out practical defense R&D in the past but now DGA manages and controls whole defense R&D process from acquisition plan to export control as supervisor and industries play a leading role in practical R&D of weapon systems.
2. French defense industries capability is advanced enough to promote independent R&D for weapon system development.

3. DGA recruits most talented and smartest engineers as their employees and some of them are able to have opportunities to experience defense industries and participate in practical weapon system R&D process through detached duty at defense industries.

3.2 The United Kingdom

3.2.1 The UK Defense R&D Overview

The UK is ranked world 5th of GDP and 6th of defense budget in the world with 60.5 billion dollars. Also, the UK is the world 5th defense export country which accounts for 5% of world weapon export market. And 300,000 of manpower are working for 9,000 of defense R&D industries and institutes. In addition, the UK is famous for its eminent defense R&D companies such as BAE systems, Rolls-Royce and MBDA etc. BAE systems is especially renowned as one of the world top 3 defense R&D companies and Rolls-Royce ranked as 18th in the world. The UK has advantages in defense technology and weapon device research field. The UK government's annual defense R&D budget is about 4.7billion dollars and this accounts for 10% of whole its' defense budget and also half of entire science R&D budget. The UK has secured world top aviation R&D technology especially in jet engine, stealth technology and airplane

wings. Also the UK has advanced level of capacity in space and missile and shipbuilding areas. Since 1980s, the UK has promoted privatization policy for national defense R&D companies in order to strengthen national defense science technology competitiveness and reduce defense expenditure. As a result of this privatization policy, many defense industries have been privatized and private industries lead major weapon system production. Since 2010, as defense acquisition policy stance has been changed to 'Open Procurement, Technology Advantage', sub-system and components related budget were drastically slashed and currently the UK concentrates its government investment on system integration technology and development technology.

3.2.2 Reform of DERA

DERA (Defense Evaluation and Research Agency) established in 1995 as defense GRI of the UK. In fact, DERA was a kind of agglomeration institute for many defense R&D related government organizations. DERA was in charge of advanced defense R&D except for nuclear field. DERA divided as 2 organizations in July 2001, which are DSTL (Defense Science Technology Laboratory) and QinetiQ. According to the DTAQ's research on the UK defense R&D promotion plan 2015, R&D for the most sensitive and strategic areas are moved to DSTL, which is 1/4 size of original DERA and QinetiQ covers the other rest functions such as non-nuclear testing and evaluation. Carlyle Group purchased its stake in 2002 and QinetiQ became privatized through a public private partnership.

DSTL is still remained under the UK MOD and responsible for strategic and core technologies for the UK MOD and also mainly studying specific areas that industries cannot conduct due to low profits. Also, under DSTL, Center of Defense Enterprise is operated which supplies fund to innovative and high risk and high return research usually promoted by SMEs or universities. DSTL has 3,500 of scientists and 12 project directorates which conduct research for air systems, land systems, naval systems, biomedical science, detection, environmental science, security science and so on. In addition, DSTL has a subsidiary named Ploighshare Innovation; the company plays a role of "gateway" of technologies that DSTL developed. This company received world class solution and technology from DSTL and commercialize them. In summary, DSTL is mainly in charge of national strategic and core defense technology R&D. On the other hand, QinetiQ is privatized as defense R&D and test and evaluation agency. Even though QinetiQ is privatized, it signed a 25 years of long-term partnership contract with the UK MOD in 2003 and currently has provided innovative test and evaluation service for military and civil platform systems. In 2006, QinetiQ was floated on the London Stock Exchange. QinetiQ has approximately 13,900 of employees and the UK MOD has 56% share of entire stocks and Carlisle Group has 31% and QinetiQ employees have last 13% of shares.

3.2.3 Implication

In the past, the UK is also used to pursue self-sufficiency policy for defense R&D like the ROK's national defense R&D goal. In 1970s, most of defense industries are state-owned companies and the UK government and industries maintained such a "cozy-relationship" so huge acquisition projects were usually determined by political decisions rather than market principle. However, Since 1980s, the UK has introduced competition system instead of traditional optional

contract system and promoted privatization of state-owned defense industries. In addition, the UK has tried to enhance its defense industries' competitiveness through strengthening international cooperation and M&A. In this context, national defense research laboratory "DERA" was reformed very innovatively. Core and strategic researches are conducted and developed by national level but other areas became privatized and had to secure its' competitiveness between other defense industries. 3 characteristics are able to be pointed out from this case study for the UK defense R&D policy.

1. Strengthening defense industry competitiveness through privatization of state-owned industries and national laboratory

2. The UK government sets up priority on each science technology areas and offer sufficient information about defense technology strategy to related research group of industry, academia and institutes. Also, Nation directly manages core/strategic defense R&D technology by operating national defense R&D laboratory (DSTL) and its subsidiary commercialize technologies that DSTL developed.

3. The UK government has promoted privatization of the UK defense industries and encouraged them to compete with foreign defense companies. As a result, currently the UK has secured various defense R&D capacities from nuclear weapon to small arms and world top 5th defense export nation with indigenous R&D and production of advanced weapon systems.

3.3 Israel

3.3.1 Israel defense R&D Overview

Defense R&D is the Israel's one of the important field to make national profits. The defense science technology industry accounts for 25% of entire industry output and 20% of entire industry manpower are allocated for defense industry. There are 150 of defense industries in Israel including state-owned enterprise, private industries and foreign-funded enterprise. 4 of Israel defense industries are ranked within world top 100 defense industries, which are IAI, RAFAEL, ELBIT and IMI. IAI, IMI and Rafael are state-owned enterprises and there output cover 35% to 40% of entire defense industry output. Elbit systems and ELISRA are private industries that have high defense R&D capacity and produce state of art weapon systems.

Israel has spent a lot of budget in defense R&D so far. 2009 Israel defense budget was 13.3billion dollars including 2.7 billion dollars of U.S. subsidies. It is estimated that 9% defense budget is invested in R&D activities and 2.5% of defense budget is spent on basic and applied research. The size of weapon system export is about 8 billion dollars in 2010 and especially missile is Israel's one of the main export projects that 65% of export weapon systems are missile products. Israel's weapon system R&D capacity is evaluated as advanced nations' level since Israel is one of the few nations which are able to produce ballistic missile defense system. Arrow 2 missile defense system, SPIKE anti-tank missile and POPEYE air to surface missile is famous for their great capability.

Israel's defense policy characteristics are as follows. Firstly, Israel is gradually promoting privatization of defense R&D industries. In addition, indigenous weapon system development is emphasized due to limitation of weapon import as a result of political effect. At the same time, international joint R&D and production with the U.S., the UK, Germany and France are

encouraged by national level. Secondly, Israel is famous for its strong weapon export strategy promotion. As a result of this promotion, 75% of Israeli weapon systems have been exported to 70 countries and domestic requirements only covers 20~30%. Mainly aircraft, missile, and photoelectron products have been exported to South Africa, U.S., India, Turkey and Europe and so on.

3.3.2 DDR&D and Rafael

Israel defense R&D is carried out by corps of IDF (Army, Navy, Airforce, Intelligence and C4I), DDR&D (Defense R&D directorate under Israel MOD) and defense industries. Defense R&D process is mainly carried out DDR&D because DDR&D is in charge of initiating weapon system projects (including feasibility studies) overseeing all developing phase such as conducting negotiation , signing on project contracts and also directing core and futuristic technologies.

Israel was suffering from France and the UK's embargo and cancellation of weapon purchase and has set up "self-reliant doctrine" that promoting indigenous development and procurement of weapon systems. In this aspect, Israel established national companies such as IMI, Rafael and BEDEK. Especially, RAFAEL's case is very thought-provoking. Rafael is the one of the largest state-owned defense industries of Israel, developing various weapon systems for air, land, sea and space application for IDF and its foreign customers. Rafael has about 7,000 employees and many subcontractors and suppliers. The special part is the fact that Rafael was established in 1948 as Israel's defense Ministry national research laboratory. Rafael was a national research institute which mainly researched for missile technology. However, [4] in 2002, Rafael was incorporated into a state-owned company with the vision of maintaining its technological

[4] www.rafael.co.il

capabilities and continuing wide-scale R&D programs. As a result of transformation from defense GRI to state-owned company, [5]Rafael has become an Israel's second largest defense company, with 2015 sales of 2,018 Billion Dollars, an order backlog of 4,959 Billion Dollars and a net profit of 118 Million Dollars. Rafael is one of the key players in defense industry market in the world and also Rafael is also one of the major investors of defense R&D sector because Rafael invests approximately 10% of its entire revenue to defense technology research. It means that Rafael actively participates in national defense R&D and secured advanced capacity in initial development, making prototype, conducting test, upgrading existing weapon systems.

Even though Rafael is a state-owned enterprise right now, it has still close relationship with Israel government and working for Israel's weapon system projects like a national defense R&D laboratory that Rafael used to be and at the same time, it is trying to secure competitiveness as one of the major weapon system companies in the world.

During 1970s~1980s, Israel's defense R&D capacity is surged dramatically with promoting aircraft development projects and huge contribution from U.S. However, from 1980s Israel's defense industries faced a crisis due to Israeli depression and world-wide armaments reduction. Israel decided to change its self-reliant national defense policy that pursuing efficiency and export-oriented product development with reducing industries scale to deal with this crisis. After that, Israeli defense industries have promoted niche-market strategy which avoid platform development which required huge investment and concentrate on subsystem development. DDR&D can be compared with the ROK's ADD and DAPA but DDR&D is mainly in charge of entire defense R&D procedure management and R&D only for core and strategic technologies

[5] www.rafael.co.il

by outsourcing (Industry, Institutes, Academia). Israeli defense industries are in charge of almost all practical R&D.

3.3.3 Implication

1. Israeli defense GRI undergone transformation and became a state-owned enterprise (Rafael) : Rafael used to be a government research institute for Ministry of Defense but it became a nationalized company and had to improve its own competitiveness. After this transformation, Rafael grew as one of the eminent defense R&D companies. Furthermore, other Israel government defense R&D companies gradually privatized and also active M&A was promoted between them to strengthen their competitiveness in world market. As a result of this policy, 25 of Israel's small and medium companies experienced M&A and became a one of the biggest Israel companies "Elbit Systems" and successfully secured considerable capacity to compete with world's advanced companies. Moreover, those defense industries tried to develop their own R&D capacity actively through investing certain portion of their profits to defense R&D. According to the KIET's research, [6]Elbit Systems, Rafael and IAI invest on average 7% to 10% of their total gross to their own defense R&D and those activities are carried out independently from government support.

2. Government encourages and supports industries' R&D activity: in Israel, practical R&D is mainly lead by defense industries, not government organization (DDR&D). Generally defense industries initiate system development in defense R&D project so Israel defense industries could secure market predominance and they can enhance their own technology capacity. Israel government supports defense industries actively through future technology prediction, feasibility

[6] Cited in : Jang wonjun, Min Hyunki, Kim Changmo, An Youngsu, *Advanced nations' defense industry development policy change and implications*, KIET, 2014.10, 224p

study, budget support, Test and Evaluation, export promotion and so on. Since industries are in charge of practical R&D and weapon system development, Israeli defense industries invest substantial efforts and budget to technology research and development. In addition, Israel industries have close relationship with IDF (Israel Defense Forces) in whole acquisition process of weapon systems. Even defense industries can be involved from concept stage of weapon development requirement and also many of retired officers of IDF are working for defense industries and manage their core technology. This kind of interactions strengthens close relationship between government and industries.

3. Defense R&D industry management policy: There are 3 types of defense industries in Israel. Firstly, there is large state-owned enterprise and they are strongly controlled by government and lead practical R&D for weapon system projects. Second, medium-sized companies in private sector and those companies are actively working for civilian sectors as well. Lastly, small firms that produces particular products. Israel thought that their defense industries cannot survive if they only produce weapon systems for domestic market so encourage overseas export from R&D stage of weapon system. Israel defense industries developed weapon systems for foreign customers using accumulated technology capability and Israel government invests a lot of budget and efforts to foster defense technology start-up companies. Those mutual efforts are required to foster competitive defense R&D industries.

Chapter 4 Comparison Study

Previous chapter reviewed about characteristics of 3 nations' defense R&D policy and found some implications. This paper will summarize each nation's characteristics and compared them with the ROK in this chapter. There are many comparable points but this paper will introduce 3 points since those are related to the issues that the ROK should deal with that already explained in Chapter 2.

1. How the nation manages and develops core/strategic defense R&D capacity?

2. Transformation trend of advanced nations' defense GRI.

3. Relationship between the government(GRI) and defense industries

Table 4 : Defense R&D status comparison

	U.K.	France	Israel	ROK
Defense Budget	$60.5B	: $41.4B(€39.6B)	$15.2B	$38B
Defense R&D budget	$4.7B (8% of whole defense budget)	$4.4B (€3.6B) (10% of defense budget)	*9% of defense budget	$2.5B (6.5% of defense budget)
Government defense R&D organization	- **DERA**(Defense Evaluation and Research Agency) - **DSTL**(Defense Science Technology Laboratory)	-**DGA** (Directorate General Armament)	-**DDR&D** (Directorate of Defense Research and Development)	**-DAPA, ADD, DTAQ**
GRI Manpower	3,500	11,298	250	3,000
Main mission	DSTL: research for future / core / strategic technologies QinetiQ : T&E	-Manage defense acquisition projects and support defense export - T&E - Supervise and control industries	-R&D planning/ Initiating weapon system project - Overseeing all developing phase, directing core technologies	**DAPA:** Weapon acquisition / Project approval / Budget **ADD:** Practical defense R&D, system development, T&E **DTAQ:** Quality assurance, defense technology planning

According to the table 4, the ROK has considerably similar defense budget with those 3 nations. In fact, the U.S. is world top defense R&D power nation but this paper does not compare the U.S. with the ROK because the size of budget and technological level gap between two nations are not comparable.

The reason why this paper selected France, the UK and Israel as comparison nations are as follows: Firstly, France and the UK are traditional economic and military power nations and have world top advanced defense R&D capacity but their defense budget is comparable with the ROK's. Secondly, In the UK's case, There are lessons to learn from "DERA (Defense Evaluation and Research Agency)" which was the UK's national research institute like ADD before 2002. Additionally, France and Israel have quite similar defense R&D management policy

that one government organization controls and supervises whole national defense R&D procedure systematically from feasibility study to Test and Evaluation. Lastly, Israel has similar environmental circumstance with the ROK that both two nations face real threats from their dangerous neighbors. This unique environment became a strong motivator for two nations to strengthen national defense R&D capacity.

4.1 Comparison 1 : General defense R&D status

In the table 4, It can be found out that defense budget of 4 nations are quite comparable even though Israel's budget is smaller than other nations. The ROK invests smaller budget on defense R&D compare with other 3 nations. Other 3 nations invested about 10% of entire defense budget to defense R&D but the ROK only invests 7% of entire defense budget to defense R&D.

In Korea, 3 organizations have different role and authority respectively. DAPA is in charge of whole acquisition and project approval and budget. Then ADD is in charge of practical R&D for approved weapon system requirements and Test and Evaluation. DTAQ is working for defense technology planning and quality assurance. Similarly, the UK also has different departments for acquisition, defense R&D and planning and also it has DSTL which is national defense laboratory like Korean ADD. On the other hand, France DGA and Israel DDR&D are the only government organization which solely manage and control whole defense R&D process from requirement to test and evaluation. Interesting point is that both two organizations are used to hold practical R&D in the past but now their main mission is changed as management and support of the entire defense R&D stage. In terms of manpower, ADD has approximately 3,000 of researchers and this figure is quite similar with DSTL's manpower. DGA has lots of

employees due to its comprehensive missions but Israel's DDR&D has very compact manpower since DDR&D only conducts some core technology research and almost all defense R&D projects are carried out by industries. Then let me elaborate more about each organization's reform in next table.

4.2 Comparison 2: Defense GRI role transformation

Table 5: Defense GRIs of 4 nations

	ROK	U.K.	France	Israel
GRI	ADD	DERA(DSTL)	DGA	DDR&D
Transformation	No big transformation since 1970	**DSTL** :Under MOD **Qinetiq** : Privatized	Project owner to Project manager	**Rafael** : Former GRI under DDR&D, became a public enterprises
Authority	Entire Defense R&D, T&E	DSTL:Strategic /futuristic research QinetiQ: T&E	Basic study, R&D, logistic support, set up weapon acquirement plan	System development management, future requirement
Industry	**- Usually produce prototype - Government seed money is essential**	-Advanced R&D capacity - Defense industry privatization policy **-carry out practical R&D in weapon system projects**	- Advanced R&D capacity DGA lead whole R&D procedure and control Industries from R&D to export **- carry out practical R&D in weapon system projects**	-Strongly controlled by government - Defense industry privatization policy **- Carry out practical R&D in weapon system projects**

Table 5 compared each nation's GRI's role change and characteristics of their defense industries. According to the table, ADD has maintained a same role since 1970 with no big changes. In addition, "ADD carries out R&D and industries produce prototype" stance continued for 40 years and industries are not really playing an initiative role in defense R&D process except for particular areas such as aircraft. Reversely, other 3 nations have undergone significant reforms and changes in their defense R&D policies.

As mentioned in previous chapter, the UK's DERA (Defense Evaluation and Research Agency) was divided as two organizations in 2002 which are DSTL and QinetiQ. The UK has operated DSTL (Defense Science and Technology Laboratory) as a national laboratory under MOD. It

means that the UK pursues to conduct certain nature of defense R&D by government. DSTL is working for future-oriented weapon system research, innovative performance and technology research, technological support for defense policy and so on. Realistically, industries cannot conduct future-oriented or innovative researches because those are not profitable and have high risk. Therefore, the UK decided to manage and care some core, futuristic and strategic technologies at the state level. On the other hand, test and evaluation facilities became privatized as QinetiQ and secured its own strength through competition with other industries. In fact the UK pursued defense industries privatization and opens their market to foreign industries. Therefore, domestic defense industries had no choice but improve their capability to survive. As a result of this privatization policy, the UK defense industries have become stronger than past and now its defense industries have great reputation in world market.

Israel once has “Rafael” as their national R&D laboratory department and Rafael carried out practical defense R&D like Korean ADD. However, it became a state-owned enterprise in 2002. Rafael has made remarkable profits and accomplishments since it became a state-owned company. DDR&D only manages and controls weapon system development process and also lead feasibility study for some futuristic technologies but for main weapon system R&D projects are practically conducted by defense industries.

DGA is also starting with an aim to research and develop nuclear deterrent and missile system in 1960s but now as a result of several reforms, its’ main mission is to supervise whole defense R&D process and French defense industries carry out actual defense R&D. Through the table 4, 3 points are shown as main difference between 3 nations and the ROK.

1. Even though whole 4 nations' defense GRIs were established with a mission of self-reliant national defense in the past, Except ADD, the other 3 GRIs have undergone experienced transformation. ADD is the only GRI that remains with same role and mission.

2. Except Korea, defense industries in 3 nations are playing a pivotal/initiative role in weapon system R&D phase.

3. Except Korea, defense GRI or defense industries of 3 nations experienced privatization policy and improved their capacity through market competition.

4.3 Comparison 3: defense R&D governance

In this comparison part, this paper will compare those 4 nations' defense R&D organizations position in their defense R&D governance. The 4 nations' official defense governance chart shows an interesting fact that only ADD is not under MOD but it is under DAPA. In fact ADD was directly under MOD before but since 2006, when DAPA established, ADD have become under control of DAPA. Even though ADD follows MOD's defense policy and requirement decision, DAPA directly control ADD and DTAQ by project approval and budget and those two R&D organizations are officially defined as public institutes controlled by DAPA. DAPA is established as an independent administration from MOD in order to strengthen transparency and openness. Through 4 pictures that describe each nation's defense R&D governance, differences between Korea and other nations are clearly found out.

1. The ROK

As Figure 1 shows that ADD is controlled by DAPA, not MND.

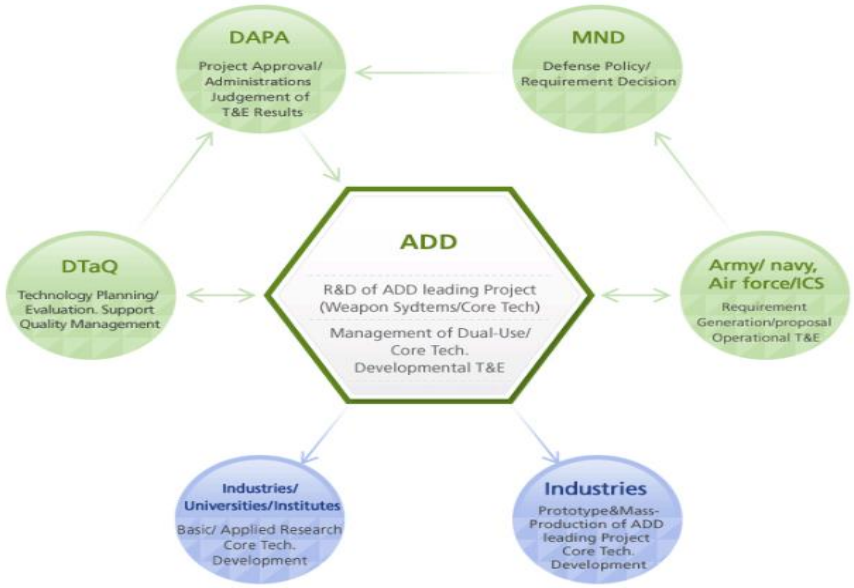


Figure 1: the ROK defense R&D process: ADD homepage (www.add.re.kr)

2. France

DGA has an equivalent position with Joint Chef of staff of France and directly under MOD.

Figure 3: France defense governance (DGA official website)

3. Israel

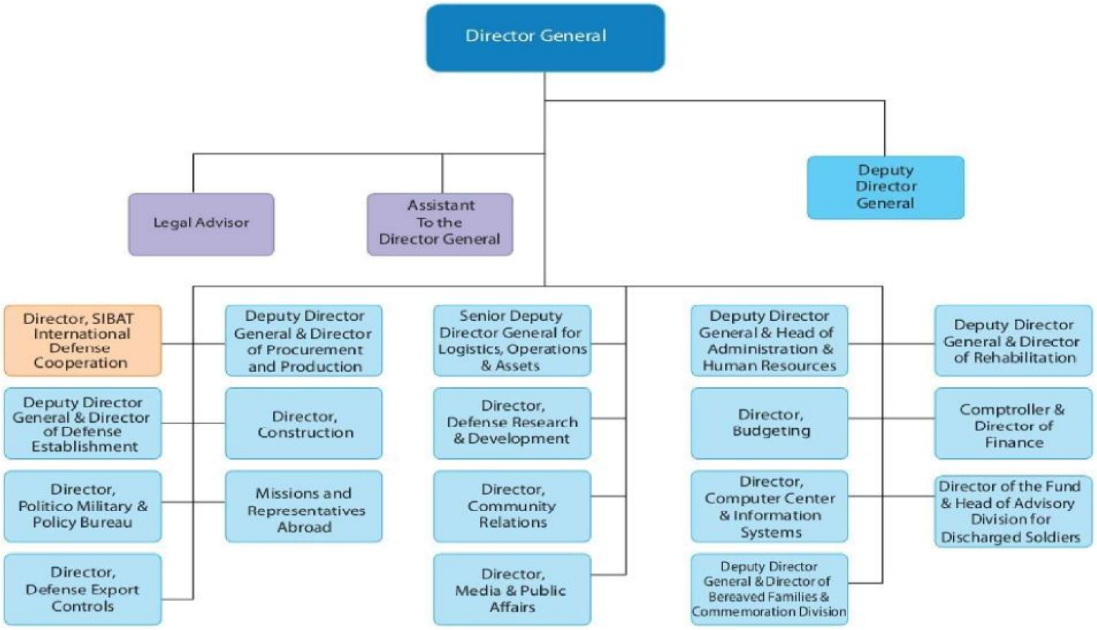


Figure 4: Israel defense governance (SIBAT official website)

This chart shows the Israel MOD's organization chart and director of Defense Research & Development (DDR&D) is located in the middle of the chart. It means that DDR&D is also one part of the Israel MOD and under direct policy guidance and control of MOD.

4. United Kingdom

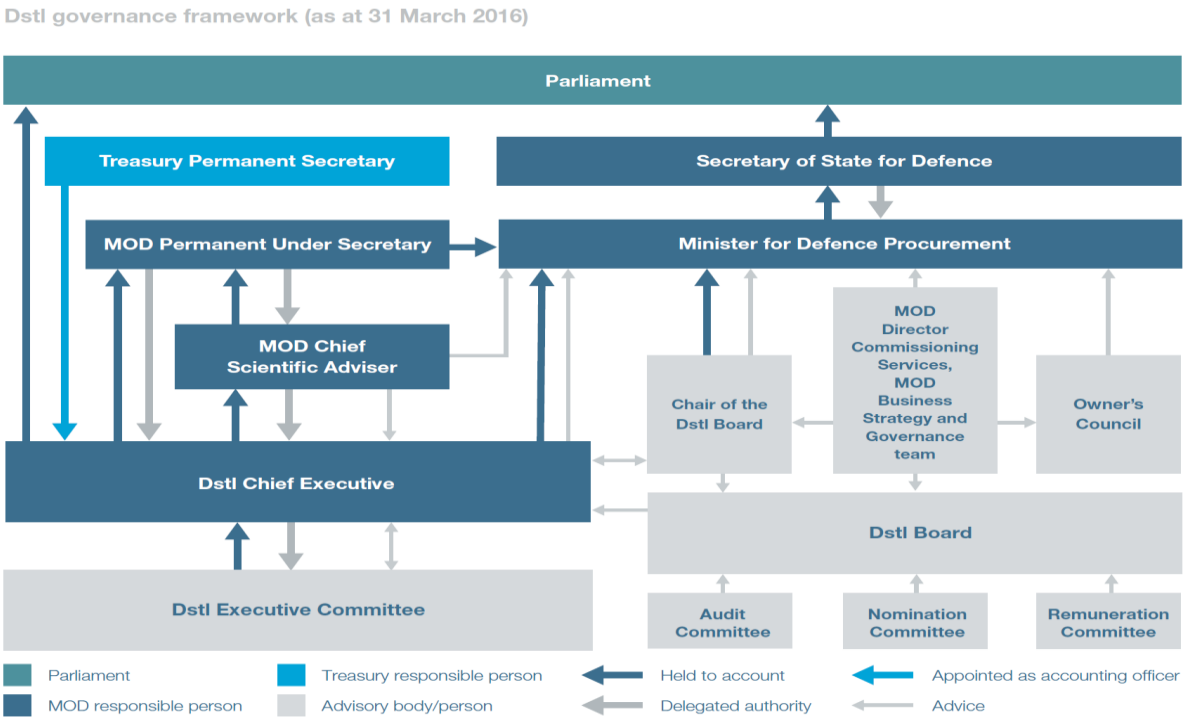


Figure 5: The UK defense governance (DSTL official website)

This chart describes DSTL's governance framework and also it shows that DSTL is directly under control and manage of MOD. In fact the UK also once tried to made acquisition administration like DAPA independent from MOD but it became back to under MOD.

It is understandable that why the ROK established DAPA as an independent administration of MOD. However, in order to make more efficient and consistent defense R&D policy, more connected and close relationship between defense R&D participants is necessary. According to Korea's current governance chart, 4 different organizations have their own missions respectively and make different decision makings based on different circumstance. Naturally, those 4 main activities are difficult to be in harmony when those different activities become connected as one "Defense R&D procedure".

4.4 Lessons from 3 nations

Table 6 gathered whole implications which were found from 3 nation's defense R&D status that this paper reviewed in previous chapter.

Table 6: Lessons from case studies: Summary

	France	UK	Israel
1. Strategic Technology	Government leads strategic technology R&D	DSTL is in charge of strategic/core defense technology R&D	DDR&D planning for future weapon systems
2. Role of Industry	Industry is responsible for practical R&D in weapon system development		
3. Defense Industry Privatization	strengthen defense industries' capacity by privatization	Test and Evaluation part of DERA(national defense laboratory) privatized (Qinetiq)	Rafael : was national defense laboratory but became state-owned enterprise
4. Consistent defense R&D procedure	DGA is in charge of entire defense R&D process	MOD sets up official priority on science technology areas	DDR&D supervise whole defense R&D process and closely work with Industries
5. Governance	DGA under MOD	DSTL under MOD	DDR&D under MOD

As a result of comparison study, 3 lessons can be considered to apply the ROK's defense R&D policy.

1. The ROK needs a defense GRI which concentrates its efforts and budget on national strategic technology development.

As the technology control become severe in advanced nations, securing advanced R&D capacity for strategic technologies will be getting harder. In the future, international cooperation will also made only among nations which have advanced technologies. To prepare for future warfare and defense technology competition, Korea should start investing to national priority technologies even though they are not included in ongoing weapon system development projects. ADD is in charge of R&D for core technologies as well but they also in charge of system development and its manpower tend to more concentrate on system development more than core technology research. Korea needs to have a research center solely for core technology that whole manpower can invest their efforts and budget to advanced technologies for long-term point of view.

2. Korea should promote new policy to strengthen industries' competitiveness in world defense market.

According to the lessons from international cases, defense industries normally actively participate in defense R&D process. They develop their own strength technology and fairly compete with other defense industries in the world. Sometimes even they have to compete with other foreign companies to win a contract of their own nations' projects. Many advanced nations' governments trust their industries' capacity so under defense GRI's control and management, their industries are able to initiatively carry out practical research and development for system development. In terms of big companies, government may be able to appoint concentration technology areas for each company to prevent unnecessary competition between them and raise them as project managers for weapon system projects of their own strong field. To foster industries like that way, interaction between government GRI and industries should be more

active. It would be a good idea that experts in GRI are dispatched in defense industries to learn and understand industries' position and process.

3. Defense R&D should be carried out in consistent manner.

MOD, DAPA, ADD and DTAQ should share and agree with same goal, priorities and position to conduct most efficient and effective defense R&D process. From defense R&D planning and acquisition decision to export promotion, whole aspects should be fully considered through sound communication. To achieve this consistent defense R&D policy, DAPA, ADD and DTAQ should be under same umbrella. The current model is good for each organization's independency but not enough for having sound and balanced communication among those 4 organizations because now they have 4 different stances and sometimes those stances conflict to each other's. R&D planning, acquisition decision, Test and Evaluation and export promotion should be well connected. The ROK needs to have one comprehensive center for weapon system projects. This center should be able to carry out systematic defense R&D with industries. During the system development process, this center should interact with industries actively and conventional technologies gradually transferred to appointed defense industries to foster industry competitiveness. In addition, the ROK should establish planning center which consists of engineers, civil servants and military officers. To design from short term to long term defense R&D planning, we need all experts in defense engineering, administration and military strategy.

Chapter 5: Conclusion

As a result of case studies and comparison studies that conducted in previous chapters, this paper will suggest a new defense R&D GRI format and defense R&D governance model in conclusion chapter.

5.1 Suggestion

Ministry of Defense			
DAPA+ADD+DTAQ			
	Core technology Center	**Planning Center**	**System Development Center**
Main mission	-Conduct National strategic and core technology research	- Defense R&D planning	- Manage entire weapon system development project
Manpower	- Researchers (Engineering experts)	- Military officers - Civilian officers - Researchers (Engineering experts) - Researchers (Planning experts)	- Project Managers (Engineering experts) - Coordinators (for Technology interaction with Industry)
Authority	- R&D for strategic and core technology - Futuristic and high risk & high return technology	- Acquisition Planning - Long/mid-term defense R&D planning - Feasibility Study (Outsourcing)	- Manage and Control weapon system development project - Supervise defense R&D carried out by Industries - Technology transfer to Industries - Test and Evaluation

Table 7: New defense GRI model suggestion

The table 7 shows main points of the final suggestion for Korean defense GRI reform based on the lessons learned from case studies. Reform only for one organization is not enough to make effective innovation but whole main participants of defense R&D should be changed together.

1. ADD, DAPA and DTAQ all should be under MOD and share consistent policy and values.

2. Part of ADD may be able to change as “Core technology center” which can solely concentrate its whole assets on core, futuristic and national priority technologies. The UK DSTL can be the good role model for this center. This center should actively interact with planning center.

3. Each Part of DTAQ, DAPA and ADD can be merged as planning center. Acquisition and defense R&D planning should be made based on full understanding of administrative aspect, engineering aspect and analytical aspect.

4. Current system development directorates of ADD and Quality Assurance part of DTAQ and export control/encouragement and international cooperation part of DAPA can be merged as one integrated system development center. This center is able to conduct one-stop system development for current developing weapon systems. All processes for one weapon system such as feasibility and applied study, design, research and development, making prototype, test and evaluation, quality assessment and export management/promotion can be made in this one center. France DGA and Israel DDR&D can be a good role model for this center.

It seems to be not realistic to have equivalent level of 3 organizations under MOD like table 6 considering of Korea’s current defense R&D governance. However, it will be more applicable if some roles and responsibilities of current governance are adjusted like Chart 6.

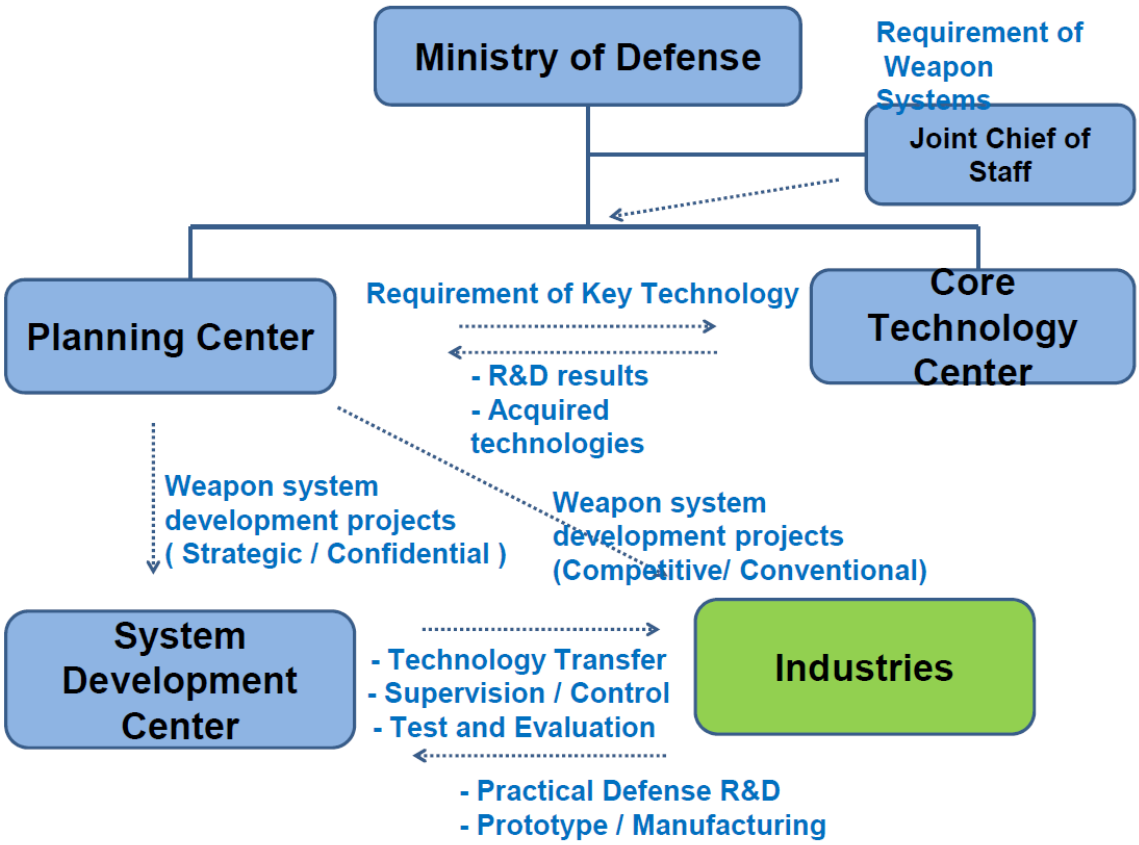


Figure 6: New defense R&D governance model suggestion

1. Korea should establish core/futuristic technology center to become first mover in defense R&D. This center will conduct research on state-of-art and national strategic technologies that "Planning center" required and offer R&D result and secured technologies to the planning center.

2. Defense R&D planning should be made under full understanding of engineering knowledge and consideration. The planning center decides way to acquire certain weapon systems and also distributes projects to System development center and Industries. System development center will lead projects which are state monopoly or

strategic technologies. Industries will lead projects of conventional weapon systems and also projects which have to secure competitive price and capacity compared to other nations.

3. System development center should control and manage government-led entire weapon system development projects thoroughly and encourage industries to initiatively lead practical R&D for the system development projects through technology transfer or technology support, export control/support and so on. Also, System development center should conduct test and evaluation for whole weapon systems to secure reliability in results. (both government-led and industry-led projects)

5.2 Conclusion

Since the 1970s, ROK started defense R&D in desperate need of national survival. Despite the lack of resources, technology, manpower and experience, ROK dramatically grew as one of the strong military powers in the world. In this process, ROK became a “fast-chaser” that follows the advanced nations’ step and experiences in national defense sector. However, from now on, the ROK should change its strategy to join the top tier countries in the global defense sector. First of all, we need to secure our own strength in technology as to prepare for the future warfare and to deal with the North Korean threats. North Korea continues its investment in defense R&D aggressively and its asymmetric war capabilities have reached a considerable level and there are also other military powers that surrounded the peninsular and pose a threat to us (or South Korea or the ROK). Therefore, defense R&D is essential for survival and our first priority of self-reliant national defense cannot be sacrificed for other national duties. However, as lessons from other advanced nations’ cases demonstrate, survival in the future is a totally different issue. Korea needs to keep developing strategic and national core technologies and to strengthen defense industry’s capacity and competitiveness. Defense GRI and governments related to defense R&D of France, the UK and Israel experienced a number of reforms and evolved with time. On the other hand, the ROK’s defense GRI and government organization have only played a limited role since the 1970s.

This paper has some limitations in making its comparisons. First the mission, position and authorities with those 4 nations’ organizations are not perfectly matched with each other. For example, ADD and DSTL carried out research and development for defense technology, whereas DGA and DDR&D are managing and control center of defense R&D process. Furthermore,

regarding the core/strategic research, while France secured nuclear deterrent technologies and the UK and Israel acquired quite sensitive and controversial technologies such as those related to nuclear power, the ROK has restricted circumstances such as having a ballistic missile range limitation and being a supporting nation of the NPT. Due to the nature of such political reasons, the ROK's core and strategic technology R&D is quite limited compared to that of other nations and this is not an issue that ROK can solve by strengthening its own R&D capacity. In addition, France and the UK are tied by the strong community called the European Union, which makes it possible to share and transfer lots of technologies and information among European nations. In fact, one of the big defense industries, "MBDA" is a merged company of France, Germany, Italy and the UK. In contrast, ROK is surrounded by Japan, China and Russia, all of which have a quite complex and sensitive relationship with Korea. Thus, geopolitically speaking, it is almost impossible to promote defense R&D cooperation with those nations. In the respect of sharing information and defense R&D cooperation, ROK's status is very unfavorable compared to that of other nations.

For all the countries in the world, national defense is an essential issue. Every country's defense R&D firstly started from the necessity for the survival of a nation, but after the end of Cold War, the entire world to pursue free market also in the weapon system development. Many advanced nations encouraged defense industries to develop their own capacity and national laboratories are eager to conduct high-risk and high-return researches. To be one of the major defense R&D players in the world, ROK should participate in this kind of change. South Korea should be able to find a way by reviewing advanced nations' past experiences. They promoted consistent defense R&D procedure, consensus on common goal and hire and foster technology experts in planning and acquisition areas. To deal with the totally different characteristics of the future

warfare and threats, the way our R&D defense should follow must go through a fundamental change. It is hoped that this paper will let people think about why the ROK's defense GRI should be changed and in which ways we can create our post role model.

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