Developing the Direction of Military Space Capabilities in South Korea

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Abstract

The repeated missile launches by North Korea pose a growing threat to Japan and the US mainland beyond the Korean peninsula. In response, South Korea is developing a missile defense system and a kill chain, but the increasingly diversified missile types and launch methods make it difficult to keep up. To address these challenges, South Korea is placing greater emphasis on acquiring space information, but its military space capabilities are inadequate. To effectively develop these capabilities, Korean decision makers should establish space partnerships with various countries and strengthen interoperability and technical cooperation among civilian and military stakeholders. Additionally, reorganizing South Korea’s space-related agencies will be necessary for more efficient development. Cooperation with the United States and Japan remains important, but complementary partnerships with other nations will be critical for addressing the evolving missile threat. These efforts will help to better protect South Korea and its allies against potential missile attacks.

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North Korea’s missile launches have increased steadily since 2011, with an average of over 15 launches per year.1 However, the number of launches reached an unprecedented frequency of 21 in 2016 and 24 in 2017. In 2018, North Korea did not launch any missiles due to a series of peaceful events, including the PyeongChang Winter Olympics, three inter-Korean summits, the US–North Korea summit, and the 19 September inter-Korean military agreement. However, the peace was short-lived, as North Korea resumed its missile launches with more than 20 in 2019.2 In 2022, North Korea conducted a total of 33 missile launches, including three cruise missile launches. Notably, from

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1 Kim Dong-yeon, “The U.S. think tank needs at least two THAAD batteries in Korea to have the entire defense capability of South Korea,” Monthly Chosun News Service, 2017, https://monthly.chosun.com/.
25 September to 14 October, North Korea launched missiles ten times within a three-week period, raising military tensions in the region.

North Korean missiles pose a significant threat to neighboring countries, including South Korea, Japan, and the United States, as they can carry nuclear and biochemical weapons. With each new missile model, such as Scud, Rodong, Musudan, and Taepodong, North Korea has been able to increase the range of its strategic targets. Recently, North Korea has further diversified its missile types by developing new missiles such as the North Korean version of Iskander (KN-23), the Army TACtical Missile System (ATACMS), and the super-large multiple rocket launcher (KN-25). These advancements in missile performance, including increased range, heighten the threat to regional stability and require urgent attention from the international community.

Table 1. Classification of North Korea’s missiles

<table>
<thead>
<tr>
<th>Classification</th>
<th>Scud-C</th>
<th>Rodong</th>
<th>Musudan</th>
<th>Taepodong</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missile Range(km)</td>
<td>SRBM</td>
<td>MRBM</td>
<td>IRBM</td>
<td>&gt; 10,000</td>
</tr>
<tr>
<td>Strategic Strike Target</td>
<td>South Korea</td>
<td>Japan</td>
<td>Bases in Guam</td>
<td>US mainland</td>
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</tbody>
</table>

North Korea’s diversification of missile launch methods is a growing concern. Traditionally, North Korea used a vehicle with infinite-track wheels, similar to a tank, to transport missiles to their desired location for firing. However, North Korea has expanded its capabilities with successful missile launches from a train in September 2021. Furthermore, North Korea has been reducing the preparation time for missile launches by switching to solid fuel, which requires less preparation time than liquid fuel. The launches have also expanded from land to sea, with North Korea testing submarine-launched ballistic missiles (SLBM) and constructing submarines capable of carrying them. These developments in North Korea’s missile capabilities further complicate regional security and demand attention from the international community.

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The South Korean Response

In response to North Korea’s increasing threat of missile launches, South Korea has been developing a missile defense system and a kill chain. The missile defense system tracks ballistic missiles fired by North Korea and intercepts and destroys them in flight before they can reach their targets. Meanwhile, the kill chain aims to preemptively neutralize threats by striking missiles before North Korea launches them. These systems serve as a crucial defense against North Korea’s growing missile capabilities, but continued development and enhancement will be necessary to ensure their effectiveness.

North Korea’s increasing diversification of missile types and launch methods poses a significant challenge to regional security. By using vehicles and trains to move missiles just before launch, North Korea makes it difficult to detect and preemptively attack its missile forces. Furthermore, the use of solid fuel limits the time available for target information acquisition, adding to the difficulty of detecting incoming threats. The development of submarines equipped with SLBMs also poses a significant threat, as they can remain at sea for extended periods, making detection and interception very challenging. These advancements in North Korea’s missile capabilities require an innovative and adaptive response to ensure the security of the region.

North Korea’s diverse and evolving missile capabilities pose a significant challenge for South Korea’s military response. To effectively operate the kill chain and missile defense system, accurate and real-time information on North Korea’s missiles is crucial.

However, despite significant advancements in its striking capabilities, South Korea’s information assets and acquisition capabilities are still inadequate. The country has heavily relied on the United States for information acquisition, and while efforts to increase its own assets such as Global Hawk and unmanned reconnaissance aircraft are underway, it remains difficult to cover all areas due to North Korea’s mountainous terrain and the curvature of the earth's

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9 Bruce W. Bennett et al., Countering the Risks of North Korean Nuclear Weapons (Santa Monica, CA: RAND, 2021), https://www.rand.org/.
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As a result, there are limitations in acquiring real-time information, and this presents a significant challenge for South Korea’s military response.\(^{11}\)

**Lesson Learned from History Regarding Military Space**

The Gulf War is often referred to as the beginning of modern warfare, and it also marked the start of space warfare. Air and space assets played crucial roles in collecting, analyzing, and disseminating battlefield information, as well as in operating and controlling precision-guided munitions.\(^{12}\) Satellites, in particular, played a significant role in overcoming weather limitations and ensuring operational continuity.

The 2022 Russian invasion of Ukraine exemplifies hybrid warfare tactics, which employ both military and nonmilitary means to achieve their objectives. In this context, Russia attempted to use space warfare by launching electronic attacks on commercial satellites providing Internet and intelligence to Ukraine before the full-scale invasion began. Furthermore, during the initial days of the conflict, various forms of electronic attacks, including GPS jamming, satellite communication interference, and internet shutdown, were conducted. In response, Ukraine requested real-time high-resolution satellite imagery from US and European companies to monitor the movement of Russian troops and gain situational awareness. Additionally, Starlink’s satellite Internet service provided Ukraine with further support.

The trend in modern warfare is to shorten the combat cycle system, which relies heavily on space assets for gathering and sharing information. The Gulf War was the first to utilize space assets for this purpose. In the 2022 Russian invasion of Ukraine, private companies with satellite technology have provided high-resolution images to monitor the war situation, complementing the information obtained from military satellites. This has allowed for near-real-time use of civilian satellite data in the conflict. As a result, the detection, identification, analysis, and dissemination of battlefield information using space assets has become essential to modern warfare, as it can overcome territorial constraints and provide real-time information to support combat operations.


Development of the Republic of Korea’s Military Space Capabilities

South Korea’s Space Development Plan and Analysis

South Korea is planning to launch its first reconnaissance satellite in 2023 and operate an early warning satellite by the 2030s. To ensure the ability to detect North Korea’s missile activities in all weather conditions, South Korea plans to launch four radar and one optical reconnaissance satellites sequentially by 2025. Once operational, these five reconnaissance satellites will provide information on North Korea’s missile activities every two hours. However, this may not be sufficient to monitor the situation, so an additional 40 micro-sized satellites will be deployed in clusters in low orbit to spy on North Korea every 10 to 20 minutes.

Once the reconnaissance satellite is operational, South Korea’s information-acquisition capabilities are expected to improve to some extent. However, due to limitations on the coverage area, resolution, and revisit time of reconnaissance satellites, it will still be challenging to monitor all parts of North Korea in real-time, and it will take time to achieve full operational capability.

Additionally, the promotion of South Korea’s satellite project has been hampered by conflicting opinions among the multiple government ministries that share responsibility for the program. For instance, the Ministry of Science and ICT and the Ministry of National Defense had a disagreement over the promotion of satellites used for civilian-military purposes, resulting in significant time and effort wasted in resolving the impasse.

International Cooperation

Space activities are critical to safeguarding national interests, and ensuring their safety and stability is a matter of national security. Space partnerships have become increasingly vital to national security strategies, providing significant advantages. By leveraging their unique capabilities and systems, allies and partner countries can save costs and offer deterrence benefits. Another significant advantage of space partnerships is their geographical location. Given the space race with China, Japan and South Korea are important partners in US space security.

The continuous missile tests conducted by North Korea have revealed that it has the capability to attack targets beyond the Korean peninsula, including Japan and US bases in the Indo-Pacific theater. Furthermore, North Korea’s defiance of UN Security Council resolutions, coupled with China’s increasing threats to re-
Regional stability, emphasizes the need for enhanced international cooperation among South Korea, the United States, and Japan.\footnote{Jessica Renee Taylor, “Obstacles to US-South Korea Alliance Regional Contingency Planning and Considerations for US Policy,” \textit{Journal of Indo-Pacific Affairs} 5, no. 6 (October 2022): 151–66, https://media.defense.gov/}

The need for missile defense and reconnaissance capabilities has driven the development of such technologies in Japan. As of 2022, Japan has the third-largest space budget and the fourth-largest number of orbital satellite assets. With seven reconnaissance satellites, Japan is also developing its own defense satellite communications system and pursuing a space situational awareness radar.\footnote{Kim Jin-woo, “우주 안보 강화하겠다는 일본...‘민간위성의 정찰위성 활용 검토’,” 경향신문, 23 September 2019, https://m.khan.co.kr/}

In addition, Japan and the United States have a strong space partnership. The two countries signed a space situational awareness agreement in 2013 and are participating in a space situational awareness training event called Global Sentinel and the Schriever Space Wargame. Moreover, in 2021, Japan deployed a liaison officer to headquarters US Space Command to strengthen information exchanges between the two countries and is strengthening space cooperation throughout the Indo-Pacific region.\footnote{“25 Nations Participate in Global Sentinel 22,” U.S. Space Command, 3 August 2022, https://www.spacecom.mil/; “Schriever Wargame 2023 Concludes,” Space Training and Readiness Command Public Affairs, 3 April 2023, https://www.starcom.spaceforce.mil/; and “U.S. Space Command Commander travels to Japan to strengthen space cooperation,” U.S. Space Command, 22 March 2022, https://www.spacecom.mil/}

Similarly, South Korea has been strengthening its space partnerships, although it has not yet progressed to developing capabilities collaboratively like the US and Japan. However, there has been an increase in international participation in South Korea’s space affairs in recent years. In 2022, the defense ministries of South Korea and the US agreed to conduct joint studies on space policy. Furthermore, South Korea is enhancing its cooperation with Australia, the United Kingdom, France, and India.

Seoul should continue to strengthen its cooperation with the United States and Japan and consider sending a liaison officer to the US Space Command to establish a cooperative system. The command already operates with liaison officers from Canada, Australia, New Zealand, the United Kingdom, France, Germany, and Japan, and plans to integrate command, control, and space situational awareness data and software tools. Therefore, it would be beneficial for South Korea to establish a cooperative system through human exchanges as soon as possible.
South Korea’s positioning, navigation, and timing (PNT) satellite businesses can create momentum for additional collaboration. In 2021, South Korea and the United States signed a joint statement on cooperation in global navigation satellite systems to jointly support the development of South Korea’s own navigation satellite system, Korea Positioning System (KPS), and strengthen interoperability. South Korea’s independent PNT capabilities could serve as a useful supplement to GPS, and this collaboration could open up more opportunities for joint development.

South Korea should further expand information-sharing channels with Japan to ensure direct and rapid information sharing, given Japan’s various space information assets. As North Korea’s threats grow, efforts to share information between the two countries become crucial. The information assets or networks of each country can upgrade situational awareness, thus enhancing regional security cooperation. Therefore, building a new South Korea–Japan relationship in the space domain will be an important factor in successful integration.

In addition, South Korea can contribute to regional security by expanding its international cooperation in the space domain. Currently, South Korea is focused on integrating into the Indo-Pacific Partnership for Maritime Domain Awareness, which moves beyond the traditional South Korea–US alliance and pursues a more active role on the international stage. Seoul could also consider joining the Quadrilateral Security Dialogue (Quad) of key Indo-Pacific allies—including India, Japan, the United States, and Australia—to work directly on security issues. To achieve greater goals in the Indo-Pacific region, Seoul should strengthen relations with Australia and India beyond its current partnerships with the United States and Japan, as they are also important regional players.

By joining the Quad, South Korea would establish strong space relations with individual countries in complementary areas of interest, such as technology transfer, interoperability, and securing supply chains to strengthen resilience. In particular, South Korea’s space situational awareness system, micro-sized reconnaissance satellites, early warning satellites, and KPS satellites would contribute to space deterrence and allies’ cooperation in sharing space information. This pro-

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vides a strategic option for the United States to focus its capabilities on the space race with China in the Indo-Pacific region.

**Civilian–Military Cooperation**

As we enter the new space era, the role of private-sector actors has significantly increased. However, these private ventures often have some ties to the military-industrial complex. In the United States, private companies provide communication, surveillance, and reconnaissance services to the military intelligence, and various civilian technologies developed with government investments are also being used for military purposes.

Several private companies, including Planet Labs, SpaceX, and Capella Space, played a crucial role in providing internet services and satellite imagery to US, NATO, and Ukrainian officials during the Russian invasion of Ukraine. For instance, Planet Labs provided imagery that refuted Moscow’s claim of troop withdrawal from the Russian border. SpaceX-supported Starlink terminals and antenna equipment in Ukraine for information acquisition and confidential transmission. Capella Space provided satellite radar images to Ukraine, and Hawkeye 60 detected Russian GPS jamming signals and alerted Ukraine. The development of private-sector actors is vital to bridging the gap in space development among partner nations. Private commercial companies offer space services, such as radar images and global data communication, as well as high-resolution imagery. Although these services may not be as high-quality as national satellite services, they can be shared without security restrictions, allowing for fast information dissemination. National space development projects can be costly and time-consuming, and cooperation with private commercial companies can help prevent gaps in necessary capabilities. However, interoperability between civilian and military space assets must be improved to achieve this goal. Civilian and military space assets differ in purpose and performance. For example, military reconnaissance satellites prioritize performance, such as accuracy and speed, over cost, while civilian satellites prioritize cost-effectiveness. Furthermore, the development trend of synthetic-aperture radar (SAR) satellites suggests a difference in operational method or performance between past and current image information acquisition systems. Therefore, technical cooperation from the initial stages

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should be pursued to enable mutual supplementation between image information acquisition systems.

**Table 2. Trends of SAR satellite development**

<table>
<thead>
<tr>
<th>SAR Satellite Development Trends</th>
<th>Past</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>Large</td>
<td>Small</td>
</tr>
<tr>
<td>Mission</td>
<td>Multiple</td>
<td>Single</td>
</tr>
<tr>
<td>Development Cost / Period</td>
<td>High / Long-term</td>
<td>Low / Short-term</td>
</tr>
<tr>
<td>Performance / Weight</td>
<td>Low / High</td>
<td>High / Low</td>
</tr>
</tbody>
</table>

During the Trump administration, the United States promoted the commercialization of space by easing regulations and encouraging private companies to participate in space development. As a result, the role of commercial actors in national security has increased, especially in satellite communications, which were previously limited to military agencies. Additionally, Washington is implementing a technology export mitigation policy and fostering international cooperation to promote technology development. South Korea can actively seek space cooperation with US private-sector actors in accordance with these US policy changes.

Meanwhile, South Korea’s satellite development technology lags behind that of other advanced countries. While structural technology, including satellite bodies and payload parts, has reached a significant level, there is a need to develop sensors, drivers, and mounting software for mission performance in orbital and posture-control fields. Additionally, data-fusion technology for SAR and electro-optical/infrared (EO/IR) image information is weak. Therefore, it is crucial to establish an international technical cooperation system to secure scarce technologies and develop core technologies.

**Organizational Development**

Advanced spacefaring countries, such as the United States, Australia, and Japan, typically have independent space agencies such as NASA and the Australian Space Agency, as well as military or intelligence agencies responsible for developing and operating reconnaissance satellites. These countries have systematic organizations for controlling and operating satellites for national security purposes. In contrast, South Korea lacks an independent organization dedicated to national security in the space domain, which hinders effective coordination and cooperation. Therefore, there is a need to restructure South Korea’s current fragmented space efforts to promote efficient coordination and effectiveness.
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Table 3. Space agencies and bureaucracies of selected nations

<table>
<thead>
<tr>
<th>Nation</th>
<th>Government Departments/Ministries</th>
<th>Space Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>Department of Transportation (DOT), Department of Defense (DOD), Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), Department of Energy (DOE)</td>
<td>National Aeronautics and Space Administration (NASA)</td>
</tr>
<tr>
<td>France</td>
<td>Direction générale de l’armement (DGA), Office National d’Etudes et de Recherches Aérospatiales (ONERA), Centre national de la recherche scientifique (CNRS)</td>
<td>Centre national d’études spatiales (CNES)</td>
</tr>
<tr>
<td>Germany</td>
<td>Bundesministerium für Wirtschaft und Energie (BMWi)</td>
<td>Deutsches Zentrum für Luft- und Raumfahrt (DLR)</td>
</tr>
<tr>
<td>Israel</td>
<td>Technion - Israel Institute of Technology (IIT), Israel Aerospace Industries (IAI)</td>
<td>Israel Space Agency (ISA)</td>
</tr>
</tbody>
</table>

In this respect, a pan-government control organization is required to collaborate with government ministries, carry out legal and institutional development, and oversee space policy development and cooperation. Such an organization can serve as a unified interface for civilian-military cooperation while ensuring efficient operation and integration of civilian-military common space assets.

Next, South Korea’s ability to efficiently improve its space operational capabilities is hindered by the lack of laws and institutions that specify the forces responsible for conducting space operations and managing space assets. As demand for military satellites, such as reconnaissance satellites, grows, sufficient budget and manpower must be allocated by establishing forces responsible for coordinating and controlling them through amendments to the Act on the Organization of National Armed Forces. Additionally, a Space Command should be created to independently conduct military space operations and enable integrated efforts and cooperation for space security.

In 2019, the United States established an independent US Space Force (USSF), which separated the new service from the US Air Force. Other developed countries with advanced space programs are also strengthening their space operational capabilities by establishing similar organizations, often centered on the nation’s air force. This is because air forces are efficient in developing space assets due to inherent similarities between the space and air domains. In light of this trend, Seoul may consider developing its space operational capabilities centered on the Republic of Korea Air Force (ROKAF).
In 2022, the United States established the Space Forces Indo-Pacific as a component of the US Indo-Pacific Command. Also, in December 2022, the United States activated US Space Forces Korea. These developments are believed to be aimed at deterring China, which is considered the United States’ biggest strategic threat, and North Korea, which poses a threat with its nuclear missile program. These USSF commands are aligned with the trend of other developed countries strengthening their space operational capabilities. Therefore, it is necessary for South Korea to establish its own Space Command dedicated to responding to missile attacks and military threats in the space domain. This would enable South Korea to participate in joint combined exercises and training and to conduct stable and integrated space operations.

Conclusion

First, South Korea should prioritize the promotion of international cooperation with advanced space nations to advance its military space capabilities. To achieve this, South Korea should broaden its space partnerships with the United States and Japan by engaging in personnel exchanges and information-sharing programs. Moreover, South Korea can potentially enhance space cooperation through participation in the Quad, contributing to regional security and collaborating on complementary areas of interest.

Second, South Korean policy makers should promote increased civilian-military cooperation in the space domain. Enhancing interoperability between civilian and military space actors is necessary to prevent gaps in capabilities. Furthermore, establishing an international technical cooperation system would be beneficial for the development of core space technologies.

Finally, it is crucial to reorganize South Korea’s decentralized space efforts to accelerate its space development. This can be achieved by establishing a pan-governmental control organization that collaborates with government ministries to promote space cooperation and oversee legal and institutional development. Additionally, South Korea should assign the Republic of Korea Air Force (ROKAF) as the lead for coordination and control and create a Space Command dedicated to conducting stable and integrated space operations. By implementing these changes, South Korea can enhance its space capabilities and play a more significant role in promoting regional and global security.

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