

A Study on the Space Development Race between South and North Korea and suggestions for South Korea's space policy

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Abstract

This paper analyzed the competition between the two Koreas in space development and presented suggestions on the direction of South Korea's space power development. The Korean Peninsula is in a competition with major countries with most advanced space technology such as the United States, China, Russia, and Japan. Amid intensifying competition between the United States and China over space supremacy, South Korea, a party to the Korean Peninsula, should be prepared for space competition and improve its space capabilities. In particular, it is necessary to present the direction of South Korea's space power development by analyzing the space development competition between the two Koreas and studying North Korea's space threats. Since 1990, the two Koreas have carried out space development in earnest. North Korea's space development has focused on space launch vehicle development while South Korea's has centered on satellite development due to the South Korea-U.S. missile guidelines.

Unlike South Korea's peaceful space development, North Korea's space development poses a threat to South Korea's security; the better North Korea's capability to launch intercontinental ballistic missiles has become, the greater threat it has posed to South Korea's security. This study is meaningful in that it analyzes the space development process and threats between the two Koreas and studies ways to develop Korea's space power. Although South Korea's space technology is far behind that of other major space powers, the successful flight of Nuri, a Korean space launch vehicle, in October 2021 exhibited South Korea's advanced space technology and demonstrated its space capabilities. Through this study, we will hope to highlight the importance of space development and help build a consensus on the development of South Korea's space power.

Keywords: *Space development, Space race, Space cooperation, Space Launch Vehicle, Space power*

I. Introduction

In his New Year's address in 2017, Kim Jong-un announced plans to launch intercontinental ballistic missiles and insisted on completing North Korea's nuclear power after successfully conducting the 6th nuclear test in September 2017 and the Hwasong-15 test in November 2017. However, as military pressure on North Korea increased due to the heightened crisis on the Korean Peninsula, North Korea expressed its intention to participate in the PyeongChang Winter Olympics and shifted its strategy to a dialogue phase by insisting on peaceful coexistence.¹⁾ The North Korea-U.S. summit was held, but it was futile and North Korea's provocation continued. At the military parade to mark the 75th anniversary of the founding of the North Korean Workers' Party in 2020, North Korea unveiled its newest inter-continental ballistic missile (ICBM), Hwasong-16, which heightened the concerns about North Korea's nuclear capability. In addition, in 2021, competition over weapon development on the Korean Peninsula intensified as evidenced by North Korea developing a North Korean version of KN-23 Iskander and carrying out the hypersonic missile test.

While space in the era of the Fourth Industrial Revolution has become a key area for military operations and security, the United States, China, Russia, and Japan monitor military activities on the Korean Peninsula in advance and continue reconnaissance and diplomatic activities for their own benefit. The United States conducts the most advanced civilian and military activities in space, using advanced science and technology. China carries out space exploration through its satellite, manned spacecraft, and moon exploration projects. Russia resumed space activities under Putin's strong leadership and vision, although it has been somewhat sluggish since the Cold War space race. Japan has secured satellite and its own projectile technology through scientific and technological cooperation with the United States, which now enables Japan to operate image-observing satellites with reconnaissance satellite-class performance. Since recognizing the importance of space development, the two Koreas, the parties to the Korean Peninsula, have engaged in space development. South Korea focuses on the development and operation of satellites under the control of missile and projectile technology due to the South Korea-U.S. missile guidelines while space development of North Korea, which successfully launched satellites twice, centered on space launch vehicles (SLVs).

It is important to scrutinize and compare the space strategy and space capabilities of the two Koreas and devise ways to develop space power to strengthen Korea's space power development. However, to date, there have been more studies by the ROK Air Force and Korea Aerospace Research Institute on ways to develop and strengthen South Korea's space power solely rather than comparative studies that

1) Koh Yu-hwan, "The Moon Jae In Government's Peace Priority and Non-Nuclear Peace Process" *North Korean Studies*, Volume 14, No. 2, 2018, p.6.

compare the space development of the two Koreas. Despite the high industrial ripple effect of space technology as space is an operational domain of a new war, there are too few studies that contribute to strengthening South Korea's space power.

As a representative study on South Korea's space capability, Cho Hong-je emphasized the construction of South Korea's space capabilities, explaining North Korea's nuclear missile strategy and the competition between the two Koreas and neighboring countries for space.²⁾ Choi Sung-hwan evaluated the space threats posed by neighboring countries in the era of space competition and suggested direction of the construction of the Korean Air Force's space power.³⁾ Park Byung-kwang analyzed the trend of space militarization in Northeast Asia and suggested policy measures that would set the direction of space development of the Korean Air Force.⁴⁾ Kim Jong-beom introduced the government-led Korean space development project and discussed the development of Korean Space launch vehicles and satellites. It emphasized the importance of international cooperation to strengthen Korea's space development.⁵⁾ Bae Hak-young proposed a conceptual development and organizational development plan for space operation to realize the direction of space power development of the Navy in the era of space battlefields.⁶⁾

In this paper, to establish South Korea's space development and space power development plan, we examined North Korea's space development and space

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- 2) Cho Hong-je, "Korea's Space Security Policy Development Study," *Aerospace Power Research*, Vol 6, 2018; Cho Hong-je insisted on building space for strong defense to prepare for threats from North Korea and neighboring countries with missile capabilities, stressing the development of an advanced space security operating system.
 - 3) Choi Sung-hwan, "Evaluation of Space Threats in the Era of Space Competition and the Direction of the Korean Air Force's Space Force Construction," *Aerospace Power Research*, Vol 7, 2017, insisted on building its own space conditions by cooperating with civil and military forces.
 - 4) Park Byung-kwang, "The militarization of space in Northeast Asia and the security of the Korean Peninsula: Implications for the Korean Air Force," *National Defense Research*, Volume 55, No. 2, 2012; Park Byung-kwang argued for the expansion of the Korean Air Force's space command, expanded exchanges with civilian agencies, and operated independent satellites while studying space trends in neighboring countries to cope with space militarization in Northeast Asia.
 - 5) Kim Jong-beom, "The trend of space military power in the international community and Korea's space strategy," *2020 Aerospace Power Seminar*, 2020; Kim Jong-beom argued for the development of Korean space power through strengthening cooperation with advanced space development countries, explaining major space development plans such as independence of space launch technology, satellite utilization services, space exploration and Korean satellite navigation systems.
 - 6) Bae Hak-young, "Direction of Naval Power Development in the Space War Era," *National Defense Research* Volume 64 No. 2, 2021. Bae Hak-young analyzed the current Navy's space operation capabilities by explaining the characteristics of naval power with high dependence on outer space. While suggesting the Navy's leading direction of space power development, it insisted on the need for research on the Navy's space operation at the level of the Ministry of National Defense.

development capabilities and threat analysis.

II. Space development and understanding of space power

1. Concept of space development and space power

Space development is all activities related to the use, exploration, and acquisition of space technology by fabricating and launching space launch vehicles and satellites.⁷⁾ Advanced space powers continue to invest in space development and develop advanced science and technology. The space industry is a key national industry that is highly value-added and technological with a very large technology ripple effect on other industries. According to a recent global investment agency Morgan Stanley's space industry report, the global space industry, worth \$447 billion in 2020, will grow about 2.5 times to \$1.1 trillion by 2040.⁸⁾ Interest and investment in space development continue to increase.

Space power enhances national economic power and industrial technology, and through the success of space development, it can increase public pride and provide convenience to people's lives by utilizing satellite information. In addition, space power judges military threats from enemies based on various information collected in space and supports the preparation of military operation plans.⁹⁾

While explaining space power, Lupton, a space power theorist, emphasized the importance of space technology to achieve national goals, as space technology can be used simultaneously by military and civilian sectors.¹⁰⁾ Hyatt explained that space power can help achieve national goals through space control and space exploration development.¹¹⁾ Jusell defined the ability to develop and control outer space as space power and explained that space is used for political, economic, and security purposes.¹²⁾

Explaining the military operation of the space force, Lupton argued that space control, which guarantees allies' freedom of space operations and can reject enemy threats, is the core of space strategy and is essential to ensure victory in war. Oberg, a former NASA space scientist, argued that space exists as a distinct area, technological

7) The Ministry of Science and ICT, *2020 Space Development White Paper* (Sejong: Ministry of Science and ICT, 2020), p.35.

8) Morgan Stanley, *Space: Investing in the final frontier*, July 24, 2020, <https://www.morganstanley.com/ideas/investing-in-space>(accessed on 2021.10.30);

9) Lee Seong-man and Kang Chang-bu, "Aeronautical Space Force Operation, Theory and Practice" (Seoul: Oreum, 2015), pp.397-398.

10) Lt Col David Lupton, *On Space Warfare* (Montgomery: Air University Press, 1988), p.4.

11) Hyatt, III, James L. "SPACE POWER 2010", ACSC, Maxwell AFB, Alabama, 1995, pp.5-6 <https://fas.org/spp/eprint/95-010e.pdf>(accessed on 2021.2.27.)

12) Jusell, Judson J., "SPACE POWER THEORY A RISING STAR", ACSC, Maxwell AFB, Alabama, 1998, pp.7-9. <https://fas.org/spp/eprint/98-144.pdf>(accessed on 2021.2.27.)

competition is essential to become a space power, and space control is the core of national power. It also argued that space dominance should be achieved through real-time space surveillance for space power development.¹³⁾ Dolman, a professor at the U.S. Air University, explained space power from a realistic point of view and insisted on building the ability to block threats from hostile forces to ensure freedom of navigation in space.¹⁴⁾ In addition, the United States Joint Publication of Space Operations 3-14 defined Space Power as the total strength of a nation that can perform and influence operations from space, through space, and in space to achieve national goals.¹⁵⁾ Space power is one of the important elements constituting national power, and major space powers recognize strengthening space power as a key element to ensure national security and strive to improve space power, including space technology development.

2. International Space Treaty and Space Development Research Method

During the Cold War era, it began in the area of detecting and providing information on the enemy's military movements through satellites in space and developed into various areas such as communication, navigation, and weather. From the military point of view, space has made operation of precision-guided arms possible through navigation satellites since the Gulf War, and space operations have become the most important area to guarantee victory in modern wars such as Iraq and Afghanistan. Space operations are so essential to the war that the United States cannot carry out advanced wars without the support of space assets. Major Northeast Asian countries are developing science and technology and building space military capabilities in the space sector to strengthen their space capabilities.

At the outset of space development between the United States and the Soviet Union, the Peaceful Uses of Outer Space and International Law was signed to ensure the peaceful use of space. After the competition between the United States and the Soviet Union for space development, the international community is developing space based on the space treaty. In particular, the Space Treaty prohibits military space activities. Article 4 of the Treaty prohibits the deployment of nuclear weapons or all mass destruction weapons into space orbit, and member states are prohibited from constructing military bases, fortification, and weapon testing on space celestial bodies for peaceful development purposes.¹⁶⁾ As U.S. space-based activities are very active and space technology plays a

13) James E. Oberg, "Toward a Theory of Space Power: Defining Principles for U.S. Space Policy" (lecture, Army & Navy Club, Washington DC, 20 May 2003)

14) Everett C. Dolman, *Astropolitik: Classical Geopolitics in the Space Age* (London: Frank Cass, 2002)

15) US JCS, *Joint Pub 3-14*, 2013.

16) UN Office for Outer Space Affairs, *UN Treaties and Principles on Outer Space*, New York, 2008, p.3 ; Ministry of Foreign Affairs, *Non-Proliferation Handbook 2021* (Seoul: Office of Foreign Ministry's Non-Proliferation, 2021), p.257; Jeong Gu-don, *Research on Civil and Military Technology Cooperation Method* (Seoul: Security Management Research Institute, 2016), p.28.

big role in the war, China and the Soviet Union continue to engage in military testing activities, including satellite interception missile tests and satellite operations. A set of assessment factors must be developed to evaluate the country's space development capabilities and threats. Kazuto Suzuki analyzed the nation's space development from an international political point of view based on three factors: hard power (military use of out space); soft power (the pride of success of space development programs); and the establishment of social infrastructure through satellite services.¹⁷⁾ Using Kazuto Suzuki's perspective on space development as a research method, this study aims to analyze and evaluate the space development and capabilities of the two Koreas and suggest ways to develop space power necessary for Korea. Table 1 shows different research methods on the national space development.

<Table 1> Space development research purpose

Category	Judging space development	Examples
Space Development	Military use of outer space	The ability to build satellites and space projectiles, attacks on foreign satellites and space assets, development of space-based weapons systems. Developing missile technology and spreading it to the outside world.
	Enhancement of nation excellence, status, and develop science and technology	The development of advanced space science and technology. Launch manned spacecraft, raise national status. Promote international exchange.
	Establishing a foundation for social Infrastructure	Communication, navigation, geography. Disaster information service provided

Source: Kazuto Suzuki, Lee Yong-bin translated, *Space Development and International Politics* (Seoul: Hanul Publishing), 2013, pp. 24-34.

17) Kazuto Suzuki, Lee Yong-bin translated, *Space Development and International Politics* (Seoul: Hanul Publishing, 2013), pp. 24-34.

III. Analysis of Space Development Competition and Threats between South and North Korea

1. North Korea's space development strategy and space power

South Korea's biggest military threat is North Korea. In general, to have independent space capabilities, countries must own space launch sites and possess the ability to build and launch satellites.¹⁸⁾ North Korea has space launch sites in Taepo-dong and Dongchang-ri and has manufactured a total of six satellites, of which only two have entered orbit. North Korea's missile and rocket technologies have the ability to put its own satellite into orbit. Through the development of strategic weapons such as nuclear, intercontinental ballistic missiles, and submarine-launched ballistic missiles (SLBMs), North Korea has made every effort to develop space satellites, including reconnaissance, communication, and early warning satellites, to break down North Korea's isolation and strengthen negotiating power.¹⁹⁾

After the Middle East War, North Korea introduced Scud B missiles from Egypt in 1976 and began developing missiles for the first time through reverse decomposition research. Eventually, North Korea built an improved version of Scud, Nodong missiles, and Taepo-dong 1 and 2 thanks to missile manufacturing technology and design capabilities acquired through missile-reverse engineering. The Unha-2 and Unha-3, and Kwangmyeongseong long-range rocket to mount satellites using Taepo-dong missiles were developed and used to enter space orbit. Attempts to launch satellite using Taepo-dong 2, Unha-2, and Unha-3 continued to fail, but the launches of the second Unha-3 in 2012 and Kwangmyeongsong in 2016 were successful. However, contrary to North Korea's announcement, the two satellites currently operating in space orbit are believed to have lost satellite function due to limited transmission and operation of satellites.²⁰⁾

Considering that North Korea tends to conduct nuclear tests before and after satellite launches, it is estimated that North Korea's satellite launches will conduct missile test data of ICBM launches and performance tests of major missile components. Russia was once in trouble due to the lack of technology to re-enter the Earth, but it earned international reputation as the world's first satellite launcher that used ICBM projectiles to enter space before the United States did. North Korea's

18) Tomifumi Kodai, Kim Kyung-min translated, *Space Development in Japan and China* (Seoul: Enbook, 2009), p. 13.

19) Cho Sung-ryul, *International Politics of Strategic Space* (Seoul: Sogang University Press, 2016), p.80.

20) Kim Gwi-geun, "North Korea attempted to enter satellite orbit six times..." "Two successes". Yonhap News Agency, April 22, 2021, <https://www.yna.co.kr/view/AKR20210422100000504?input=1195m>(accessed on 2021.7.29)

Kwangmyeong 3 satellite in 2012 was surprisingly similar to the appearance of South Korea's first satellite launched in 1992.²¹⁾ Considering that it was similar, it can be evaluated as improving the performance of missile projectiles and obtaining missile launch test data through space projectile tests rather than launching low-performance satellites with a large-scale budget space development.

North Korea's space strategy is very limited to grasp due to the lack of external public information. However, it is estimated that North Korea has established and implemented its national space strategy, considering the characteristics of large-scale national budget and space development under long-term plans.

North Korea is expressing peaceful space development externally in accordance with the UN principles of peaceful space development. The official North Korean space development agency is the National Aerospace Development Administration (NADA). However, the NADA is an official agency organized in 2013 to avoid U.N. sanctions when the North Committee of Space Technology was subject to sanctions for continuing ballistic missile development.

North Korea claimed that it developed satellites in accordance with the first five-year space development plan for five years from 2012 to 2016 and successfully sent Earth observation satellites twice in space orbit. Following the failure of the launch of Kwangmyeongseong 3 in April 2012, Kwangmyeongseong 3-2 was successfully launched in December 2012. Based on the space science and technology used to build the Earth Observation Satellite that was successfully launched, North Korea began developing geostationary satellites, strengthening the satellite control capabilities of the Earth Satellite Control Center, and successfully launched Kwangmyeongseong 4 in 2016.²²⁾

It is estimated that the 2nd National Space Development Five-Year Plan has been established and implemented since 2017, but space development-related activities such as long-range rockets and satellite launches have not been detected until December 2021, the last year of the five-year plan after the intercontinental ballistic missile success test in 2017. This explains that North Korea's space activities are likely to develop for military purposes, including the development of intercontinental ballistic missiles and hypersonic missiles.

North Korea's space power can use long-range rocket technology to manufacture space launch vehicles and put satellites into low orbit at an altitude of 500 km. It can be speculated that there are some restrictions on performing a given mission in response to the harsh environment of a satellite in space. North Korea's ability to interfere with or curb the dominant space operation capabilities of the ROK-US

21) Cowing Keith, "North Korea's Satellite Launch Flops." *MSNBC*, 2012.4.12.
<http://nasawatch.com/archives/2012/04/google-earth-is.html>(accessed on 2021.6.22)

22) "The National Space Development Plan mentioned by North Korea," Yonhap News Agency, February 8, 2016, <http://www.yonhapnews.co.kr/bulletin/2016/02/07/0200000000AKR20160207050400014.HTML?input=1195m>(accessed on :2021.7.8)

cooperation is still low. However, since the ROK-US combined military operations are supported by the space system, it will try to build the ability to interfere with the operation of space assets, including early-warning satellites for detecting missile and nuclear explosion, GPS satellites for precision-guided weapons, command control, and long-distance communication satellites. North Korea possesses electronic jamming capabilities that can target GPS satellites and South Korea-U.S. communication satellites located in geostationary orbit and continues to develop space technology as an asymmetric space power, which requires countermeasures.

The Defense Intelligence Agency (DIA) has determined North Korea's independent space launch capability and satellite jamming capability pose a threat to U.S. space security by enabling the country to test intercontinental ballistic missiles and attack foreign satellites in the event of a conflict. North Korea is assessed to have electronic jamming capabilities for navigation and communication satellites and that major missile flight data information obtained by launching long-range rockets can be used for intercontinental ballistic missile developments.²³⁾

The Center for Strategic and International Studies (CSIS) reported that North Korea's ballistic missile and space launch capabilities provide basic technology that could be used to attack other satellites and detonate non-precise warheads around target satellites in the future, which will cause major damage to satellites. In addition, North Korea recently succeeded in developing a super-strong electromagnetic pulse (EMP) weapon, which could attack South Korea and the U.S. space assets, and attempted an attack on a target satellite near space orbit through a nuclear explosion.²⁴⁾ It also noted that North Korea's advanced hacking capability has a very high threat of cyber hacking to major U.S. space ground systems and satellite operation control stations.²⁵⁾ North Korea's space capability is very primitive compared to that of Russia and China, but its cyber-attack capability poses a big threat to U.S. space assets.²⁶⁾

2. South Korea's space development strategy and space power

South Korea continues to develop space programs led by the Ministry of Science and Technology. The Air Force continues to lead manpower investment and space operations in the space sector to advance to the aerospace force. Although South Korea maintains a combined defense posture through surveillance of North Korea's

23) Defense Intelligence Agency, *Challenges to security in space* (Washington D.C: DIA, 2019), p. 32.

24) Harrison Todd, "Space threat assessment 2020," CSIS Aerospace security project, Mar 2020, pp. 38-40.

25) Gabriel Dominguez, "North Korea, Iran advancing counter-space threats, says USSPACECOM chief", <https://www.janes.com/defence-news/news-detail/north-korea-iran-advancing-counter-space-threats-says-usspacecom-chief>(accessed on 2021.7.29.).

26) Harrison, Todd, *Space Threat Assessment 2021*, March 2021, p. 25. <https://www.csis.org/analysis/space-threat-assessment-2021>(accessed on 2021.4.22)

military movements that utilizes the U.S.-South Korea joint surveillance assets, the operation of independent surveillance assets that do not rely on U.S. intelligence surveillance assets has limitations on improving the South Korean military's space power. Since satellite development and satellite launch vehicle development were carried out under the control of the Ministry of Science and ICT, there are restrictions on the military's independent and leading space development. In 2021, the government announced that it would develop into a world space powerhouse by adopting three major space strategies: promoting space exploration projects through the development of South Korean launches, developing satellites, supporting national services using satellites, and strengthening civilian space development capabilities in the New Space era.²⁷⁾ In October 2021, it succeeded in testing the first Korean space launch vehicle (SLV), Nuri.

According to the Ministry of Science and ICT's 3rd Basic Plan for Space Development, the number of satellites in Korea is currently operating and does not have satellites exclusively for the military, but in July 2020, SpaceX, a private space company, launched and operates South Korea's first military-only communication satellite.

The development of satellites began in the 1990s, and optical observation satellites and radar satellites are used for civilian purposes, but their low resolution limits their use in military operations. Korea's national space development budget is \$720 million, which is very low compared to other space powers.²⁸⁾ Amid intensifying space competition among neighboring countries surrounding the Korean Peninsula, South Korea has not invest enough in space technology. In the Ministry of National Defense's 2019-2023 mid-term defense plan, the proportion of space power, including reconnaissance and communications satellites, is very low at 2.8% of the total budget for improving defense capabilities.²⁹⁾

South Korea seeks to expand surveillance and reconnaissance assets that depend on the U.S. to transfer wartime operational control, but it relies heavily on the U.S. intelligence capabilities due to the lack of high-resolution sensor technology essential for military satellites and the lack of independent space launch vehicles. As a result of the May 2021 summit between South Korea and the U.S., the ROK-U.S. missile guidelines were lifted, which eliminated restrictions on the range and warhead weight of missile development, and the signing of the Artemis Agreement with the U.S. has increased space development cooperation between South Korea and the U.S. Recently, the test flight of the South Korean SLV Nuri was successful, but the dummy satellite failed to enter the final orbit. However, it has achieved great

27) The Three Space Strategies Announcement, *Dong-A Science*, 21.3.25.

28) Morgan Stanley, "Space: Investing in the final frontier," July 24, 2020, <https://www.morganstanley.com/ideas/investing-in-space>(accessed on 2021.10.30);

29) Yoon Woongjik, "The trends of space development in neighboring countries and what we need to prepare," *National Defense Foundation*, No. 1785, 2020, p. 7.

results in verifying the performance of Korean space launch vehicles. The Agency for Defense Development (ADD) has succeeded in testing space launch rocket engines using solid fuel and plans to carry out micro-reconnaissance satellite projects, which are expected to actively develop the space capabilities of South Korea in the future.

As security cooperation between South Korea and the U.S. in outer space continues, the Air Force shares space situations on space objects and satellites over the Korean Peninsula with the U.S. Space Command to avoid threats and support safe space activities. However, as it shares U.S. space information, it has limited independent space surveillance activities, lacks the ability to respond to space threat activities in other countries, and has difficulty securing additional space power due to budget use related to aircraft systems such as fighter plane purchases and flight operations.

Recently, the Army has recognized the importance of space operations and pushed for the Pegasus Project, a basic plan for the development of the Army's space power. In the Future War, ground operations plan to lead joint operations by expanding the scope of operations using space and improving the Army's ability to operate space to ensure victory in war, and consensus on the importance of space operations at the Army level is increasing.³⁰⁾ The Navy is striving to strengthen its naval power to carry out space operations by adding the doctrine of space operations in naval operations. However, in the defense sector, there are too few space-related experts and no detailed defense space development plan has been established, so space operational capabilities must be strengthened by establishing a defense space development plan and space power plan at the Ministry of National Defense.

3. Analysis and evaluation of competition for space development between the two Koreas

(1) Military use of outer space

When evaluating the military use of North and South Korea's space assets for military operations, North Korea succeeded in entering space orbit twice with its own space launch vehicle. North Korea is trying to obtain intercontinental ballistic missile capabilities through the development of long-range rockets for space development. If North Korea launches a long-range rocket for the purpose of space development, it will develop a satellite with better performance. However, the satellite developed by North Korea was similar to the low-level satellite developed by South Korea in early 1990. Securing space technology through the development of long-range rockets can give North Korea technical confidence in the development of ballistic missiles. During the second five-year space development plan from 2017,

30) Kim Sang-yoon, "The Army and Space Power Development 'Pegasus Project' promoted," Kookbang Ilbo, July 8, 2021. https://kookbang.dema.mil.kr/newsWeb/20210709/4/BBSMSTR_00000010023/view.do(accessed on Oct. 24, 2021).

North Korea continued to launch ICBM tests, develop KN-23 North Korean version of Iskander, and the Hwasong-8, hypersonic missile tests, and did not launch satellites. It can be estimated that North Korea's purpose of space development is to calculate major data on missile development through space launch vehicle tests and improve ICBM technology capabilities. South Korea is not able to respond to North Korea's intercontinental ballistic missile development and space threats effectively as its ability to detect missile launches and provide warnings is primitive. South Korean military satellite projects are underway to expand reconnaissance surveillance capabilities for North Korea, but military utilization of the space is at a low level. Recognizing the importance of space operations, it is not easy to invest in the space sector that requires astronomical budgets because a lot of information is supported by the U.S. Currently, North Korea's threats in space include electronic attacks such as jamming on satellites and high-performance EMP bomb attacks, which are the biggest threats to the ROK-US alliance.³¹⁾

(2) Raise national excellence and status

North Korea uses space development as much as possible to curb public sentiment and maintain internal solidarity as well as its system by securing high-tech science and technology from foreign invasions. The Rodong Newspaper and the Korean Central News Agency promote it as a historical event in which North Korea's excellent science and technology, strengthening its national power, and prosperity are carried out around the world due to the success of launching satellites Kwangmyeongseong-3 and Kwangmyeongseong-4.³²⁾ North Korea is the ninth country in the world to put satellites into space orbit with its own SLVs. North Korea focuses on space development to emphasize internal control and the achievements of the Kim Jong-un regime and is mobilizing ICBM development by securing long-distance rocket science and technology. In addition, the fact that North Korea can launch nuclear missile attacks on other countries by possessing nuclear and missiles has a great impact on enhancing North Korea's status in the international community and strengthening its external bargaining power in denuclearization negotiations.

Since the 1990s, South Korea has been recognized worldwide for its satellite development and operational capabilities through satellite development and overseas satellite launch. South Korea's practical satellite and meteorological satellite mounting sensors are technically as sophisticated as those of countries with advanced space technology. South Korea's space launch vehicle sector has been restricted from developing vehicles due to the South Korea-U.S. missile guidelines, but cooperation with Russia has enabled South Korea to acquire basic capabilities for

31) Pry Peter, "North Korea EMP threats," June 6, 2021, <https://emptaskforce.us/wp-content/uploads/2021/06/REPORTempthreatNK21A.pdf>(accessed on July12,2021).

32) *Rodong Simun*, December 13, 2012; *Korean Central News Agency*, Feb 17, 2016.

SLV development and satellite in-orbit delivery through the success of launching Naro in 2013. The Nuri, launched from the Naro Space Launch Site in October 2021, demonstrated South Korea's remarkable space launch vehicle technology by clustering the four 75-ton engines made with its own technology. Although the three-stage rocket failed to deliver the dummy satellite in orbit due to the early end of the combustion, the successful flight of the Korean space launcher successfully verified the space launcher's flight performance. If the three-stage rocket oxidizer tank pressure error is resolved, the likelihood that next launches in 2022 will be successful is higher. South Korea failed to achieve its goal of bringing a payload of more than 1 ton into space orbit, but succeeded in forming a consensus on the people's interest in space development and active national budget support for space research and development. The Nuri test launch was a long-term space development project with a budget of 2 trillion won over 11 years. Space launch vehicle technology is so difficult that it must be acquired and developed through its own space science technology due to the limitation of international technology transfer. The development and launch of the Nuri that involved a total of 500 private companies was a new turning point for South Korean private space companies to lead space development and improve their technology, and South Korea can take pride in becoming a successful country in space development.

(3) Establishment of social production infrastructure.

Through space development, the space nations can provide satellite image production, mapping, national geography, forest, and agricultural development information based on geographic image information taken through optical satellites. Satellite communication satellites enable real-time communication with countries around the world. Navigation satellites can provide real-time navigation information to vehicles and aircraft. Space development can provide convenience to people in real life based on space technology. North Korea announced that it took and use images captured by satellites, but it is difficult to find specific evidence for actual satellite images and data utilization. Since the North Korea's two satellites currently in operation are believed to have lost their capabilities as satellites, the results of social infrastructure construction have not been confirmed through space development obtained by North Korea through satellite and space launch vehicle development. Although they were reported to be used as an observation satellite and a communication satellite, its actual use is limited due to no announcement from North Korea. In contrast, South Korea's optical satellites send geographic information on the Korean Peninsula and South Korea provides actual satellite data, and sells geographic information data at the request of other countries. Satellite communication is located in geostationary orbit, and the public is using satellite communication services. In addition, meteorological satellites are also located in geostationary orbit, providing weather information on the Korean Peninsula to

support pre-alerts and disaster information, providing useful information to the public. The Korea Positioning System, a Korean satellite navigation system project, will be launched to provide accurate navigation, autonomous driving, and IoT services to the public by having its own satellite navigation system from 2022.

IV. Suggestions for Korea's space power development plan

North Korea's space development and ballistic missile tests pose a direct threat to South Korea. Although space cooperation between South Korea and the U.S. continues, military cooperation in outer space is limited. The reality is that the South Korean military lacks its own ability to respond to North Korea's potential space threats. South Korea's preemptive response to North Korea's space threat is very crucial. Currently, the Korean Air Force is leading the space operation. In recent announcements and academic studies of the Army's Basic Plan for Space Development, space is recognized as the Army's battlefield and calls for military transformation in response to the era of the Fourth Industrial Revolution.³³⁾ However, there are many shortcomings in the practical space sector. Development needs are emerging in various fields such as training space manpower, budget allocation, and space situational awareness capabilities.

Still, the South Korean military has limited actual power for space-based operations. North Korea's space development and space technology research are deepening military threats to neighboring countries by enhancing the latest ICBM capabilities, developing hypersonic missiles, EMP weapons, and satellite attack weapon systems. It is very important to receive support for Korea's insufficient space capabilities through the ROK-US combined defense posture and to develop the space capabilities of the Korean military. In the face of North Korea's asymmetric space asset operation, to prevent the security crisis on the Korean Peninsula, the South Korea-U.S. alliance should be strengthened. The following is a plan and direction for South Korea's space power development and response to the increase in space threats and the militarization of space by neighboring East Asian countries and North Korea.

First, in the era of New Space, private space companies must increase their space technology and international competitiveness. More than 300 private companies and 500 space science and technology personnel were deployed to develop the Nuri SLV to successfully verify the performance of the rocket test. South Korea should also improve the level of science and technology in space launch vehicles and satellite development and increase competitiveness in the international market by securing

33) Jung Min-seop, "A Study on the Innovation of the Future Army's Combat Concept: Focusing on Changes in Combat Concepts Following the Fourth Industrial Revolution," *Military Research*, No. 150, 2021.

technology through private-led space development and intensively fostering space development startups. The space industry in the era of the 4th Industrial Revolution is the most likely area to develop and has high industrial ripple and added values, so the national space power should be improved by developing the South Korean space industry through continuous investment in the country.

Second, it is necessary to foster capabilities to manufacture and operate space projectiles through continuous research and development of space launch vehicles in South Korea, improvement of SLVs, and long-term investment support. Since 1990, South Korea has implemented satellite-centered space development in accordance with restrictions on the development of SLVs imposed by the ROK-U.S. missile guidelines and has been recognized for its satellite manufacturing and operational power around the world. With the successful flight of the first stage rocket with four 75-ton engines from the Nuri SLV in 2021, South Korea was expected to become the seventh country in the world to launch more than one-ton payload into space but failed to enter the final orbit with a dummy satellite due to the early end of the combustion of the third stage rocket with a 7-ton rocket. SpaceX, the top space launch company, failed its first launch in 2006, failed three times in a row until 2008, secured space technology through the process of failure, and is now the best space launch company in the world. Although it had difficulty developing space launch vehicles due to restrictions on the transfer of missile technology, research, and rocket production have achieved great results for 11 years. South Korea should strive to improve satellite launcher technology and build reliability so that it can respond to the increasing need for small and medium-sized satellite launches in South Korea and launch satellites for special missions at any time it wants.

Third, it is necessary to improve the space capabilities of the South Korean military through space cooperation with the US military. The South Korean military should build its ability to respond to increasing space threats, including the North Korean military's GPS jamming, low-level satellite attack missile production, EMP weapon development, and cyber-hacking attacks on satellite systems. The South Korean military should improve its space capability by taking advantage of the increased space development and cooperation in the development of South Korea-U.S. space, including the signing of the Lunar exploration Program Artemis Agreement, the lifting of the South Korea-U.S. missile guidelines, and cooperation. The South Korean military should strengthen its space capability by exchanging information on space situational awareness information with the U.S., establishing an electronic optical space monitoring system, participating in space operations in the U.S., and exchanging professional space personnel. Currently, the Korean Air Force is taking the lead in carrying out space operations between Korea and the United States, and since 2020, the Army and Navy have also recognized the importance of space operations and have been conducting research on space organization composition and doctrine. At the level of the Ministry of National

Defense, it is necessary to establish and implement a plan that would help foster Korean military space experts, organizing organizations, and develop space capabilities. Forming and operating separate units on space development in different branches can lead to conflict between the military branches over space operations, so the Ministry of National Defense should take the lead in building space units and presenting blueprints in space operations. Through a cooperative program with the U.S. Space Command, the South Korean military will have to jointly respond to threats in space and maintain military cooperation with the U.S. Space Command to secure the ability to jointly respond to crises on the Korean Peninsula. The establishment of responsiveness to North Korea's advancement of nuclear missiles and potential space threats will guarantee South Korea's peaceful space development by strengthening the South Korean military's space power and taking a space lead over North Korea.

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