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Space policy and space technology

Chapter 4

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Introduction

The multiple civilian uses of satellites have integrated space activities to our daily lives. This trivialization should not conceal the crucial security dimension of space technologies, which is directly inherited from the beginnings of the space conquest, even if the circumstances have changed.¹

The first artificial Earth satellite, Sputnik, launched on 4 October 1957 in the midst of the Cold War. At that time, the United States and the Soviet Union each sought to promote their political and economic models and to increase their sphere of influence, notably by competing for their “first” achievements in space, and against the backdrop of the development of their nuclear capabilities. This context of rivalry strongly marked the beginnings of space activity and determined some of its lasting characteristics. The symbolic value of having a launcher, allowing for the autonomous launch of a national satellite, is still strong. Being part of this select club, which counts only 11 other members,² becomes an element of national pride that governments easily capitalize on for both national and international public opinion.

Scientific progress is another major component of spatial activity at its onset. Sputnik was launched as part of the International Geophysical Year (IGY), an international scientific event aimed at exploring the earth’s environment from July 1957 to December 1958.³ It is worth noting that the continued use of satellites to gain a global understanding of Earth–space system is found today, 60 years later, in programs studying Global Change. A challenge affecting the whole planet, the study of global change benefits from the growing number of satellites contributing data. The development of small satellites and the increasing accessibility of space technologies through miniaturization and standardization⁴ also allows new actors to acquire an initial spatial competence with both a scientific and a technological appeal.

From now on, the ever-available images of the globe have become indispensable to the management of territories and resources. Furthermore, the development of space technologies for telecommunications and navigation, while already crucial as telecommunications infrastructure, is becoming increasingly important and could allow for a new leap forward, especially with the expected ubiquity of the Internet of Things.

It is therefore at multiple levels that an indisputable security dimension of space policies and technologies is displayed, and consequently that they find their place in the EU–ROC dialogue.

The inherent strategic dimension of space capabilities built at the interface of civilian programs and national security concerns

The early days of the space age combine national strategic concerns and a growing support for international scientific research. The commitment of both the United States⁵ and the Soviet Union to provide the means for the international community to study the earth’s environment beyond the atmosphere is embedded in broader national security concerns. Yet the priorities

of these two giants differ according to their respective geopolitical concerns, thus resulting in different technological skills.⁶ The United States lacked reliable information on Soviet capabilities because of the opacity of the Soviet system and the inaccessibility of its vast territory.⁷ Since 1947,⁸ the satellite has thus been seen as an ideal means for acquiring data, allowing a cartography of the USSR, which has proved indispensable for military purposes.

As for the Soviet Union, it faces other challenges: the remoteness of Soviet bases from the United States' territory and the difficulty of ensuring a credible nuclear strike. While the development of an intercontinental missile was also conducted in the 1950s in the United States, the presence of American bases in Europe makes this technology less decisively important than for the USSR. The first Soviet and American achievements illustrate these particular motivations. The USSR has a powerful launcher, while the United States is very quick to implement the capsule recovery program known as Discoverer, used for photographic reconnaissance.⁹

The capacity to observe the entire planet is therefore not only an essential contribution in terms of strategic competence vis-à-vis a potential adversary, but also a tool for crisis management and for the verification of disarmament agreements.¹⁰ The emergence of civil satellites, such as the American Landsat in 1972 and the French SPOT in 1985, marks the start of a new era of diffusion of images taken from space and accessible to all. The gradual improvement of the image quality over the years¹¹ contributes to a regime of transparency,¹² which limits the risks of escalation by ensuring an increasingly broad dissemination of information.

This dual affiliation – scientific and in the interests of national security – did not disappear 60 years later, though it took different forms. The main motivations of a State to develop a spatial capacity are still the desire to display its mastery of advanced technologies as a sign of modernity, to acquire new means of developing its economy, and to play a greater role on the international scene through its access to information in near real time – usually referred to as “*maîtrise de l'information*.”

Indeed, concrete real-time information concerns about security environments continue to play a vital role in national approaches. Even though Europe and the Republic of Korea first devoted themselves to the development of civil space activities, the improvement of the resolution of space systems and the dual nature of the remote sensing technologies lead to a crucial capability that can represent a new potential in their security relationship. It is ultimately the stance adopted by the bearer of these technologies that plays a decisive role in the display of security objectives, either via national means or through a preference for cooperation based on open information and transparency. From this point of view, the history of European space construction tends to favor the development of science-based systems, just as the sensitive geopolitical situation of the Korean peninsula leads to a predilection for civilian programs.

The unique construction of European space capabilities and the lack of national interest driving forces

The development of space capabilities requires sufficient technological and industrial means available for a national political project. When Sputnik was launched, France and the UK immediately undertook their own national programs, hoping to eventually obtain access to space. In parallel, financial considerations led the main European States (France, UK, Germany, and Italy) to develop partnerships, though this does not mean that they abandoned their own national ambitions. The first European cooperation efforts were set up through various frameworks that did not necessarily rally the different States, as each followed its own logic. The ESRO (European Space Research Organization) is dedicated to the development of scientific satellites and promotes cooperation between Member States and the US. The ELDO

(European Launcher Development Organization) aims to develop a launcher that will provide Europe with a real independence.

The creation in 1975 of the European Space Agency attests to the awareness of the necessity to have a better synergy. Fifteen years after the United States and the USSR, and in a completely different context, European space policy is definitely taking shape. It displays its exclusively civil status in its founding convention. European governments understand that the strategic nature of space activity lies in the mastery of the key technologies needed for its development: launchers and satellites. In 1979, the experimental flight of the Ariane rocket establishes Europe's ambition for autonomy in space, largely carried by France.

Since the ESA's mission is devoted to research and development, the awareness of the strategic and critical dimension of space technologies tends to be lost as soon as the sector developing spatial applications blends into wider sectors of activity. Furthermore, the renunciation of autonomy for programs with a strong connotation of national pride, such as manned flights, reinforces the trivialization of space activities. The agency's scientific satellites are of an excellent standard, as well as its prototypes of applications satellites for Earth observation, meteorology, or telecommunications. Cooperation is the key word, within the ESA but also with the United States and a growing number of other countries, including Japan, India, Russia, and China, among others. In parallel, the Ariane program symbolizes the importance of the commercial aspect, which has now taken precedence in official discourses over means for the assertion of sovereignty, with the latter notion still being imprecise in the case of European integration.

A revival of space policy takes place in the late 1990s and early 2000s with the intervention of a new player, the European community and the publication of a first document, "A Coherent European Strategy for Space" on the initiative of the European Parliament in 1989. In fact, there are several phenomena that favor the establishment of an EU space policy that goes beyond the ESA's technological and scientific competence. The political dimension is decisive because the European Union is an established partner in international negotiations and space is likely to feature more and more in trade agreements.

The economic dimension of space applications and the gradual establishment of an industrial policy related to aerospace business combinations on a European scale also contribute to the definitive involvement of the European Commission in space affairs. Furthermore, the acknowledged importance of information in building a knowledge economy provides an additional reason for the commission to become involved. At last, the European Single Act established in 1998 conferred a broader mission upon the European Community, with regard to political and economic aspects of security. Two programs established in 1998, the Galileo navigation system and the GMES (Global Monitoring for Environment and Security) program, account for the EU's decisive involvement and for the need to build synergy with the ESA.

In 2001, a new step is taken with the production of a common document produced by the European Commission and the ESA titled "Europe and Space: Turning a new chapter":

In a more unpredictable geopolitical context space activities are increasingly a strategic game changer. Space is a question of science, exploration and international cooperation (as underpins the International Space Station) and plays a very practical role in terms of boosting innovation, economic growth and security on the other.¹³

These two programs respond to concerns of strategic independence, as can be seen through the clear will to develop applications deemed crucial. Since its early beginnings, Galileo thus includes a strong economic dimension, to the extent that the program was even financed through a PPP (Public Private Partnership). As for the GMES, whose name becomes Copernicus in 2013 when its commissioning appears as a federative program, it was intended

to improve global management by making the best use of existing tools and by complementing them with the launch of Sentinel satellites.

European perspective on cooperation opportunities for the EU and South Korea in space security

Since 2016, with the first joint programs now in place, Europe is capitalizing on its technological skills and is committed to achieving its ambitions for innovation while at the same time focusing on formalizing its foreign and security policy. Opportunities for cooperation with South Korea can thus be considered in various ways.

In the field of space cooperation, a solid foundation has existed since 2010, based on the partnerships established by the National Agencies and the ESA. Europe, in the broad sense, then ranks first among international actors (see Figure 4.1), giving it a real international visibility even if some partnerships are bilateral. Another important element is the diversification of the states involved, including South Korea. The EU has been progressively integrated into this dynamic, with the Galileo Navigation System Cooperation Agreement being formally signed on 11 October 2006 at the EU–South Korea Summit. Since then, Europe’s clear aim for open cooperation remains current, as space becomes a tool of foreign policy before even being a component of security policy.

These two dimensions are explicitly introduced in the 2016 Space Strategy, which in agreement with the ESA¹⁴ has four main objectives: maximize the benefits of space for society and the EU economy, ensure a globally competitive and innovative European space sector, reinforce Europe’s autonomy in accessing space in a safe and secure environment, strengthen Europe’s role as a global actor and promoting international cooperation.¹⁵

This order of priorities is perfectly in line with the principles of the “Common Vision: A stronger Europe” Strategy for the European Union’s Foreign and Security Policy, also published in 2016.¹⁶ In this paper, the EU insists on the need for a pragmatic analysis of the international strategic environment and on its desire to promote a rules-based global order based on multilateralism. This position is also taken up by the European Parliament, which in a resolution of September 2017¹⁷ calls for a reinforcement of European autonomy by endeavoring to preserve a safe and usable space environment. There is therefore a real convergence of interests in Europe to deepen EU–ROK cooperation in the field of space technology, especially since South Korea appears to be sharing a number of principles such as a global vision, the search for an increased national and international security, the desire for diversified cooperation, and the progressive construction of civil space skills with an increasingly dual potential. Given these commonalities, different proposals should be considered, applicable to both to regional security goals and to more global objectives.

From now on, the Space Situation Awareness is a decisive issue. The increase in the number of launches of small satellites (cubesats and nanosats) and the development of constellations of hundreds or even thousands of satellites, not only increases the risk of collision but makes the issue of debris even more worrying. Furthermore, because of the importance of satellites in economic activities and their potential role in terms of national security, it is necessary to think about the physical or cyber threats that may arise. Finally, the tendency – influenced by the American position – to consider that war in space can become a reality reinforces the need for detailed and continuous information on activities in orbit.

The need to develop an efficient network of spatial surveillance has been gradually acknowledged by various actors. National agencies were among the first,¹⁸ as they operated their own satellites with an increased attention when some of the latter had a military purpose. While the ESA conducted its own parallel analysis since the 2000s, the EU finally drew consequences from its new missions conferred by the Lisbon Treaty in terms of security issues.

It is through the question of debris, which is at the core of its competence, that the ESA council adopted in December 2000 a resolution for a European Policy on the protection of the space environment. A workgroup made up of members of the ESA and the national space agencies of Italy, the United Kingdom, France, and Germany elaborated and presented a project for a European standard in 2002. The work was coordinated by the ESOC and focused on the definition of a standard for the safety of orbiting satellites. This standard comprised preventive measures and introduced the principle of orbit protection. It pertained to the conception and production of satellites and launchers, to the operations phase, and to the solving of problems posed by aging vehicles.¹⁹

In parallel to these concerns, and in light of the increasing interest of Member States, the ESA is eager to develop its own competences and stated new ambitions for space surveillance according to its R&D mission (while the EU is responsible for diplomatic and political initiatives). According to the study on the “Feasibility of performing space surveillance tasks” a space-based optical architecture was proposed in 2005.²⁰ The European Coordination Group on Space Debris carried out a report entitled “Europe’s eyes on the sky,”²¹ using studies already issued by the Space Surveillance Task Force such as “Space surveillance for Europe – a Technical Assessment” released in 2006.²² The introduction made it clear that Europe had no systematic operational capability for space surveillance and was strongly dependent on external information, mainly on the US Space Surveillance Network. Calling for the development of an independent system, the report was intended to provide material for an interagency and intergovernmental discussion in a future European Space Surveillance System (ESSS), and eventually for a Space Situation Awareness System (SSA).

The results, endorsed by the ESA Cabinet meeting of November 2008, led to the launch of the SSA, implemented as an optional program with 14 Member States participating financially. It focused on 3 main areas: space weather (SWE), near-Earth objects (NEO), and Space Surveillance and Tracking (SST). Its aim was to give Europe an independent capability to watch for objects and natural phenomena that could harm satellites in orbit. During the 2009–2012 Preparatory Phase of the SSA program, precursory applications were developed to serve as a test bed for the novel techniques and algorithms needed for the Space Surveillance Tracking System. Although ESA is aware of what was politically at stake with the European SSA due to the sensitive nature of data exchange, the Member States with the most capabilities stayed in the background. At the 2012 ESA ministerial Council in Naples, France did not confirm its commitment to the project, while the United Kingdom and Germany chose to get involved in the space weather and NEO segments, both much less sensitive. The second phase (2013–2016) had been extended to 2019. However, irrespective of national reluctances, the global dimension of space surveillance now leads to take into consideration a global system that is becoming more and more indispensable and in which the EU has also been interested in for about a decade.

The interest shown by the EU is due to its new political legitimacy to deal with security matters with largely economic aims since 2007–2008 and the Lisbon Treaty. However, the purely military aspects remain the responsibility of Member States. The arguments put forward by the EU are mainly of an economic and industrial nature, emphasizing the need to protect investments in space infrastructures, to ensure the continuity of services and the viability of space activities, and, more broadly, to support the competitiveness of the European industry. Thus, in 2010 and 2011, the EC asserted that implementing a specific program was necessary.²³ This policy continued through the framework program Horizon 2020. It highlighted the objectives of gaining technological independence as well as holding the necessary data for space monitoring.

It has become clear in 2019 that intra-European cooperation faces delays and difficulties. The latter show the sensitive character of exchanging information on the monitoring of satellites in orbit, and the concern for national control over monitoring instruments. This reluctance should not be underestimated in the case of an EU–South Korea partnership even though pre-defined forms of exchange could be devised to exclude some data deemed confidential. To a certain extent, the discussions between actors currently being carried out internally in Europe can serve as a guide for setting up a framework for specific conditions for security and information exchange. As a first step, it would be possible to envision a possible subscription system based on the Galileo agreement model. Yet this option could run the risk of being in competition with the private system currently being set up by the American initiative. It would thus be necessary to think of a complementary approach with a specific public dimension that would justify its existence.

The EU–ROK cooperation project can be conceived in several stages. An initial agreement between the two partners as part of the strengthening of the security partnership would be needed. This initiative could then be opened to new entrants, based on a multilateral model similar to the one of the World Weather Watch, with each having its own system while exchanging data. If the global ambition of a program for space surveillance cooperation is to be considered on a medium term, a shorter deadline should be envisioned for the more regional recommendation of pooling capacities for Earth Observation. The development of new networks belonging to private actors such as Planet company now allows for the acquisition of data in near real time through optical and radar technologies. However, in an environment as delicate as that of the Korean peninsula and its geopolitical stakes, using different sources of information appears as an essential guarantee of security. The mutualization of access to images, and especially the guarantee of distribution, even in times of crisis, would represent a mutual advantage both for Europe, which wishes to be involved in the maintenance of security in Asia, and for South Korea, which would have access to complementary and independent sources.

Korea's space activities

Space activities of the Republic of Korea began in 1992, with the launching of a small scientific satellite for experiments, called “Uribyul-1,” developed by the Korea Advanced Institute of Science and Technology (KAIST). Following the launching of Uribyul-2 in 1993, the Korean government recognized the need for an organized and comprehensive plan at the state level. A Long-Term Plan for Space Development (1996–2015) was established and confirmed in 1996 at the National Science and Technology Council. One of the purposes of the Long-Term Plan consisted in the development of a multi-purpose satellite (KOMPSAT, named “Arirang” in Korean), which is a low-orbit earth observation satellite. After the successful launch of Arirang-1 in 1999, continually KOMPSAT-2 was launched in 2006, KOMPSAT-3 in 2012, then KOMPSAT-5 in 2012, and KOMPSAT-3A in 2015. A plan to launch Korea's first space launch vehicle (KSLV-1, named “Narocho-1” in Korean) laid the foundation for the legislation and policy in the field of outer space activities. The plan led to an enactment of Space Development Promotion Act (SDPA) in 2005, by which the Korean government is required to formulate a Basic Plan for the promotion of space development every five years. The aim of the Basic Plan is to prescribe mid- and long-term policy objectives and basic direction-setting on space development.²⁴ Following the first Basic Plan 2007–2011 and the second Basic Plan 2012–2016, the third Basic Plan 2018–2022 was adopted in February 2018 by the National Space Committee.

After two failures in 2009 and 2010, KSLV-1 successfully launched a small 100 kg class satellite in a low-earth orbit in January 2013. The research and development of KSLV-1 had been carried out in cooperation with Russia, by which the 1st stage of KSLV-1 was

undertaken. Joining the Missile Technology Control Regime of ROK was an essential prerequisite for that cooperation, since the Korean government had to demonstrate convincingly the launching of KSLV-1 only for civil uses and no transfer of technology to the third party.

From 2003 to 2013, a total of three science and technology satellites entered orbit successfully. Korea's first geostationary Communication, Ocean and Meteorological Satellite (COMS) was launched in June 2010. The ocean color imager of COMS, the first of its kind to be placed in geostationary orbit, makes 10 observations of the ocean around the Korean peninsula per day.

It appears that a five-year rolling Basic Plan stems from the Framework Act on Science and Technology enacted in July 2001, since when other Acts concerning science and technology are enacted or amended, they shall be commensurate with the purpose and basic ideology of that Framework Act. The latter provides in its Article 7 that a Master Plan for science and technology shall be formulated every five years. It is worth noting that a Medium and Long-Term Plan 2014–2040 for space development was established in November 2013, after only two years of the second Basic Plan, and that the Medium- and Long-Term Plan specified in its subtitle that it is to modify and complement the second Basic Plan. This modification is directly attributable to the inauguration of the Park Guen-hye administration. During her campaign for president, she unveiled her own manifesto for lunar exploration. Her blueprint was to explore the Moon by 2020 by a Korean indigenous space launch vehicle KSLV-2. After her election as president, the manifesto was selected as one of the Park administration's top 100 policies. For this, a test KSLV-2 for the purpose of full-scale tests for liquid propellant engines with 75 tons of thrust was scheduled to be launched in 2017. In order to implement such a national agenda, the second Basic Plan in itself had to be modified. Since its amendment in two years could be in violation of SDPA, however, it was inevitable to formulate the Medium- and Long-Term Plan not provided for within SDPA. Regardless of her political will, launching a test KSLV-2 and a lunar orbiter were postponed.

Considering the end of the second Basic Plan, the discussions of formulating the third Basic Plan should have started in the second half of 2016 at the latest. However, because there was the Medium- and Long-Term Plan, it seemed that the then-government did not see a need for a new Basic Plan. As the impeachment of President Park was upheld by the Constitutional Court of Korea in March 2017, and consequently the Moon Jae-in administration took office in May 2017, however, the work to establish the third Basic Plan began in earnest. Even though space development was not included into the Moon administration's top 100 policies, in contrast with the Park administration, it was necessary to review the previous government's space policy, and to set up a new space policy to adapt the new government. After a year of work, the third Basic Plan was adopted in February 2018.

Legal and policy framework for space activities

The national space policy of the Republic of Korea, such as the Basic Plans, is decided by the National Space Committee (NSC) established under SDPA. Being under the control of the President, the NSC is the highest decision-making body to deliberate on important matters concerning space development. NSC deliberates on the following:

1. matters concerning a Basic Plan, a Master Plan for the utilization of satellite information, and a Basic Plan for preparing against dangers in outer space;
2. matters concerning the coordination of important policies of the government with

- major duties of relevant central administrative agencies in relation to a Basic Plan;
3. important matters concerning the designation, operation, etc., of institutions specializing in space development;
 4. matters concerning evaluation on the use and management of space development projects;
 5. matters concerning financing and investment plans for space development projects;
 6. matters concerning permission to launch space launch vehicles;
 7. other matters the chair-person brings to the National Space Committee for deliberations.

The NSC comprises no more than 15 members, including a chairperson who is the Minister of Science and ICT. The following persons have become NSC members: Vice Minister of Strategy and Finance; Vice Minister of Trade, Industry and Energy; Vice Minister of Foreign Affairs; Vice Minister of Defense; Deputy Director of the National Intelligence Services; and persons with abundant knowledge and experience related to the area of space who are commissioned by the President. In order to efficiently conduct affairs of the NSC, the latter shall have a Working Committee for the Promotion of Space Development chaired by the Vice Minister of Science and ICT. To sum up, only an agenda passed by the Working Committee, which is a *de facto* first deliberative body, is sent to the NSC. The NSC and its Working Committee are not a permanent body, since they convene only in the presence of matters to be deliberated on. In setting a Basic Plan, the Ministry of Science and ICT (MSIT) establishes temporarily a planning committee not mandated by SDPA, of which the Basic Plan is actually made out. The planning committee is subdivided into several subcommittees for space transportation, satellites, space exploration, policy, etc.

According to Article 7 of SDPA, for the purpose of promoting space projects systematically and efficiently, a specialized institution may be designated by the Minister of MSIP. This institution plays the role of an implementing agency that carries out the space projects based on Basic Plans and Master Plans, and performs comprehensively activities for the development, launch, operation, etc., of space objects. The Korea Aerospace Research Institute (KARI) was designated as the aforementioned specialized institution in October 2016.

Major space programs during the presidency of Moon Jae-in

Even though the field of outer space doesn't constitute one of the Moon administration's top 100 policies, there's no denying that the third Basic Plan is in line with Moon's government policy. It is because the third Basic Plan was decided by the NSC, which is under the control of the President. In this regard, it is quite interesting that the phrase "major programs by the Moon administration to be taken" is clarified in the third Basic Plan. Major programs are categorized into four types: space launch vehicle, satellite, satellite navigation, and space exploration.

The third Basic Plan provides a vision "to improve the quality of life of the people and to contribute to national security and economic growth by means of various space programs."

However, there's no choice but to mention that the Basic Plans thus far have been weighted toward improvements in technology.

1) Space launch vehicle

Soon after KSLV-1 launched in 2013, the Republic of Korea started to develop KSLV-2 independently. The goal of KSLV-2 is to launch a 1,500 kg payload into a 600~800 km low-earth orbit (LEO) with the completion set date of 2021. KSLV-2 is a three-stage launch vehicle consisting of the 300 ton 1st stage with 4 75-ton liquid engines, the 2nd stage with 75-ton liquid engines and the 3rd stage with a 7-ton liquid engine. Being a single stage rocket with a 75-ton liquid engine, a test KSLV-2 was successfully launched in October 2018, for the purpose of full-scale tests for liquid propellant rocket engines with 75 tons of thrust. As planned, in 2021, Korea will attempt KSLV-2 twice, having a test satellite for the first attempt and a small scientific satellite for the second. After 2022, KSLV-2 will be launched once a year, in particular with a Compact Advanced Satellite 500-3 (CAS500-3) in 2023 and CAS100-3 in 2024. The Korean government aims to enter the global commercial space launch vehicle as early as 2031.

KSLV-2 has been launched from the Naro Space Center that is located in Korea's southern coast, about 400 km from Seoul, and which is Korea's first satellite launch pad and the world's 13th space center. A tracking system has been installed in the Naro Space Center and the Jeju Tracking Station in order to receive flight data from the space launch vehicle. The Jeju Tracking Station has been used to track a European space launch vehicle "Vega," launched by ESA/CNES.

2) Satellite

Satellites have the highest competitiveness in various fields of Korean outer space activities. A total of 15 satellites will be launched during President Moon's 5-year term: 2 Compact Advanced Satellites; 2 geostationary Korea Multi-Purpose Satellites; 2 KOMPSATs; 2 Next Generation Mid-Class Satellites; and 5 reconnaissance satellites. The development of the KOMPSAT series began for the purpose of earth observation. KOMPSAT-1 was jointly developed with the American company, TRW Inc., since Korea had no experience of developing a multi-purpose satellite then. Based on the experience of developing KOMPSAT-1, however, the development of KOMPSAT-2 enabled Korea to achieve a rate of self-sufficiency of 91.5% in satellite design and 65.2% in the fabrication of satellite parts. Payloads technologies of KOMPSAT have been gradually improving as follows: KOMPSAT-3, capable of 70 cm resolution optical observation; KOMPSAT-5, equipped with an imaging radar; and KOMPSAT-3A, capable of 55 cm or less resolution optical and IR observation for the second in the world following the US. In case of KOMPSAT-3A particularly, the technology of improving the optical image's quality by 30% or more without degradation using diagonal data to provide 38 cm images was developed for the second satellite, following the EU. Scheduled to be launched in 2021, KOMPSAT-7 will be equipped with the high-resolution space borne camera "AEISS-HR," which possesses the world-class 0.3 m or less resolution optical imaging capability. Aiming to launch in 2021, KOMPSAT-6 will be equipped with the SAR.

The Compact Advanced Satellite (CAS)-500 project is under way jointly by KARI and the Korean Industry. KARI will transfer the core technologies to the industry. Once the first CAS-500 is launched in the first half of 2021, the platform will be used to carry various payloads such as optical cameras, radar, microwave and hyper-spectral systems in order to satisfy various public demand. For the second CAS-500 which is slated to be launched in the second half of 2021, the industry will be responsible for the overall development with KARI

performing the technical audit and technical support. The CAS-100 project, led by the KAIST, is also ongoing for scientific and educational purposes. The first CAS-100 was launched in October 2018. Korea replaced COMS with two different geostationary satellites called GEO-KOMPSAT 2A and 2B: one for meteorological observation and the other for monitoring marine environments. Launched in December 2018, GEO-KOMPSAT 2A requires only 10 minutes to observe the entire sphere and 2 minutes to observe the Korean Peninsula compared to the 3 hours and 15 minutes required by COMS to observe the whole sphere and the Korean Peninsula respectively. GEO-KOMPSAT 2B, which was launched in February 2020, revolves in the same direction as the earth's rotation, so it can aim at the Korean Peninsula at all times to monitor the marine and environmental conditions continuously.

The high spot of the development of satellites is a plan to launch five reconnaissance satellites by 2022, code-named "425 project" formulated in 2013, comprising four Synthetic Aperture Radar satellites and one Infrared satellite. Korea has been constructing Kill-Chain, Korea Air and Missile Defense (KAMD), and Korea Massive Punishment and Retaliation (KMPR), to prepare for taking over wartime control of military from the US and to cope with nuclear and missile threats. The last one of 32 projects in Kill-Chain, all satellites of the 425 project will be developed by Korean industries.

Despite steady advances in satellite technology, there is a big obstacle to developing and launching satellites. It is that some core parts of the satellite, such as thruster valves, a gyroscope, solar arrays, a radar controller, and so on, depend on import. However, this problem in Korea is unavoidable in that satellites must be developed within a certain time limit in order to meet public demand.

Table 4.1 Localization of KOMPSAT-related technologies

	<i>KOMPSAT</i> -1 (1999)	<i>KOMPSAT</i> -2 (2006)	<i>KOMPSAT</i> -3 (2012)	<i>KOMPSAT</i> -5 (2013)	<i>KOMPSAT</i> -3A (2015)	<i>KOMPSAT</i> -6 (2020)
Satellite bus design	Acquire technologies abroad	91%	100%	100%	100%	100%
Payloads design	Acquire technologies abroad	Acquire technologies abroad	96%	25%	98%	83%
Parts and components of satellite bus	Overseas purchase	65%	64%	62%	67%	65%
Parts and components of payloads	Overseas purchase	Acquire technologies abroad	65%	Acquire technologies abroad	67%	41%

(Source: The third Basic Plan)

3) *Space exploration*

In the field of space exploration, it is necessary to mention that the Moon administration revised generally one of the top policies of the former administration, by which a test lunar orbiter was scheduled for launch in 2017, and a lunar lander in 2022 and a lunar sample-return

orbiter in 2030 by KSLV-2. This government seems to assess them as being a kind of political slogan, and the latter plan cannot be done with the current state of technology.

Therefore, this administration classified the Korea lunar exploration program (called “Korea Pathfinder Lunar Orbiter [KPLO]”) as a two-step process, taking into account only the level of related technology. The first step is to develop an experimental lunar orbiter whose launch is targeted for no later than 2022 from overseas.²⁵ The experimental orbiter is aimed at securing the necessary basic technology for lunar exploration, such as reducing weight of the orbiter, navigation and propulsion, deep space communication, and so on. Korea has accumulated around 70% of the key technologies needed for lunar exploration through the previous earth-orbiting artificial satellite technologies. In order to make up for what it lacks, the experimental orbiter project has been carried out based on international cooperation with the US. For this, the KARI and the National Aeronautics and Space Administration (NASA) have signed on an Implementing Arrangement in December 2016. To be specific, the KARI is responsible for the design, fabrication, assembly, and general operation of the orbiter equipped with five payloads (a 5 m high-resolution camera, a wide-field polarized camera, a magnetic field sensor, a gamma ray sensor, and space internet test equipment) to be developed in Korea. The NASA provides a payload for precise shooting of the Moon’s permanent shadow area onto the experimental orbiter, and technical support for mission design, deep space communication, and navigation technologies.

However, the problem is that not all successes of the first step lead to the second step, in which a lunar lander will be developed and launched by no later than 2030. According to the third Basic Plan, one condition must be satisfied, so as to advance to the next step. It is the success in the development of KSLV-2. That means the lunar lander must be launched by KSLV-2. If the lander will be successfully launched by KSLV-2, a spacecraft to return an asteroid sample will be launched by no later than 2035.

4) Korean Positioning System

The construction of the Korean Positioning System (KPS) is a project launched in Moon’s administration. Comprising a total of seven satellites, KPS is scheduled to be completed in 2035. For this, firstly, Korea will build a ground test site four years from now in 2023, and develop a core satellite navigation technology in 2024. Secondly, a satellite for verification will be launched in 2028, the purpose of which is to secure technology for inclined orbit satellite operation. Finally, three geostationary satellites and three inclined orbit satellites will be launched in 2035. It is estimated that it will cost over \$3.5 billion to build 7 KPS satellites.

According to the third Basic Plan, the necessity of KPS is emphasized in two aspects. It is to ensure the safety of the public, and to maximize additional values based on position, navigation, and timing. With respect to the first, since Korea has not had any GPS satellites, the nation has had to entirely rely on GPS satellites of the US. So, broken signals of GPS for any reason cause tremendous loss in Korean infrastructure, including traffic network, energy, telecommunication, banking, emergency relief in case of disaster, etc. In this regard, there’s no choice but to mention national security, taking into account the circumstances both inside and outside of the Korean peninsula. In particular, in the event of a crisis such as a war on the Korean Peninsula, signals can be blocked by countries with GPSs, such as the US and Russia, to preclude their enemy forces from using them. There’s no denying that the KPS project shall address such a possibility. The error range of the GPS in Korea is about 10 m now, and will be reduced to less than 1 m.

Concerning the second necessity, it is expected that building KPS will start a ripple effect throughout the national economy. The third Basic Plan predicts that the construction of KPS

will create over 18,000 jobs in direct research and development investment, and over 57,000 jobs in indirect employment during its operation. Besides, direct R&D investment in KPS will have the effect of generating about \$1.6 billion worth of production and an added value of over \$1 billion.

South Korean perspective on cooperation between the ROK and the EU

For the past three decades, Korea has keenly focused on developing technologies for satellites and space launch vehicle, by acquiring technologies in a roundabout way through joint development with the US, Europe, and Russia. As a result, Korea attained a certain standard, and will need to cooperate, continuously and within the limits of the possible, with them. However, the problem is that this approach seems to reach its limits. Since most of the technology that Korea has not yet acquired belongs to strategic materials or items related to non-proliferation of a small number of developed space-faring nations, now it is not easy to acquire indirectly the technology, and even to purchase parts and components abroad. In addition, those nations, particularly including the US and the EU, have perceived that space environment becomes increasingly more congested, contested, and competitive by an increasing number of space objects in outer space. That is precisely why outer space should be approached strategically, with continuous efforts to autonomously research and develop space technologies.. Considering outer space to be one of the means to secure the best possible leadership in international relations, they have tried to internationalize their internal standards and best practices. The Draft International Code of Conduct for Outer Space Activities (ICoC) proposed by the EU and Space Policy Directive-3(National Space Traffic Management Policy) of the US are notable examples. For this, they need support from as many countries as possible to shape international consensus practices and standards in favor of their own space policies. For instance, the EU learned an expensive lesson from the process of consultation for adopting the ICoC.

The possibility of cooperation between Korea and the EU in the field of space needs to be discussed, taking into account that both sides may have different priorities. Contrary to Korea, which still perceives outer space from a technical point of view, the EU is on the top rung of all areas of space activities and has applied the field of outer space to other areas, such as internal and external security policy and foreign policy. Tracing back to a communication “The Community and Space: A Coherent Approach” in 1988, space policy became one of the policies of the EU on the basis of Article 189 of the Treaty of Lisbon, which entered into force in December 2009. In accordance with Article 189, the EU shall draw up a European space policy to promote scientific and technical progress, industrial competitiveness, and the implementation of its policies. In a 2011 communication “Towards a space strategy for the EU that benefits its citizens,” the EU regarded space as a driving force to cement its position as a major player on the international stage and believed that it contributed to the Union’s economic and political independence. For this, one of priority actions for the EU space policy “secure space to achieve security and defense objective” was presented. This priority action is in line with the EU’s Common Security and Defense Policy (CSDP). A project “Multinational Space-Based Imaging for Surveillance, Reconnaissance and Observation (MUSIS)” is a prime example.

It should be noted that there is gradually a perception in Korea that space policy is becoming more important not only technologically, but also strategically. This change comes from the experiences gained through Korea-US Space Policy Dialogue and Korea’s involvement in the international discussions of emerging issues in space activities. Korea-US Space Policy Dialogue, which was held in Washington DC in 2015 and in Seoul in 2016, addressed the most recent international and domestic issues. For example, there were the ICoC, Report of

the UN Group of Governmental Experts on TCBMs in Outer Space Activities, key issues under discussion in the *Committee on the Peaceful Uses of Outer Space*, *Space Situational Awareness (SSA)*, etc.

Some issues such as SSA and Space Traffic Management (STM) may become a common interest of Korea and the EU as a strategy. On the basis of sharing information between the allies, both SSA and STM are an indispensable requirement for the EU's access to securing space to achieve its security and defense objectives; that is, for the purpose of EU's CSDP. The same is true for Korea, in consideration of its plans to launch and operate many satellites, including reconnaissance satellites, and the situation in the Korean peninsula and its surrounding areas. It will be not until a strategic partnership between Korea and the EU is built in the field of space that cooperation related to strategic items will be possible between the two sides. Potential participation of Korea in space exploration projects of the EU or/and ESA can help it become interested in such partnership building. For this, the first step is to establish a bilateral dialogue unique to space issues between Korea and the EU.

Conclusion

Europe and South Korea have significant capabilities in the space sector. Their policies share a predominant interest for civil, scientific, and economic activities, with a special focus on the monitoring of the earth, the environment, and space. More broadly, the EU and the ROK seek to develop technological skills through innovation to secure their status and influence. Their common objectives in strengthening international security are also part of the same approach favoring an open and multilateral framework.

The combination of these factors undeniably provides a framework for in-depth exchanges on the practicalities of cooperation in space matters from a broad security perspective, which could then be applied in a pragmatic way through concrete examples. Space technologies could thus strengthen the images of both the EU and the ROK by giving them the means to contribute effectively to multilateral international security.

Figure 4.1

Table 4.1

¹ The New Space phenomenon, although highly publicized, represents an additional aspect but does not change the classical strategic dimension of space activities conducted by Member States.

² In chronological order: Soviet Union (later Russia), United States, France (before the creation of the ESA), European Space Agency (ESA), China, Japan, India, Israel, Iran, North Korea, South Korea.

³ Dates were set according to the high solar activity expected during this period.

⁴ Cubesats increasingly known and used.

⁵ Explorer and radiation belts.

⁶ VERGER Fernand (eds.), GHIRARDI Raymond, SOURBES-VERGER Isabelle, *The Cambridge Encyclopedia of Space, Missions, Applications and Exploration*, Cambridge, Cambridge University Press, 2003, p. 418.

⁷ STARES Paul B., *Space and National Security*, Washington DC, Brookings Institution Press, 1987, p. 219.

⁸ Rand Corporation.

⁹ Corona and capsules.

¹⁰ SALT ABM Sourbès Isabelle, “Overhead Imagery for Arms Control and Disarmament Purposes: A European Perspective.” *Multilateral Verification and the Post-Gulf Environment: Learning from the UNSCOM Experience* (ed.), Steven MATAIJA, J. Marshall BEIER, Toronto Center for International and Strategic Studies, York University, 1992, pp. 187–198.

¹¹ Ability to distinguish two objects dramatically increasing in 40 years: 1st civilian satellites Landsat1 = 80 m. (1972), SPOT1 (1985) 30 m, IRS1D (1997) 5 m, Planet (2018) less than 1 m.

¹² J. C. Baker, K. O’Connell M., R. A. Williamson (ed.), *Commercial Observation Satellites*, Rand-ASPRS, 2001, p. 643.

¹³ [https://eeas.europa.eu/headquarters/headquarters-](https://eeas.europa.eu/headquarters/headquarters-homepage_en/46673/Space:%20EU%20budgets%20%E2%82%AC16%20billion%20for%20space%20program)

[homepage_en/46673/Space:%20EU%20budgets%20%E2%82%AC16%20billion%20for%20space%20program](https://eeas.europa.eu/headquarters/headquarters-homepage_en/46673/Space:%20EU%20budgets%20%E2%82%AC16%20billion%20for%20space%20program).

¹⁴ Joint Statement on Shared Vision and Goals for the Future of European Space.

https://m.esa.int/About_Us/Welcome_to_ESA/Shared_vision_and_goals_for_the_future_of_Europe_in_space.

¹⁵ <https://ec.europa.eu/docsroom/documents/19442>.

¹⁶ https://eeas.europa.eu/topics/eu-global-strategy/17304/global-strategy-european-unions-foreign-and-security-policy_en.

¹⁷ Résolution du 12 septembre 2017 www.europarl.europa.eu/doceo/document/TA-8-2017-0323_EN.html?redirect.

¹⁸ CNES et GRAVES.

¹⁹ Karl-Heinz Böckstiegel, Marietta Benkö, Stephan Hobe, *Space Law: Basic Legal Documents*, Vol. 2 (Utrecht: Eleven International Publishing, 2005), chapters 13–14.

²⁰ See the subsequent publication by Flohrer T., Krag H., Klinkrad H., Schildknecht T., “Feasibility of performing space surveillance tasks with a proposed space-based optical architecture,” *Advances in Space Research*, Vol. 47, Issue 6, (2011): pp. 1029–1042. Abstract, <http://adsabs.harvard.edu/abs/2011AdSpR..47.1029F>.

²¹ “Europe’s eyes on the Skies. The proposal for a European Space Surveillance System,” *ESA Bulletin* No. 133 – (February 2008), pp. 42–48. www.esa.int/esapub/bulletin/bulletin133/bul133f_klinkrad.pdf

Its members were coming from the British National Space Center, Centre National d’Etudes Spatiales, Deutsches Zentrum für Luft- und Raumfahrt and ESA.

²² Lucas del Monte *The ESA’s Space Situational Awareness initiative: contributing to a safer Europe* (on line: 2015), pp. 1–6. www.researchgate.net/publication/265894241_The_ESA's_Space_Situational_Awareness_initiative_contributing_to_a_safer_Europe.

²³ See EC/ESA Joint Secretariat Paper on Space and Security

www.europarl.europa.eu/meetdocs/2009_2014/documents/sede/dv/sede170310ecesaspaceandsecurity_/sede170310ecesaspaceandsecurity_en.pdf.

²⁴ In SDPA, the term “space development” means any of following activities: (a) research on the design, manufacturing, launch, operation, etc., of artificial space objects and development of technology therefor; (b) use and exploration of outer space and activities to facilitate such activities. It is understood that “space development” is identical to the term “space activities.”

²⁵ An US company SpaceX’s Falcon 9 space launch vehicle has been selected to launch KPLO.