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The Transition Effect of Korea's Space Development

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Abstract

In the 1990s, South Korea recently launched Space Development and is pushing for a step toward Space. In the Space Launch Vehicle field, the development of Practical satellite type Launch Vehicle (Korea Space Launch Vehicle II) has progressed to the stage of proprietary development, and in the field of Satellite development, they also have a great deal of competitiveness. This study will be a shortcut to rediscovering our potential and looking for breakthroughs by reviewing and re-examining the effects of past Space development.

Keywords: *Space Development, Korea, Satellite, Launch Vehicle, History, Effect, Exploration Space Activity, Astronaut, Lunar Exploration, National Space Plan, Industry Competitiveness, Science Rocket, Governance*

1. Introduction

In the 1990s, South Korea recently launched Space development and is pushing for a step toward Space. In the Space Launch Vehicle field, with beginning Science Rocket I in the 1990s, since 2001, we have substantially expanded our investment and developed to the stage of proprietary development of the Korea Space Launch Vehicle II, a Practical satellite type Launch Vehicle. In the field of satellite development, we started to invest in space development in the late 1990s, which is a late start to advanced countries. Despite of the low budget, we have secured a lot of competitiveness in the satellite field. In the Satellite Utilization field, we are expanding the use of public and commercial applications by providing various satellite information such as high-performance optics, radar, mid-infrared images, and ocean and weather observation information. In the field of space exploration, we are preparing the framework for the space exploration field, which is the unexplored area of South Korea, with started development of test moon orbit line based on NASA and international cooperation. In the field of industrial ecosystems, the space industry has been fostered, including the realization of the transfer of national space technology, the export of satellite, ground equipment, satellite image, and venture startup and commercialization [1].

This study will be a shortcut to rediscovering our potential and looking for a breakthrough by reviewing the effects of past space development [2].

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2. Progress of Development and Level of Korean Space Development

Korea has launched a space development business 30 to 40 years later than advanced countries, but has achieved remarkable results through continued investment by the government in the past. In the 1980s, the Korea Aerospace Research Institute ('89) and the KAIST Satellite Research Center ('89) were established to lay the foundations for national space development, and from the 1990s, the space development project was promoted in earnest. The KAIST satellite research center launched a small test satellite, 'KITSAT-1' ('92), to enter satellite country, and developed follow-up satellites of ' KITSAT-2' ('93) and 'KITSAT-3' ('99). Through the Korea Aerospace Research Institute, Korea Multi-Purpose Satellite-1 ('99) was developed and we obtained Practical Earth Observation Satellite Technology. By successful development of Science Rocket I (KSR-I) ('93) and Science Rocket I (KSR-II) ('99), Launch Vehicle Solid rocket foundation technology has been acquired. In the 2000s, the foundation of space development was strengthened. Satellite technology and performance enhancement with Science and Technology Satellite-1 ('03) and Korea Multi-Purpose Satellite-2 ('06) were acquired, and liquid rocket foundation technology was also acquired by developing Science Rocket I (KSR-III) ('02). By the beginning of 2010, Korea has become as an emerging country in space development and accomplished many projects such as Chollian satellite launch ('10) to enter geostationary satellites, Launch of Korea Multi-Purpose Satellite-5 (Radar) ('13) and No. 3A (Infrared) ('15) followed by Korea Multi-Purpose Satellite-3 (optical) ('12) to begin diversification of satellite image and multi-satellite operation, and Successful launch of Naro (KSLV-I) ('13) to join the space launcher. Currently, based on the results of the existing research, in order to enter the space development advanced countries, Korea Space Launch Vehicle (II) is being developed to secure the ability to launch practical satellites, and Space development field is being expanded by Lunar Exploration project [3].

3. Key Achievements of Space R & D

3.1 Satellite

In the small satellite field, KITSAT Satellite series and Science and Technology Satellite series were promoted for scientific mission, and we are now carrying out related tasks through the next generation small satellite business. KITSAT-1 is a small-sized (42kg-sized) satellite manufactured by KAIST (with transferring technology from Surrey University, UK) in order to nurture technical personnel in the field of satellite and secure space basic technology. In 1993, it successfully developed and launched the second satellite, and the third satellite in 1999. Scientific and technical satellite development project was started with the development of No. 1 since October 1998 with the aim of developing space science experiment and satellite technology. Subsequently, the satellite 2 was launched in October 2002 and failed in two launch attempts in 2009 and 2010 using the Naro. When the third launch of the Naro in 2013 was successful, the Naro Scientific Satellite, which was reduced in function instead of Science and Technology Satellite-2, was used. The 150kg-sized Science and Technology Satellite-3 was launched in 2013 and demonstrated the payload technology related to the infrared image system. Currently, it is carrying out the role of the existing KITSAT satellite and Science and Technology Satellite series through next generation small satellite development project, and plans to launch the next generation small satellite-1 in 2017. The purpose of this miniature satellite development project is preliminary research and development on the core technology of satellite body and payload, testing of space environment and space science experiment. In addition, it is aimed to nurture advanced R & D personnel with theory and practical experience of satellite related technology [4].

The next-generation mid-sized satellite business, which is responding to the demands of various public sector satellite information and is being promoted to foster and export industrialization of the satellite industry, aims to enter the satellite market by developing a 500kg class medium-sized satellite standard platform,

dramatically shortening the development cost and period, securing its competitiveness. Currently, the next-generation mid-sized satellite business is a first stage project, and two precision ground observation systems are being developed by 2020 [5].

The Korea Multi-Purpose Satellite development project is focused on the government's space and satellite technology as a complex of advanced science and technology that will lead the high-tech industry in the coming 21st century. In July 1993, it was promoted with the goal of "entering the top 10 in the space technology world in the 2000s" as the main task of the five-year plan of the New Economy. In May 1994, it was decided to promote "multi-purpose practical satellite development project" and in August of the same year, the Ministry of Land, Infrastructure and Transport was launched, and successfully launched the Multi-Purpose Satellite-1 in 1999. Subsequently, we succeeded in establishing the Multi-Purpose Satellite-2 with high-performance cameras, and No. 3 with higher resolution camera and No. 5 with all-terrain observations were successfully developed. Korea provides commercial sub-meter optical image as the fourth in the world and the world's first high-resolution mid-infrared image with Korea Multi-Purpose Satellite-3, and also provides radar image (SAR) as the fifth in the world with Korea Multi-Purpose Satellite-5.

The geostationary satellite development project was established with communication broadcasting weather satellite in December 2000 in accordance with the revision of 'the mid-term and long-term basic plan for space development'. In November 2002, the National Science and Technology Council confirmed the development plan for the telecommunication marine meteorological satellite. A preliminary study was carried out for the Communication Oceanic and Meteorological Satellite for one year from May 2002, and in August 2003, the Committee for the Development of Communications and Oceanic Meteorological Satellite deliberated and verified detailed implementation plan and joint operation regulations. In September 2003, an agreement was signed with the Ministry of Science and Technology, the Ministry of Maritime Affairs and Fisheries and the Meteorological Agency. Communication Ocean Meteorological Satellite effectively copes with the preservation of the marine environment and management of marine fishery resources and minimizes human and material damage caused by weather disaster by increasing the accuracy of disaster weather and local weather forecast within 30 minutes by securing our weather satellite. In 2010, it acquired the status of the world's first geostationary orbit satellite and the world's seventh weather satellite owning Telecommunication Oceanic and Meteorological Satellite (Chollian Satellite). Currently, we are developing two Geostationary Korea Multi-Purpose Satellites for meteorological and marine and environmental observations. The Geostationary Korea Multi-Purpose Satellite (2A) is to be launched in 2018 with a meteorological payload and a spacecraft payload, while the Geostationary Korea Multi-Purpose Satellite-2B will be launched in 2019 with a marine payload and environmental payload [6].

3.2 Space Launch Vehicle

The Launch Vehicle field was launched in late 1980s and completed the development of a single-stage solid Science Rocket I (KSR-I) in 1993, and the launch tests were conducted on June 4 and September 1 of the same year. We then developed Science Rocket I (KSR-II), a two-stage solid Science Rocket I, and carried out launch tests successfully on July 9, 1997 and June 11, 1998. And, the first liquid Science Rocket I (KSR-III) was developed and successfully launched on November 28, 2002. In addition, the Korea Aerospace Research Institute (KARI) has successfully launched the third launch (The first launch in August 2009, the second launch in June 2010) of Naro(KSLV-I), the first Space Launch Vehicle in Korea that is capable of bringing a 100kg satellite to the low Earth orbit, on January 30, 2013. And the second launch in June 2010) on January 30, 2013. Naro(KSLV-I) is developed based on required technologies of Launch Vehicle which are acquired through KSR-III launch test in 2002, such as thrust vector control, thruster attitude control, inertia induction control, kick motor, etc. Currently, Korea Space Launch Vehicle II is being developed to launch a 1.5-ton practical satellite. The Korea Space Launch Vehicle II is accomplishing the fourth step in the development of a total of seven stages of Launch Vehicle, and related various launch vehicle subsystems (structure, electronic mounting, control, etc.) are under development. In addition, Korea Space Launch Vehicle II engine has been carrying out the initial model test, which is the third stage of the six-stage liquid engine development process [7].

3.3 Astronaut Emissions

The Korean astronaut project was executed in April 2008, when the first astronaut in Korea carried out space activities and scientific missions at the International Space Station through the Soyuz spaceship in Russia. It is aimed at manned space research according to the national long-term space development plan and the need for research on manned space technology. The first Korean astronaut candidate was selected in December 2006, and the two selected Korean astronauts received basic training and advanced training for the space station crew from January 2007 to March 2008. In April 2008, she boarded the Soyuz spacecraft in Russia and spent about a week in the International Space Station, where he returned to the Baikonur base in Kazakhstan after conducting scientific experiments, science promotion, communication with the ground, and relaying space activities. This process will be used as basic data for manned space technology. In addition to creating economic value through improvement of scientific technology and international status through securing manned space technology and wide spreading effect throughout industry, astronaut emission project is also aimed at promoting self-esteem of citizens by successfully discharging astronauts. It provides socio-cultural significance, such as providing opportunities to grow dreams.

3.4 Lunar Exploration

The Lunar Exploration Plan of Korea was comprehensively specified in the 1st Space Development Promotion Basic Plan('07.6), and the lunar exploration plan was specified in the Space Development Promotion Detailed Practice Roadmap('07.11). The 2nd Space Development Promotion Basic Plan('11.12) reflected the development plan of the Lunar Orbiter ('23) and Lunar Lander ('25) in the roadmap. Test Orbit Line Development in 2018 and Development of Lunar Orbiter and Lunar Lander in 2020 are established through the long-term plan of space development project and the national government task of the Park Geun-Hye government in 2013. In cooperation with NASA, we are working on the development of a test lunar orbiter through international cooperation as the first stage. In the first stage, we will design and manufacture the test track, launch and operate it, and build a deep space communication ground station. The second stage is to develop the Lunar Orbiter and the Lunar Lander independently and launch using the Korea Space Launch Vehicle II. Lunar Exploration is expected to create intangible value as well as the effect of related technologies on other industries, as well as enhancing the national brand value and enhancing the self-esteem of the people.

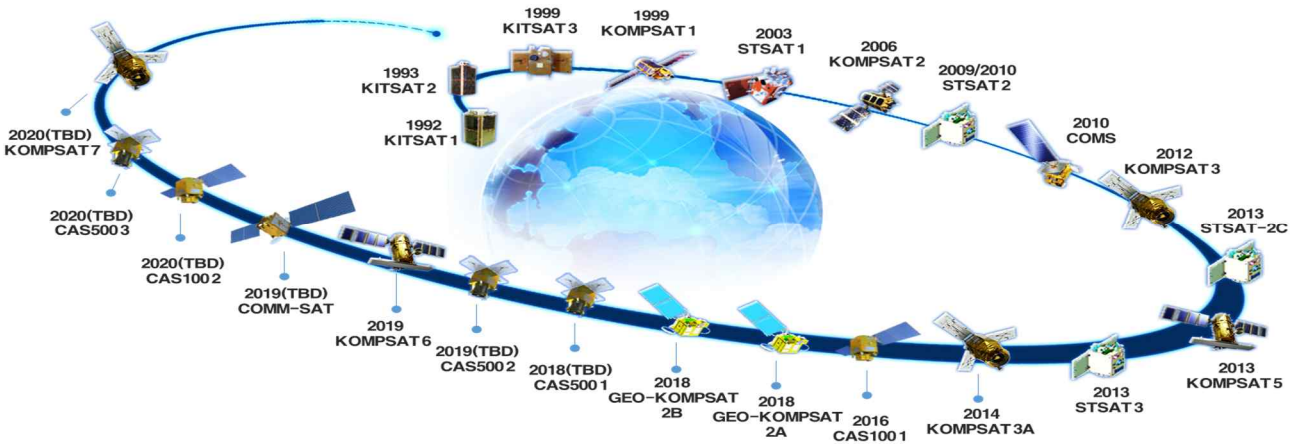

Figure 1. National Demand for Satellites[8]

4. Space Development Prospect

Future space technology is expected to be at the center of human society change. The development of space technology will contribute to making life more convenient and safe by offering the benefit of Space Utilization to human beings, and the expansion of space technology and the expansion of space into space are expected

to serve as key driving forces for change and development of future society. In addition, space technology is expected to solve the problems faced by mankind (such as climate change observation, natural resource management, disaster response, earth-threatening object response, etc.) Based on the achievements of Launch Vehicle and Satellite, Korea will expand space activities such as Space Exploration. And Korea will secure space development capability step by step through strengthening industry competence, developing core and future technologies, improving space diplomacy, etc.

In the field of 'Launch Vehicle Development', we aim to develop Launch Vehicle capable of launching geostationary satellites and Big-sized Launch Vehicle, starting with Korea Space Launch Vehicle II, and we are continuously developing the performance of the 75-ton class engine secured through the development of the Korea Space Launch Vehicle II, and developing multi-stage combustion cycle technology and engine re-ignition technology to improve the efficiency of the upper engine. In the development of satellite technology, we are constantly upgrading the Earth observation satellite technology, and acquiring various Satellite Payload technologies (electro optics, ultra-spectroscopy, image radar, infrared, etc.). In addition, we will pursue the development of advanced satellite technology such as formation flight and ion propulsion technology, and we will also develop the deep space navigation/communication technology, sample retrieval technology, and earth reentry technology necessary for space probe development based on the satellite technology. In the field of 'Satellite Information', we will step up the 'all-weather high-resolution satellite information integration service', 'global environment satellite information construction and service', and 'smart satellite information fusion service', then we will provide three-dimensional service on Satellite Information for future smart society. The 'Planetary Probe Development' field is a new space development field following the development of existing satellite and launch vehicle, and it is being pushed forward with beginning of development of Lunar Orbiter. After successfully developing Lunar Orbiter, we plan to challenge the development of Mars and deep space probes based on the acquired technology.

In order to continue this national space development plan, it will be necessary to provide consistent and strong policy support (reestablishment of space development governance, reconstruction of budget securing system, and establishment of international cooperation promotion plan). In domestic terms, it is necessary to respond to the diversification of Space Activity and the increase of government departments of Space Utilization, and in external terms, it is necessary to have a capacity to cope with the intensification of competitiveness of space industry and new technical approach and utilization and a system to support it [9].

5. Conclusion

In the advanced countries, the purpose of the space development is to improve the quality of life, safety guarantee, enhancement of nationality, creation of new technology, future growth engine, contribution to the international community, space resource acquisition, meet intellectual curiosity, and enlarge human residence area [10]. It is actively pursuing a wide range of fields with Space Probe and space science research as well as developing various launch vehicles & Satellite and Satellite Utilization. In developing countries, the 'improvement of the quality of people's life' through acquisition of the earth observation information provided by Satellite is presented as the logic of space development. Rather than compete with advanced countries in space, they are pursuing economic and practical space development through the use of satellite information in developed countries or joint participation in satellite development. However, some countries in particular international situations, such as Pakistan and Iran, are pursuing space development aimed at acquiring strategic technologies such as launch vehicle technology [11].

Korea should cooperate simultaneously with challenging space activities for space development and national security that are beneficial to the improvement of the quality of people's life. We should choose and concentrate not on all the fields of advanced countries, but on our economic scale, technology capacity, public interest, and social value. Space businesses and space jobs should be created by encouraging private companies to participate in space development through providing launch quantities and providing technical support. Considering the demand and expectation of the people first, and through the space development with the people in the process of promotion, we should try to improve the emotion of the people[12].

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