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POLITICAL ASTRONOMY: SOUTH KOREA SPACE DEVELOPMENT UNDER
THE INTERNATIONAL POLITICAL DIMENSION



A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Arts in Korean Studies
Inter-Department of Korean Studies
GRADUATE SCHOOL
Chulalongkorn University
Academic Year 2022
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อวกาศรัฐศาสตร์: การพัฒนาเทคโนโลยีอวกาศของเกาหลีใต้ ภายใต้มิติของการเมืองระหว่างประเทศ



น.ส.นัฐนรินทร์ เอื้อสุขภักดี

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาศิลปศาสตรมหาบัณฑิต

สาขาวิชาเกาหลีศึกษา สหสาขาวิชาเกาหลีศึกษา

บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย

ปีการศึกษา 2565

ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

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By	Miss Nutnarin Ueasukpakdee
Field of Study	Korean Studies
Thesis Advisor	Associate Professor Piti Srisangnam, Ph.D.

Accepted by the GRADUATE SCHOOL, Chulalongkorn University in Partial
Fulfillment of the Requirement for the Master of Arts

----- Dean of the GRADUATE SCHOOL
(Associate Professor YOOTTHANA CHUPPUNNARAT, Ph.D.)

THESIS COMMITTEE

----- Chairman
(Associate Professor Buddhagarn Rutchatorn, Ph.D.)

----- Thesis Advisor
(Associate Professor Piti Srisangnam, Ph.D.)

----- External Examiner
(Assistant Professor Nithi Nuangjamnong, Ph.D.)

นัฐนรินทร์ เอื้อสุขภักดิ์ : อวกาศรัฐศาสตร์: การพัฒนาเทคโนโลยีอวกาศของเกาหลีใต้
ภายใต้มิติของการเมืองระหว่างประเทศ. (POLITICAL ASTRONOMY: SOUTH
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DIMENSION) อ.ที่ปรึกษาหลัก : ปิติ ศรีแสงนาม

มนุษย์ รู้จักเทคโนโลยีอวกาศ ตั้งแต่ยุค 1950 ในช่วงเวลานั้นเป็นช่วงยุคสงครามเย็น ที่
สหรัฐอเมริกา กำลังแข่งขันเทคโนโลยีอวกาศ กับ สหภาพโซเวียต เทคโนโลยีอวกาศ ถูกใช้ทำมา
เพิ่มประสิทธิภาพให้กับกองกำลังทหาร และการจารกรรมต่างๆ เพื่อการต่อสู้ในสงคราม ในปัจจุบัน
จุดประสงค์ในการพัฒนาเทคโนโลยีอวกาศ แตกต่างไปจากในอดีต หลายๆประเทศลงทุน และ
พัฒนาเทคโนโลยีอวกาศ เพื่อเป้าหมายเศรษฐกิจ การสื่อสาร หรือแม้กระทั่ง จุดประสงค์ลับ ซึ่ง
เกาหลีใต้ เป็นหนึ่งประเทศที่มีศักยภาพ ในการลงทุนและพัฒนาเทคโนโลยีอวกาศ ทั้งที่ลงทุน
พัฒนาเองขึ้นเอง หรือลงทุนพัฒนาร่วมกับคนอื่น และด้วยประเด็นความขัดแย้งกับเกาหลีเหนือเอง
สำหรับการพัฒนาเทคโนโลยีอวกาศ เกาหลีใต้จะวางตัวอยู่ตรงไหนในโลก



จุฬาลงกรณ์มหาวิทยาลัย
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สาขาวิชา เกาหลีศึกษา
ปีการศึกษา 2565

ลายมือชื่อนิสิต
ลายมือชื่อ อ.ที่ปรึกษาหลัก

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DEVELOPMENT UNDER THE INTERNATIONAL POLITICAL DIMENSION. Advisor:
Assoc. Prof. Piti Srisangnam, Ph.D.

Human Knows about space technology development since 1950s era during that time U.S. and Soviet Union were main actors in “Space race” war. Space technology development of U.S. and Soviet Union in proxy war era were emphasized to develop for competition of political ideology and power of military. At the present time the purpose of space technology development different from the past, many countries that try to develop space technology for economic benefit, technology benefit, communication benefit or hidden connotation others. South Korea was the one that have potential and interesting to develop space technology because of the conflict with North Korea. Although, South Korea have potential of technology to develop own space technology but actor of South Korea in international level is only middle power state so, the co-operation is better way for South Korea space development.

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

Field of Study: Korean Studies

Student's Signature

Academic Year: 2022

Advisor's Signature

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Nutnarin Ueasukpakdee

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CHAPTER I

INTRODUCTION

1.1 Significance of Study

In history, space was an intangible issue because this issue always tight with religion such as “God had created this world, this world was a center of universe”, so the way to find a truth about space that hardly in those eras, nevertheless when technology had developed, the truth of space had disclosed. In 17th century, Galileo invented refracting telescope for look through planet, this meant people were interested about space long time ago. Space technology that has been developing from past until now, but the era called “Golden era” for space technology development which was in Cold war era.

The Society of human had always battled each other because of resources, conflict and others hidden agenda. In the past people had battled each other's with hard power such as efficiency of armament, large quantity of troopers, battle strategy but in 1945 after world war2 finished the battled of ideology had begun among Communism ideology group that leads by Soviet Union and Capitalism ideology group that leads by United states. During the Cold war each country not only direct encountered with opponent troops but also each country wants to spread own ideology and soft power to others country and both countries had a contended develop hi-technology armaments because both countries want to intend to warn or intimidate an opponent and to showcase one's own capability. Among Soviet Union and United States, the distinguished technology that was hot issue to competition in cold war era is Space technology that called “Space race”. At the present time, although have many international organizations to help for negotiation in international conflict that make the war that flight with face to face was hardly happened, but this not meant that all of country in the world were alliance between each other or have not the others sorts of war.

Besides the competition of trade, economic, culture, hard power, and soft power such as trade war between United states and China. At the present time the international conflict had remained, however each country avoided to directly encounter among as because of international benefit. Space technology and outer space were a new thing for people, but people were received many benefits from space technology because space technology were covered in many technology types such as communication satellite, GPS, internet, digital technology communication technology or missiles. Moreover, many technologies we use at present day that make from space technology experiment such as air bag technology, MRE food, space ceramic. That cannot decline that the most of communication technology related to space technology. The beginner in space technology development were Soviet Union and United states as Space race but nowadays have many countries that develop space technology such as France, China, Japan, India and even South Korea, this is meant many countries in the world be awakened to developed own space technology, despite space technology was inapplicable to ordinary people and had abundantly price .Besides the progressing of technology, Space technology development got others side benefit such as Science, technology, economic or politics, moreover space technology can also got bad effect . This issue was only focus on Science and technology issue or others issue.

In the 1950 era, Korea was not a famous country because in those era Korea encounter internal war, external war or invaded from eternal country so, Korea in those eras was a poverty-stricken country. After both Korea signed in The Korean Armistice Agreement that made Korea divided to North part and South part at 38 parallel. South Korea is the one country that have a rapid growth economic after cold war era, South Korea can transcend from underdeveloped country to developed country within approximately 50 years. Moreover, for indicator innovative economy of Bloomberg Innovation Index, South Korea innovation been the top10 and transmit from Fast Follower innovation era to First Mover innovation. South Korea is a country as known about who export a K-wave culture or called “Hallyu” whether K-pop song, K-drama series that inserted about

many Korean cultures such as food, fashion, nationalism that all expand Korean cultures either one context or another context. Recently, K-drama field seems like to produce film that have story about space such as Space sweeper (2020), The Silent Sea (2021), which does mean South Korean people will had an interesting in space issue more than past interested to develop own space technology.

Korean history had evidence that Korean people studied about astronomy since 14th century. King Sejeong era that had invented sundial, armillary sphere, celestial globes, this is the beginning of space study in Korea, that meant in the past Korea in the one country that flourish Civilization. Many technologies in South Korea always lean on neighboring countries such as Japan, China but South Korea started to establish own space technology institute since 1974 in this year Korean National Astronomy Observatory (KNAO) was established under the Ministry of Science and Technology. Afterwards KNAO that changed name to Korea Astronomy and Space Science institute 한국항공우주연구원 (KASI). Beside KASI in South Korea have many institutes that research about space technology such as Korea Aerospace Research Institute 한국항공우주연구원 (KARI), Korea Space Science Society 한국우주과학회 (KSSS) etc. All of them been under controlled by Ministry of Science and ICT. In addition to many research institutes that research about space technology in South Korea, many universities in South Korea have a field or major in space science such as Department of Aerospace Engineering, Department of Physics & Astronomy in Seoul national university and Department of Astronomy, Yonsei University.

KARI



Figure 1 Korea Aerospace Research Institute (KARI), Daejeon, South Korea.

KASI

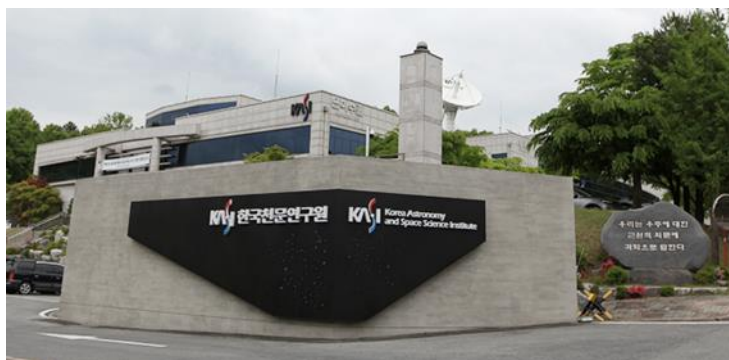


Figure 2 Korea Astronomy and Space Science institute (KASI) Daejeon, South Korea

KSSS



Figure 3 Korea Space Science Society (KSSS): this institute were conduct much research, journal, conference about space issue,

Although at the present time, compared with U.S., Russia, China, and Japan. South Korea is novice for Astronomy, but South Korea had a broad vision more than rush development. South Korea had many space projects such as KSLV- I, ARGO-M, Lunar exploration, STSAT-2, KITSAT-1, KSR-1, KSR-2 etc. According to above that represented South Korea want to develop space technology conscientiously. Space technology program that South Korea want to develop, many program were supported by alliance country as United State. Although South Korea that interested to develop space technology, unfortunately space technology was overabundantly for interest by one country so, imitation or use international connection were essential method.

Since 2017 Moon Jae-in, president of South Korea launched NSP (New southern policy) for opened relationship between South Korea and ASEAN + India. South Korea sees many benefits from the relationship such as Economic, Technology

by planned centered around '3ps' People, Peace and Prosperity. That indicated South Korea has been preserved old alliance country and find a new connection in international level. Because at the present time North Korea was not only one state that South Korea concerned but in east asia region that conducted with superpower country such China and Powerful country such Japan. When compered South Korea with those 2 countries whether economic or armament, South Korea is only small state so alliance connection and finding new relation been indispensable for South Korea.

From that mentioned above make curious thing that involved in this issue How space technology development important to South Korea? What South Korea received benefits from space technology development? Economic, Technology or hidden connotation others. This is the significance of this issue that researcher want to study.

The example: Astronomy cooperate agreement plan between South Korea and U.S.

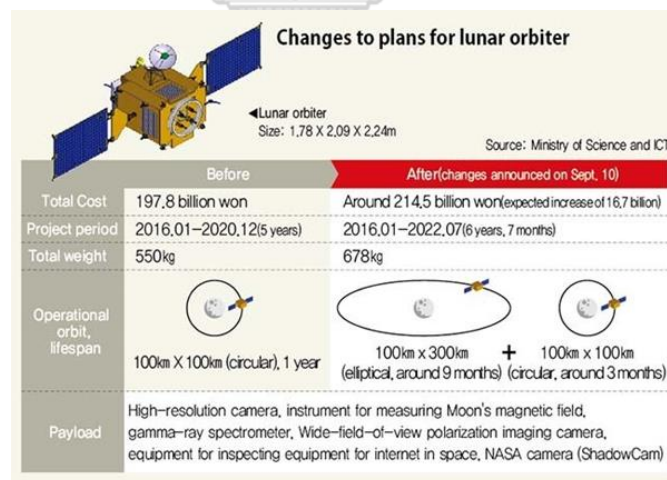


Figure 4 Korean Lunar Exploration Program, the cooperation program between Korea Aerospace Research Institute (KARI) and National Aeronautics and Space administration (NASA)

1.2. Objective of the Study

The aim of the study in topic Political Astronomy: South Korea space technology development under the direction of international politics dimension are

2.1 To study procedures of space technology development in South Korea.

2.2 To study affectation of space technology development in South Korea in international politic term.

1.3. Question of study

3.1 Why South Korea focused on the space technology development?

3.2 How the space technology development effect to South Korea politic role in international level?

1.4. Hypothesis

South Korea intended to developed space technology because South Korea been farsighted to benefits of this issue whether in economics term, communication technology. Moreover, the tension situation in Korea peninsula was an important point that pushed South Korea developed space technology for self-defense. Because of tension situation in Korea peninsula and conflict between South Korea and North Korea, sometimes we herded news about “North Korea has fired a suspected submarine-launched ballistic missile test”, that incident was made international felt anxiety especially South Korea and Japan that located near North Korea. This reason will be a one important reason for space technology development in South Korea.

Although, space technology development that use country capital in high abundantly rate but at the present time South Korea reminded develop space technology relentlessly. From successful of economic development that in the next step South Korea will set target to are leader in technology.

Moreover, space technology development effected in South Korea role of international politics. For competition issue of international level which space technology development was called “Space race” because each country that had

space technology development which divided between by U.S. polarity a China polarity. In addition to relation between United States and South Korea so South Korea will participate with U.S. space project more than China space project.

Hypothesis conclusion for my question of study: Why South Korea focused on the space technology development? In Researcher hypothesis can separate in 2 issues: Politics issue ,1.1 State stability- because situation in Korea peninsula that made South Korea been on the alert to self-defense. 1.2 International relationships- space technology development that had high price and using advanced level technology, so each country will be cooperation for develop this technology, so South Korea can get an alliance and connection

1.5 Scope of study

This study focuses on relation between South Korea space technology development with international political and Development of space technology in South Korea since South Korea started to develop space technology until current day and future direction.

1.6 Definition of Terms

Astronomy: meaning is the science that studies the laws of the stars that studies celestial objects and phenomena. This subject was conducted many subjects such as physics subject, chemistry, math for explain their origin and evolution or objects of interest include planets, moons, stars, nebulae, galaxies, and comets. Explaining phenomenon include supernova explosions, gamma ray bursts, quasars, blazars, pulsars, and cosmic microwave. More generally, astronomy studies everything that originates beyond Earth's atmosphere.

Outer space: empty space upper from the earth to atmosphere between celestial bodies that containing predominantly a plasma of hydrogen and helium, electromagnetic radiation, magnetic fields, neutrinos, dust, and cosmic rays. The Outer space does approximately temperature -270.45°C ; -454.81°F

Space technology development: for this research is meant the development progress of space technology from beginning until now in South Korea.

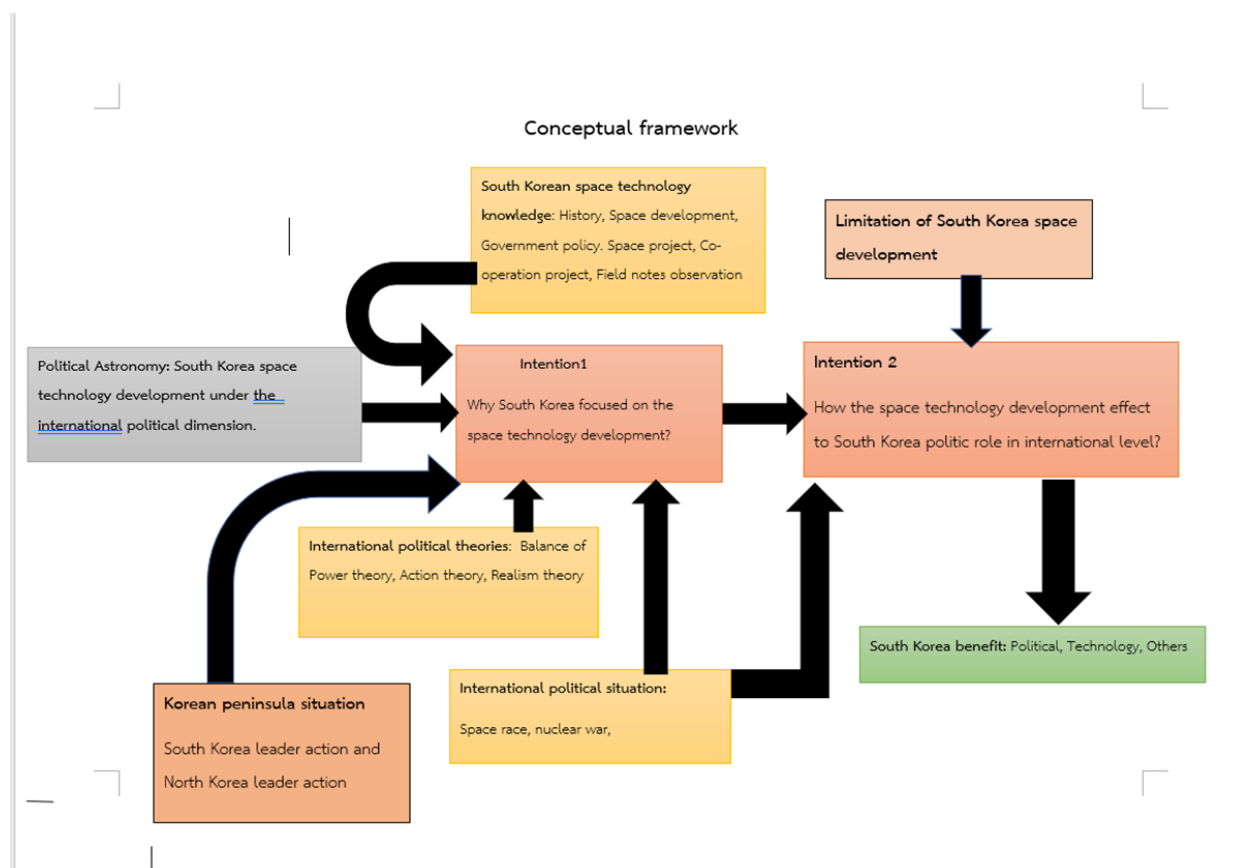
Korea: is former country in East Asia, on a peninsula southeast of Manchuria. A kingdom prior to 1910; under Japanese rule 1910–1945 and dividing at 38°N , for this research will mention in context about history before separating in Korean war 1950 era.

South Korea: A state of eastern Asia at the southern part of the Korean peninsula. Korea was divided at 38°N into a northern Soviet zone and a southern American zone after World War 2 related from Korean armistice agreement. For this research will mention in context South Korea since 1953 after South Korea founded the state.

1.7 Research Methodology

This Study was qualitative research which analyzing about phenomenon and data that found in scope of relation of South Korea space technology development and international politics dimension. Moreover, using documentary research from primary documents and electronic documents such as books, articles, research website, news in South Korea space technology knowledge and international political theories such as Balance of Power theory, Action theory, Realism theory. Afterwards bring all data to analyzing with context analysis method, descriptive method and use inductive research to find keys of question in this study.

1.8 Conceptual Framework



CHAPTER II

THEORIES AND LITERATURE REVIEW

2.1 Theories

Theories that use in this Thesis can divide to 2 sides Knowledge Space technology and Astronomy development knowledges parts such as communication technology, armament technology and many present appurtenances. Since proxy war era between U.S. and Soviet space technology that developed continuously whether for competition or others reason. At the present time the competition was remained, but competitor change from between and U.S. and Soviet to U.S. and China, others new competitor 2. International relation theories parts

Action theory

This theory explained about action and re-action between state. Why A state did this action? Why did B state respond this way? This theory use internal factors more than external factors such as state ideology, deciding and state policies, benefit of state, international relation policy. **X= State action**



In this theory explain about action that North Korea and South Korea did each other. After North Korea and South Korea were divided, both Korea was distrust each other though both Korea have Korean Armistice agreement. When North Korea did some action, such as developed nuclear technology, South Korea will respond by connect relation with U.S. and developed space technology for flight with nuclear technology.

Balance of power theory

This theory explained that the world had many states. Hence, that have a power polarity group of state. When that have many powers polarity group, Balance of power was a important for peace. The situation between state a and state b that effect to the others state. The action from state cause of 2 point 1. Preserving power and influence 2. Want to get more power and influence.

In this theory explain, why North Korea want to develop nuclear technology and How South Korea respond to North Korea action, so theirs develop nuclear technology South Korea must preserve national security and internal security. When North Korea did some nuclear action, South Korea will respond by international law and invective. The responding between North Korea and South Korea were related of balance of power theory. North Korea and South Korea were developed own states for flight each other, North Korea claimed that South Korea have a good relationship with U.S., this point threaten to national security of North Korea. In the other hand, North Korea developed nuclear technology that also threaten South Korea national security so, both Korea wants to preserved national security of own state. Developing space technology of South Korea and developing nuclear technology of North Korea is one issue that both Korea use balance of power each other. Both Korea wants to preserve own national security moreover, both Korea wants to expand power and influence, each state that try to present good thing for expand good image of state

Realism theory

This theory was explained from experience and adopted to present situation, because the world that all of wars, conflict, each state wants to seek to benefit and power and want to preserved national interest. State actors set up in anarchy environment so, each state be suspicious of national security, when A state develop technology armament that effect to other state feel anxious in A state because the national security of A state is instability circumstances in others state. this situation called “Security dilemma” When South Korea successful launching Naro project in 2013 in this year, North Korea had a plan of 3rd nuclear project.

In this theory explain about the worst situation such as the war so, each state must find a way to encounter this situation. Both Korea have bad memory of Korean war and North Korea believe cause of Korean war is foreign intervening so North Korea that develops nuclear technology because in the past Korea were invade by others that make both Korea were distrust each other so, both Korea must find contingency plan for the worst case. The worst case of North Korea is threatened from others so, North Korea might to developed weapon for protect state but South Korea, neighbor state that threatened by nuclear weapon launching experiment so, South Korea developed technology and use alliance supporting for flight with North Korea.

2.2 Literature review

Most of articles in space technology issue that only study in science side but nowadays that started to study in space technology related to others issue whether economic, law, politics, communication more than in the past. This is mentioned to the benefits in space technology not only related to science but also related to many issues around human.

2.2.1 Literature review Politics and Law field

Pongnakorn Nakornsantipap (2004) studied about “*Politics in Outerspace*”: the politics in outer space, has three important objectives. First, to study the progressing of space technology, the development direction and the effect that may occurred from that space technology development. Secondly, to analyze to compare with from and core of order arrangement to use benefit from space at present; besides, to expect the trend in the future. the co-technology education concept to study the effect from space technology development. This thesis also emphasized on answering the main question of this research how does the space technology development effect politic, economic, society and environment.

The research result found that nowadays, the world has many conflicts that take effect from benefit using in space. The conflicts trend to more expand and will take to necessarily arrange the relation of politic, economic, society in the world again to terminate the conflict crisis and order or rule problems, which relate with conduct activity in space. In this thesis researcher that studied about politics and outer space in overall image and occurred at the moment, studied for 18 years ago so, the information was old. Besides, the study in this side has a little and most of all study that studied in science field. Hence, I want to study outer space or space technology related with Politics in middle power state.

Space Law

Doo Hwan Kim studied about “*Space Law and Policy in the Republic of Korea*” :Korea has a rapidly expanding space programmer. The government is giving priority to the aerospace industry and enacted an Aerospace Industry Development Promotion Act in 1987, a Space Development Promotion Act in 2005 and a new Space Damage Compensation Act in 2007. the legislative history, comment for these three space acts including especially launch licensing, registration of space objects, use of satellite information, astronaut rescue, liability for compensation, third party liability insurance, financial support for the aerospace industry and establishment of committee and plans to assist the Korean space effort.

In this article emphasize study in Law of space in South Korea, from this article indicated South Korea that try to develop many spaces project so, the government could launch policy or law that support to space technology development or space act, each government have a different policy about space project because South Korea space technology development remained a limitation from international relation and the contrast in Korean peninsula. The article weakness was old information and studied in only about law and policy which can change fellow the government.

G.P.Zadorozhny proposed his vision “Outer space was control by law like high sea that protected from every aggression”

R.Y. Jennings LL and Mr. J.E.S. Fawcett proposed about main idea of space law “*A Draft Code of Rules on the Exploration and Uses of Outer Space draft and Rules concerning changes in Environment of the Earth*” that gave a definition of air space and space craft. Air space is the space above land, water surface no more than 80,000 meters. Outer space is space is above air space. Space craft is a vehicle that can move in orbital movement or space and do the mission at space station. The testing any nuclear device or the disposal of radioactive must do under suggestion from United Nation. Do not anything that effected to change of natural environment in Outer space.

Andrew G. Haley proposed the “metalaw” the law can use extra-terrestrial intelligent beings and he proposed "space medical jurisprudence" before launching the space craft must be covered the space craft by process - launch sterilization and internal sterilization for protect contaminated form outer space.

Ulrian G. Verplaetse proposed and tried to conduct the air law, space law and telecommunication law to one passage. In his vision space law is a hidden agenda of politic and artificial satellites is not under by space law. Planet cannot possess (res nullius) and cannot be owner together.

Eug'ene Pe'pin proposed the concept of foundation space law: space law must be independent from international law and world law or universal law. The legislative of space law must be related form real science knowledge. All the nations of the world have a free for exploration and use in space, planet. Space and planet must be not proposed by only 1 nation. Spacecraft have a right to innocent passage by appeared a nation flag. Many states must provide assistance for the space craft that emergency landing. The state that proposed space craft must have

compensated for damage about from space craft. Before takeoff the space craft must be advance notice and noticed about radio frequencies.

Cho Hong Je (2013) studied “*Space Development and Law in Asia*”

Space activities should have a legal for manage. The United Nations established COPUOS to examine legal issues concerning the peaceful uses of outer space. At the time, the military sector of the U.S.A. and the Soviet Union oversaw the space development, and they were not welcomed to discuss the prohibition of the military uses of outer space at the legal section. As the social and economic benefits derived from space activities have become more apparent, civil expenditures on space activities have continued to increase in several countries. Virtually all new spacefaring states explicitly place a priority on space-based applications to support social and economic development. Such space applications as satellite navigation and Earth imaging are core elements of almost every existing civil space program. Such as, Moon exploration continues to be a priority for established spacefaring states as China, Russia, India, and Japan. Recently, Companies that manufacture satellites and ground equipment have also seen significant growth. Most of the work was performed by the Institute of Space and Aeronautical Science of the University of Tokyo, the National Aerospace Laboratory, and, most importantly, the National Space Development Agency. Japan eases restrictions on military space development. Under this legislation, the Space Activities Commission of the Ministry of Education, Culture, Sports, Science, and Technology, which was responsible for the development of Japanese space program, will be abolished. Regulation of space policy and budget will be handed over to the Space Strategy Headquarter formed under the Prime Minister’s Cabinet. Space Strategy will be supported by a Consultative Policy Commission as academics and independent observers.

Park, Won-Hwa (2009) studied about “*Outer Space Activities and an Observation of Related Laws of Korea*”: U.S. pressured South Korea to abort its nuclear weapons program for prevent another possible military encounter that can easily develop into a war between South and North Korea. The situation of South

Korea is in much contrast with its neighbor, North Korea, which has fired Taepo Dong 1 and Taepo Dong 2 to put its alleged satellite respectively into the Earth orbit. The range of this rocket believed to be reaching more than 5,500 km, a range of the intercontinental ballistic. South Korea that has just geared its full powers for its outer space industry and started with putting and manufacturing sounding rockets, producing satellites but relying on foreign launching facilities, and learning launching capacities.

In this research study about relation of space technology and law in South Korea and international relation between South Korea and alliance. Although, South Korea have many spaces project plans but if use system theory and balance of power theory to analyze in this issue, South Korea is middle power stage while U.S. is a superpower stage so, South Korea space technology development must be observed and supported by U.S. and depend on international politics situation. Curiously, if South Korea can reunification with North Korea or South Korea have a nationalism government, by only South Korea latency can develop personal space technology or cannot. (Park Won-Hwa 2009)

Most of study about space law that proposed about boundary of space technology using. Each state has freedom to develop space technology but only for exploration, study and must have compensate for damage about space activities. The legislative should be relating science knowledge and universal law. Outer space should take advantage together and should not monopolized by only one. Space technology development should not use for offensive reason such as threaten others. At the present time many states want to play a role in space technology so, space acts and space law must be clearly and regulate space activities orderly. Space law is arguing issue, for regulating Space law that related from international law or related from only science knowledge because of outer space is not have boundary so outer space cannot have possessed by someone. In addition to for space vehicle,

each country can develop and experiment for exploration propose but cannot use for threatening other and be responsible damaged cause from own space vehicle.

National security

This group of literature review were proposed about national security

G.P.Zhukov supported the ideology of study and peace cooperation but do not permit for military such as ballistic , espionage satellite, missile. But can use for protected myself

Sir William Hildred Sir Frederick Tymms proposed the right of sovereign in space planet 3 points. 1.The right of sovereign in space planet was essential for preserved benefit. 2. The right of sovereign in space planet was not impracticable 3. The law cannot explain the border of air and space will have a problem.

Alex meyer proposed the idea that “should not expanded the sovereign power to space but each state can use sovereign power only at space base. By this ideology that comparable with analogy maritime law and space craft must have a national flag that related from the law of flag.

In this thesis was explained about boundary of sovereign power in outer space because each country wants to expanded sovereign power to outer space. This issue can make a conflict so, law regulation can solve in this problem.

Phan-orn Powcharoen (2021) studied “*Nuclear Problems on the Korean Peninsula*” The problems causing tension in the Northeast Asian region is North Korea’s nuclear development project. Prediction North Korea began a nuclear development project in the 1950s and became a threat to world community peace and security. Since the early 1990s, tensions on the Korean peninsula caused by the nuclear development project elevated. North Korea to denuclearize. Negotiations made North Korea feel insecure about national security in addition to maintaining the threat perception of North Korea. Therefore, despite negotiations, North Korea

continued to advance its nuclear development project and eventually declared itself to be a nuclear state in 2012.

Mcnaair proposed the concept of the difference between air and space. The summery was air can be possessed by contain in vessel, but space cannot possess. In this article is got a reason that the contain in vessel or space vehicle can possess by country that produce but for the others that was from exist in natural in this point nobody can possess.

Maurice Lemoine proposed the concept of “the thesis of the freedom of the air and the thesis of sovereignty” and the air can expand power related physical possibility. In this thesis compared between air and space because of in the air each country has a sovereignty upper territorial sky of own but for outer space should not possess by someone.

John cobb cooper proposed concept of space planet and state power of space planet that related from maritime law “State have a full sovereign power in land, surface of the water and sky atmosphere that aircraft can flying” As mentioned previously that called territorial space. The higher from territorial space to earth’s surface that called contiguous space. The upper from contiguous that was a universal space. “A State can exercise power rights in outer space beyond the region of earth attraction “

Jong-bum Kim (2017) studied “*Cultural Idea and Space Development*”

The Knowledge of space development can be classified in three types: national security, scientific inquiry, and commercia. In the rhetoric analysis of Kim Young Sam, Kim Dae Jung, Roh Moo Hyun, and President Lee Myung Bak, the periods when Korea's space development began in earnest, the pragmatism of strengthening industrial competitiveness through space development has been consistently emphasized.

D. Goedhuis proposed “a principle of sovereignty over territorial airspace” that permit transit and traffic right. And he used principles of nationality related to space craft and aircraft problem and damage compensated such as the damage on surface, damage on air space.

R.Y. Jennings criticized the international civil aviation convention that only support Superpower state and membership state benefit.

Jessep and Taubenfeld proposed that the civilization of space technology must be legislative to cover about the space performance for prevent future problem that related the principles absolute or strict liability.

Myres Mcdogal proposed public order of the world community for prevent the flagless space performance.

Korovine proposed the state sovereign power cannot covered to outer space because science reason. When the world revolves around itself so, the state cannot cite international status. The freedom of space or outer space that meant using the benefit from outer space.

Kang Han Cheol(1991) studied “*Military Use of Satellite and Control of Civil Use*” the 'militarization' of aerospace technology and the 'battlefield-worthiness' of space are becoming more and more at issue. Korean peninsula, the last major theatre where the 4 world powers' national interests stand face to face ,understanding and organizing necessary legislations for establishing national security from any space threats. After briefly summarizing the problems of Korea's current legislations, particularly with the National Space Development Act (proposal), drafted by Ministry of Science and Technology, in mind, this article reviews and offers certain legislative directions to which Korea should pursue for national security of outer space.

Kim Doo Hwan studied “**The Main Contents and Comment on the Aerospace Industry Development Promotion Act of 1987**” Korea now has a rapidly expanding and developing space project with exploration aspirations. The government is giving priority to the aerospace industry. The three space acts including especially launch licensing, registration of space objects, use of satellite information, astronaut rescue, liability for compensation, third party liability insurance and establishment of committee and plans to assist the Korean space effort. the Korean government will establish the Korean Space Agency as an governmental organization in future, it is necessary to revise the contents of the Government Organization Act that desirable and necessary for us to establish an Asian Space Agency (ASA).

Chin Young Hwang(2019), Jong Bum Kim studied “***Study on Restructuring of Space Governance in Korea***” The purpose of this study is to explore the c status of the space development system in Korea following the successful launch of test vehicle, The study investigates the space development system of leading countries such as USA, France, and Japan with keen focus on the administrative organizations and thereafter draw implications for Korea. The analysis of the existing situation in Korea focuses on governance, such as space-related government organizations, space development agency, and specialized research funding agency. As a result, this study proposes the need for full-scale discussion on building a space agency.

Wichain Intasi, “Models for Explanation on Nuclear Weapons Proliferation: Some Suggestions from case study countries in asia” Many scholars have developed models to explain why states go nuclear. Among these models’ national security imperative or model that viewed states pursue nuclear weapons in order to defend themselves from their rival states has been frequently employed in several studies. The national security model is based on the realists' tenet that each state must protect itself due to a state of anarchy of international politics. But, after investigating China and India's motivations to develop nuclear weapons, the study finds that other

factors for example domestics, scientist's role and national pride contribute to explain why China and India searched for atomic bombs. When studying nuclear weapons proliferation, therefore, other models should be taken into consideration, because each country has different background- including economic, political and social environments.

Poowin Bunyavejchewin studied “*South Korea’s Middle Power Diplomacy: The Establishment of MIKTA*” Since the 1990s international power of South Korea increased rapidly. The country is now considered as the middle power. Middle power diplomacy which propounds a global role for the country has been a constant theme in South Korea’s. foreign policy for nearly two decades. Park.Geun-hye government put forward the. Idea to establish MIKTA and informal consultative group between the five middle powers of Mexico, Indonesia, South.Korea, Turkey and Australia which came into exist in September 2013. This article examines South Korea’s middle power diplomacy in general and the establishment of MIKTA.

Most of research that study in political issue of space technology emphasize about national security because space technology can be relating with military and armament technology. Most research does not agree with expanding sovereign power to outer space. Space technology is a powerful technology that can affect to others. People believe outer space is endless so, each country want to expand influence and power for get benefit as though colonial era. Related from space law outer space can take benefit together but cannot proposed. The national security issue, that concern about war and conflict such as North Korea and South Korea. Because of both Korea that concern own security so, North Korea could develop nuclear technology and ballistic missile for protect own state but South Korea retort that North Korea action is violate the Korean Armistice Agreement so, South Korea developed space technology for use technology battle with North Korea.

2.2.2 Literature review Science and technology field

Kim Jong bum (2018) studied “*The Transition Effect of Korea’s Space Development*” Since 1990s, South Korea recently launched Space Development and is pushing for a step toward Space. The development of Korea Space Launch Vehicle II has progressed to the stage of proprietary development, 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.

Keum-Oh Lee, Junseong Lee, Soon-Young Park, Woong-Rae Roh, Sung-Hyuck Im Gi-Won Nam and Daeban Seo (2021) studied about “*Korean Reusable Launch Vehicle Development Strategy Using SpaceX’s Strategy*”: SpaceX shows various strategies such as constructing various payload portfolio through the reuse of Falcon 9 and Falcon Heavy, constructing the launch vehicles using one type of engine, the transition from kerosene engine to methane engine. In this study, a variety of payloads and trajectories from KOMPSAT to GEO-KOMPSAT were constructed, and ten launch vehicles using kerosene gas generator cycle engine, kerosene staged-combustion cycle engine, and methane staged-combustion cycle engine were reviewed. Of the ten launch vehicles, the reusable launch vehicle using a 35-ton methane engine was rated as the best in terms of development potential. In this article studied about space technology and space vehicle that South Korea used in the past. South used to use Russian space technology and U.S. space technology but after South Korea had good relationship with U.S. the direction of South Korea space might be controlled by U.S. and use U.S. technology in South Korea space project.

Barbara ward and Rene dubos published the book “*Only One Earth: The Care and Maintenance of a Small Planet*” in this study that emphasized the unit of the Earth and its environment and recommendation about environment problem that makes by human such as in the global atmosphere, the oceans, the world's weather system. So, this problem needs co-operation to make policy for solved a problem. This book reflected about the survival of planet.

In this thesis offer about earth environment problem that make human want to find a new place to immigration in outer space, this point is refer to new colonization in outer space.

Il-seong nha (1997) studied about “*Astronomy in Korea*” that has been briefly described in three parts. The first part deals with a history of modern astronomy in Korea. the second part is introduction of material available for the study of the oriental astronomy history. A large amount of document accumulated for nearly 2000 years and some instruments of historical value are well preserved. The last part is the present time with represents the fast establishments made successfully in recent years since the late 1970

In this article studied about astronomy knowledge in Korea for 2000 years ago. In the past South Korea astronomy knowledge imported from South Korea astronomers that have ever been to study at China.

Oscar Schachter proposed the idea that “*Outer space and the celestial bodies would be the common property of all mankind*” each state should not possess that related the free principle and equal.

In this thesis studied about biology of celestial bodies. Although, this thesis only studied about in science field but can bring some data to analyzing in my thesis.

Grigori Tunkin proposed “free for exploration and use by all states and were not subject to national appropriation”

Jacek Machowski proposed when the space craft that haven’t astronaut fell down to earth surface those space craft must be proposed by the state flag space craft or state that space craft fell down.

Jaroslave Zourek and Michael Milde proposed “Nobody know that the limit of space” when space was limitless and space can change and modification so, the sovereign power cannot claim.

Mcmahon asked about reconnaissance satellites for infraction issue and how to solve the problem. The right of destroy violation space craft and the international law violation.

Jung Hyun Jo, Woo Kyoung Lee, Nammi Choe, and Jeongho Baek studied about “ *A study on the navigation message contents of the future Korean navigation satellite*” Many studies relating the satellite navigation has been done by a relatively small research community in Korea. the opinions suggesting about future Korea’s own satellite navigation system. Due to geographic, economic, and technological reasons. A development technical roadmap regarding the Korea’s own navigation satellite was established on the Korea Space Development Plan in general term. The four global navigation satellite systems are operating or deployed. Many regional navigation satellite systems are in the planning and development phase. Particularly in Asia, China has launched several satellites to complete their own global navigation satellite system, COMPASS until 2020. In this study, the validity or the feasibility of the Korea’s own satellite navigation system is not discussed; rather the possibility and suitability of the additional information to the current operational navigation message is main target. For the first payload of the future Korea’s satellite navigation satellite, a regional augmented system is more likely. In this study that focused on the aspect.

Kim Youn Suk (1997) studied “*Technology and development: Impact of Technology on the Korean Economy*” Korea has undoubtedly developed one of the most dynamic economies in the world. Having realized a successful industrialization, Korea that interesting in science and technology. Korea has the problems of meeting competition from countries with more efficient industries as well as those with lower labor costs. Korea must muster the human capital, as well as financial and other resources for domestic R&D to maintain an industrial growth, complemented by imported technology. Korea must promote its own technological innovation imposed on it in the changing global economy. This journal proposed the

profound impact of science and technology on Korea's economy implication for the global economy.

Joo-Hee Lee, Yeon-Kyu Kim, Jong-Woo Kim and Gi-Hyuk Choi studied *“Astronaut's Earth observation on the international space station”* Ministry of Science & Technology (MOST) and Korea Aerospace Research Institute (KARI) were preparing for the first Korean astronaut project. KARI is making plans for the Korean astronaut missions with others and investigates a lot of manned space missions. Among the suggested items, Earth observation on the Russian Module of ISS is the one expected mission for a Korean astronaut. This paper proposed to give a brief introduction of ISS Russian Module and research fields of Earth observation for astronaut mission.

Hong-Je Cho(2018) studied *“Militarization of Space and Arms Control”* Since the first launch of Sputnik 1 was launched, space issues become to consider economic, political, or scientific human life in the communication field. That proved in the recent Iraq, Gulf, and Kosovo Wars, space capability actor of modern warfare. Space power is become to indicated of national power. Commercial and military activities were developed by the US and former Soviet Union, but in the 21st Century many nations participate in space activities either directly or indirectly. Because of the importance of space and security interests, China, Japan, the EU, as well as US and Russia, spur military and commercial space development. Space development contributes to positive human life but can increasing concerns about the final frontier-outer space-could become a theater of war. Space technology is now integrated into terrestrial ecosystems, especially in the United States and other economically advanced societies.

Gong Hyeon Cheol, Lee Joon Ho, Oh Bum Seok (2008) studied *“Trend of Domestic and International Development of Space Launch Vehicles”* South Korea have a plan to produced a Korean space launch vehicle(KSLV-I) in NARO Space Center that located in Goheung, in Korea. The launch of the 2nd technology satellite

of 100kg with KSLV-I. In addition to the traditional space activities of U.S.A. and Russia, Japan launched the lunar satellite, Kaguya in 2007, China launched the lunar satellite, India launched the lunar satellite Chandrayaan in October, 2008. In this paper that proposed the trend of domestic and international development of space launch vehicle considering all these space development activities.

Sanggoo Kim*, Dongweon Yoon* and Kwangmin Hyun (2010) studied *“Ground Stations of Korean Deep Space Network for Lunar Explorations”* Many states of the world have been develop space plan and South Korea also has a plan for the launch of Lunar orbiter in 2020 and Lunar lander in 2025. For the success of the planned Lunar exploration that enhance the required deep space communication technologies to achieve the goals,. In this research that investigating overseas DSNs and deep space communication systems, and present the link margin and other technical requirements for successful DSN deployment. In addition, we propose a best strategy to secure domestic ground stations for the Korean Lunar exploration missions.

Most of research in science and technology issue can related for this thesis that study about South Korea space technology. South Korea started to invest in space technology since 1974 and launched many space project such as space vehicle, KSLV-I, KSLV-II, KSR

From the literature review that seen because of outer space were limitless and space technology have a new development technology everyday so, the legislative for space never covered every outer space and every space performance. Every space performance risk to have a problem such as interest, environment, and international relation but in the other hand space technology seem like have a benefit more than average, so many countries or states that have an enough budget almost interesting about the investment in this technology. Not only for show rattling like in proxy war era, but also use benefit from the leading of technology to developing a convenient life, developing armament military. At the present time

that have a developing technology competition such as cyber armament, fasting and precising of information intelligence. So, it not a new trend that many states want to develop own space technology. At the present 2022 South Korea that pass about president election and have a new leader form conservative party. From now on the world must be focus about conflict of North Korea and South Korea.



CHAPTER III

DEVELOPMENT OF SOUTH KOREA SPACE TECHNOLOGY

3.1 History of astronomy knowledge development in Korea

The study of astronomy in Korea first appeared in the period of Korea's three kingdoms (삼국시대) that consisted of Goguryeo (고구려), Baekje (백제), Shilla (신라). Korea's three kingdoms 삼국시대 in the 4th -7th era Goguryeo who has mural paintings with astronomical charts in Goguryeo tumuli. In the 5th – 7th era Goguryeo, **Pyongyang Cheomseongdae 평양첨성대** an observational platform was built. In the 6th -7th era Baekje, Baekje's astronomers dispatched to instruct astronomy in Japan. In 632-647 A.D. Silla Dynasty, Gyeongju Cheomseongdae, an observation platform, was built. In 718 A.D. Silla Dynasty, Nugaakjeon which was the administrative office for standard time was founded. Nearly all of Korea's astronomy knowledge is based on Chinese astronomical knowledge. In this chapter we will study about Korea's astronomy knowledge from the very beginning , which is in Korean's three kingdoms period up to our present day which is 2019 A.D. After the Korean War, astronomy knowledge was split into 2 very politically different countries, North Korea and South Korea both had different purposes and needs in using their knowledge. North Korea developed space and nuclear technology to help provide them a sense of national security, but South Korea developed space technology for various purpose such as to develop communication technology, and to invested in space technology for many future benefits.

Table 1 Goryeo Dynasty 고구려 (918-1392)

Goryeo Dynasty 고구려 (918-1392)	Actions
918 A.D.	Taebokgam 태복감, the royal astronomical office was founded
1023 A.D.	Sacheondae 사천대, the royal astronomical office retitled from Taebokgam.
Goryeo Dynasty 고구려 (918-1392)	Actions
1308 A.D.	Seoungwan is the royal astronomical office that was founded combining Sacheongam with Tassaguk.
11 th century A.D.	Gaesong Cheomseongdae 개성 첨성대 is observational platform was built
1309 A.D.	Shoushi calendar (a lunisolar calendar) was enforced.
1389 A.D.	Datong calendar (lunisolar calendar) was enforced

Goryeo Dynasty 고구려 (918-1392), this was the first era in which we found evidence about astronomical knowledge from the findings of astronomical instruments and facilities such as astronomical offices, observation platforms, and lunisolar calendars.

Table 2 Joseon Dynasty 조선 (1392-1910)

Joseon Dynasty 조선 (1392-1910)	Actions
1395 A.D.	Cheonsang- Yeolchabunyajido 천상열차분야지도 is a stone star chart was produced.
1432-1438 A.D.	astronomical instrument development project was performed
1433 A.D.	Ganuidae 간의대 is observational platform was built.
1432-1442 A.D.	astronomical calendar research project was performed
Joseon Dynasty 조선 (1392-1910)	Actions
1442 A.D.	.Chilijeongsan-Naepyeon 칠정산내편 and Chilijeongsan-Oepyeon 칠정외편 is a lunisolar calendar was published
1466 A.D.	Gwangsanggam 관상감 is the royal astronomical office retitled from Seoungwan 서운관
1654 A.D.	Shixian calendar is a lunisolar calendar that effected by the west was enforced 1896 era Gregorian calendar is a solar calendar was adopted.

Joseon Dynasty 조선 (1392-1910) The usage of astronomical instruments that were developed in the Goryeo Dynasty era, were adapted to usage , such as the lunisolar calendar, the solar calendar, and the stone star.

Table 3 1970s

1970s	Actions
1974 A.D.	Korean National Astronomy Observatory, (KNAO) was founded as a national observatory
1978 A.D.	Sobaeksan Optical Astronomy Observatory (SOAO) was built on Sobaeksan mountain (소백산).

In 1980 A.D. Korean National Astronomy Observatory was renamed as the institute of Space Science and Astronomy, and a Radio Astronomy Observatory was built.

Table 4 1980s

1980s	Actions
1985 A.D.	Taeduk Radio Astronomy Observatory (TRAO) was built in Daejeon by KASI.
1986 A.D.	KNAO was renamed to the institute of Space Science and Astronomy (ISSA).

1980 era, Korean National Astronomy Observatory was renamed to the institute of Space Science and Astronomy, Radio Astronomy Observatory was built

Table 5 1990s

1990s	Actions
1992 A.D.	The first Global Positioning Systems (GPS) station was built
1996 A.D.	Bohyunsan Optical Astronomy Observatory (BOAO) 보현산천문대 was built
1999 A.D.	Korean Astronomy and Space science institute (KASI) established another institute that Korea Research Council of Fundamental Science and technology (KRCF).

1990 era South Korea was built GPS station and Optical Astronomy Observatory. In this era South Korea interested to develop space technology especially explore and observatory and have founded others space institute. Development space technology in this era got stuck because Asian financial crisis in 1997.


 Table 6 2000s

2000s	Actions
2003 A.D.	The first Korean Space telescope FIMS was launched onboard STSAT-1
2009 A.D.	The construction of the Korea VLBI Network (KVN) completed, and the construction project of GMT (Giant Magellan Telescope) initiated.

2000 era South Korea developed space vehicle and set Korea VLBI network and future plan project; this era South Korea invested in space technology that related with telecommunication

Table 7 2010s

2010s	Actions
2012 A.D.	East Asia VLBI Research Center was built and SLR system was established by 2012
2014 A.D.	KMTNet system was installed in Chile, South Africa and Australia.
2016 A.D.	OWL network system have a plan to established in 2016.
2019 A.D.	The construction of GMT was completed in 2019

2010 era, South Korea try to develop own space technology and have co-operation in space project with others. South Korea try to develop advance technology and hope to be a leader of technology

Famous Korean Astronomer

During the Joseon dynasty in the 18th century, **Seo HoSu 서호수** (1736-1799) was an astronomer in King Yeongjo and Jeongjo's era, he edited Sangwigo in Donggukmunheonbigo **동국문헌비고** and restored Hancheonui **혼천의** that is a armillary sphere and improved time set up and calculated as national standard in day time 24 solar system.



Figure 5 Seo HoSu 서호수

Lee won chul 이원철 (1896-1963) was the first pioneering Korean Ph.D recipient in science specifically in the field of astronomy and meteorology.

Hong Daeyong 홍대용 (1731-1783) in the late period of the Joseon era, he tried accepting western scientific systems and presented a new version of the universe. He invented many astronomical instruments such as Hancheonui **혼천의** (armillary sphere), Tongcheonui **통천의** and advocated new concepts about the “Rotating Earth Theory and the Universe”.



Figure 6 Hancheonui **혼천의** - armillary sphere

Yi Sunji 이순지 (1406-1465) he worked in developing Korea's astronomical almanac in King Sejong's era. He studied about traditional almanac from China and Arabia and he was the author of Chijeongsan-Naepyeon **칠정산내편** and Chijeongsan-Opyeon **칠정산외편** (theory book). He collected discourse astronomy and meteorology in Chinese meters in Jegayeoksangjip **제가역상집** and systematized astronomical study.



Figure 7 Yi Sunji **이순지**

Jang Yeongsil 장영실 (1390-1450) He was a great mechanical engineer in the Joseon dynasty period, he made Daeganui 대간의 (large simplified armillary sphere), Soganui 소간의 (small simplified armillary sphere), Aungbuilgu 앙부일구 (Scape sundial), Ilseongjeongsiui 일성정시의 (Sun and Stars time determining instrument)



Figure 8 Jang Yeongsil 장영실



Figure 9 Aungbuilgu 앙부일구 -Scape sundial



Figure 10 Ilseongjeongsiui 일성정시의 Sun and Stars time determining instrument

Yi cheon 이천 (1376-1451) He was an engineer in the 15th century during King Sejeong's era. He invented many astronomical instruments. He also produced Daeganui 대간의 (large simplified armillary sphere), Soganui 소간의 (small simplified armillary sphere) with Jang Yeongsil. Apart from astronomical knowledge Yi cheon had influenced the production of gunpowder weapons and metal printing.



Figure 11 Yi cheon 이천



Figure 12 Gagui 간의- simplified armillary sphere

Yu Bangteak 유방택 (1320-1402) was an astronomer who calculated the position of the stars and sun that inspired the creation of a star stone chart called “Cheonsandyeolchabunyajido” 천상열차분야자 this was an instrument that represented the achievements of Korea’s historical astronomical knowledge.



Figure 13 Yu Bangteak 유방택

In the history, most of Korea astronomy knowledge that related from China astronomy Knowledge. Astronomy Knowledge imported to Korea by Korean Astronomers have ever been to study in China so, many astronomical instruments that applied from China such as simplified armillary sphere, Sun and Stars time

determining instrument, Scape sundial. In addition to, Korea uses astronomy knowledge to make Korea almanac and collected discourse astronomy and meteorology in Chinese meters and systematized astrology about astronomical study. Obviously seen, Korea astronomy Knowledge in this era related with astrology and natural phenomenon that use to predict future event.

3.2 The Beginning of space technology development in South Korea

When the space race was competed fiercely, many countries supported 2 different beliefs, led by the Soviets and the U.S. ,Korea was seriously effected by the space race because, Korea was a one of the battlefields in the proxy war era. Although right now when we hear the word “space race” it seems a science fiction story , but the development of these technologies helped us realize the future situation. After Korea divided into the North and the South, the competition became more furious because each country wanted to show the rattling of their own political systems, technology, and show the happiness in people’s lives.

The evolution of South Korea’s space technology and astronomy research can be divided into 3 space acts. 1) The Aerospace Industry Development ¹Promotion Act of 1987, 2) the Space Development Promotion Act of 2005, 3) the Space Damage Compensation Damage Act of 2007.

From 1974-1985 there had been a National observatory for Astronomy.

South Korea began to develop their own Space technology since 1974 under control of the “Korean National Astronomy Observatory (KNAO)”, the presidential of Ministry of Science and Technology was established. In 1978 it was inaugurated in the name of “Sobaeksan Optical Astronomy Observatory (SOAO)” And in 1985 they established “Taeduk Radio Astronomy Observatory (TRAO)” in Daejeon.

From 1986-1997 it was upgraded to Annex Research Institute.

In 1986, the Korean National Astronomy Observatory (KNAO) restructured into the Institute of Space Science and Astronomy (ISSA). In 1991 the Institute of

Space Science and Astronomy (ISSA) renamed it to Korea Astronomy Observatory (KAO). In 1992 KASI Observatory was installed Global Positioning System (GPS) in Daejeon. In 1994 Bohyunsan Optical Astronomy Observatory (BOAO) recorded its first light.

In 1995 The solar flare telescope (SOFT) was installed at Bohyunsan Optical Astronomy Observatory (BOAO). In 1997 an X-ray detector, the first payload for space observation in Korea loaded and launched Korea's Sounding Rocket II (KSR-II).

1999 - 2007 the age of Independent public corporations.

In 1999 Korea Astronomy Observatory (KAO) sponsored International Astronomical Union's (IAU) Symposium for the first time in Korea (Number 197, Astrochemistry).

In 2000 Near Earth Object (NEO) research team was designated to become a National Research Laboratory (NRL). In 2003 Far-ultraviolet Imaging Spectrograph (FIMS) were the first Space Telescopes in Korea made by using Science and Technology also the first time launching Satellites (STSAT-1) The University of Science and Technology Korea (UST) joined with other institutes.

In 2004 The Korean government proposed to the National Assembly admiration a "Draft for the Space Development Promotion Act" that provided systematic legality for the space and astronomy industry. In 2005 Korea Astronomy Observatory (KAO) renamed to The Korea Astronomy and Space Science Institute (KASI) and the Korean government had a plan based on a resolution of the National Science and Technology Council and revised the Mid-and Long-Term National Space Development Basics in 2005. In 2006 International Global Navigation Satellite System (GNSS) and Service Global Data Center (IGS GDC) were operated by KASI. In 2007 Space Weather Monitoring Lab. (SWML) opened.

From 2008- Present was a period of large-scale observational facility development.

In 2009 Joined in the Giant Magellan Telescope (GMT) plan or KASI operated by the United Nations's (UN). The Korean government is actively fostering in the

aerospace industry. In 2011 The operation of Korean's Very Long Baseline Interferometry Network (KVN) began. In 2013 MIRIS (Multi-purpose IR Imaging System), the main payload and launched STSAT-3. In 2014 Participation in Atacama Large Millimeter/submillimeter Array (ALMA) EAO was founded because of collaboration with China, Japan, and Taiwan. In 2015 Korea Microlensing Telescope Network (KMTNet) commissioned at three sites in the southern hemisphere center for National Space Situational Awareness (SSA) Organizing the first inaugurated SLR in Korea, Sejong Satellite Laser Ranging (SLR) observatory. In 2016 Commissioned Optical Wide Field Patrol Network (OWL-Net). In 2018 East Asian VLBI Network's (EAVN) operation started and launched Near Infrared Spectroscopic Surveyor (NISS).

Korean's space policies are based on the national space program and the following three space Acts. This shows that the Korean government is interested to in developing space technology. South Korea has launched many space projects, so the Korean government could participated the new space center in Korea, it has a duty such as legal basis, systematically, created a promotion plan and fundamental space development. The Korean space agreement composed of 29 articles that covers many issues such as the establishment of a basic plan for space development, registering both international and domestic object space objects, Designation for space exploration, considering space vehicles and giving licensing or cancelling, Compensation for damage and result of space object, Supporting of civilian space project exploration and utilization the information.

3.3 Present situation of South Korea space technology development

Since Korea was divided into North part and South part, both states that have different policies in National, Economic, and Social Development Plans. In 1974 that Korean National Astronomy Observatory (KNAO), began using most space technology that is used in telecommunication sectors such as telecommunication satellites, broadcasting system in analog versions. South Korea's space development systems have telecommunication systems, aviation and many more types of technology. The foundation of Astronomy knowledge that bring to use in many

technologies. But at the present time, space technology is getting ahead of other technologies used inside the world, each superpower state was competing about space technology especially in space technology that is used in outer space, astronautics, and outer space observatory because outer space is the newest site that humans know. South Korea founded Korea Space Launch Vehicle Projects (KSLV) to indicate about the potential of South Korea's space development, but this project requires high budgets and advanced technology that South Korea cannot produce by themselves. So, each space project needs the support from alliance states especially the U.S.

South Korea is trying to develop its own space technology to become a player in the space industry. So, South Korea develops Korea Space Launch Vehicle project (KSVL) for develop space and others technology such as communication satellite, observatory satellite, rocket, arms. At the present time, South Korea is focusing about outer space such as launching satellite, rocket, or shuttle to explore a new thing in space. Although, many states pay attention to space technology, but only a few states can success in launching a spaceship to outer space because of the reasons that mentioned above. But co-operation and good relation can make South Korea successful in launching spaceships to outer space. Attached are the details that write in Chapter 4 in the topic of co-operation of space technology projects.

KSLV-I Naro-1 project

Naro was the first carrier Korean space satellite vehicle developed by KARI and Russian technology that is used as the propellant. This project was developed since 1992. The First launching in 2009 failed because the fairing of the rocket did not separate. The Second launching in 2010 was also a failure, because when the rocket was launched at 137 seconds the rocket signal was lost. The Third launching was in 2013, this was a first time that South Korea successful launched KSLV-I.

KSLV-II Nuri project

Nuri was a second Korean space project after the Naro project that started in 2010 but this project was for earth observation. The satellite contained three stage launch vehicles with weights of 1500 kilograms and payload to low-earth orbit and it used a dummy satellite. The First launching in 2021 failed to reach the orbit because the third stage shut down 46 seconds early. The Second launching in July 2022 was successful, putting all satellites onto the 700 km (430 mi) Sun-synchronous orbit (SSO). Because of the success of this project, South Korea became the 7th state that ability to put a satellite weighing more than a ton and heavier into orbit after U.S., Russia, France, China, Japan, and India.

The intention

Why South Korea focused on the space technology development?

What is mentioned in when answering the question can answer “Why South Korea focused on the space technology development?” Korea history has shown us many studies of astronomy which indicated Korea’s interested to study about astronomy since the beginning of time. Korea’s study of astronomical knowledge has resulted in many astronomical inventions. Since Korea divided in two because of political conflict, the study of astronomy also divided. In addition to nuclear problems on The Korean peninsula, tensions make both Koreas compete in developing many internal issues such as facility, public utility, living life, and the economic. For the case of North Korea, North Korea has study in space technology and has their own space administration that called the “National Aerospace Development Administration or NADA”(국가우주개발국) This administration was founded in 2013 and it regulated from the policy of “Korean Committee of Space Technology” or KCST (조선우주공간기술위원회). Although The status of North Korea in international politics is an undesirable state because of Korean peninsula tensions and nuclear developing but for space technology development in North Korea that’s related to principle of peace with Juche ideology (주체사상). In addition to space development technology that have high budgets so, North Korea depend on

international organization. NADA have mission statement to research, take responsibilities, security, and compensation about space project. In 1980 KCST started to research and develop about satellites such as earth observation satellites, weather observation satellites, communication satellite. North Korea has many space vehicles, most of space the vehicles in North Korea are observational satellites and communication satellites. The first space launches in North Korea started in 1998 named The Kwagmyoungsong-1 (광명성 1 호) satellite project, this project by the North Korean government claimed that it was successful to place a satellite on low earth orbit but others country foreseeing this project saw it as a failure. After launching Kwagmyoungsong-1 North Korea make a progress to develop a space project, that later produced Kwagmyoungsong-2, Kwagmyoungsong-3, Kwagmyoungsong-3 unit 2 and Kwagmyoungsong-4. North Korea has “North Korea's Deep Space Exploration Program” this program has plan to develop space vehicles to travel to the moon (North Korean Lunar Exploration Program), mars (North Korean Mars Exploration Program) and compete with The KSLV program of South Korea. In addition, North Korea has a space plan for future space flights, space station development, and launching more space vehicles. In 2017 North Korea planned to produced Kwagmyoungsong-5 (광명성 5 호). From the information mentioned above we can see that North Korea wants to develop space technology to compete with other country and show potential that North Korea can develop space technology and can launch space vehicles to outer space. Although, presently North Korea's only success is launching satellite to reach orbit, this space technology is considered out of date in present space technology standards, but North Korea will try their best to develop space technology including missiles and ballistics. From the tension in the Korean peninsula that forced both North Korea and South Korea to develop their own technology. Space technology is technology that can show country potential. From the information mentioned above we can summary the point of “Why South Korea focused on the space technology development?” In the political side, most of the space development could use co-operation from others country or organizer because space development uses a high budget and advance

technology. So, interest in big projects that effected to internal and external states are high. When governments are interested in space projects that means the government decreases its interest in other topics such as facility, education, and public health which causes hatred from the population. Alliance countries might get benefit from co-operation, but enemy countries might be suspicious about big development project. For North and South Korea's case it might be a paranoid situation, when North Korea developed space technology, South Korea and its allies mistrust North Korea because they develop missiles, ballistic and nuclear.

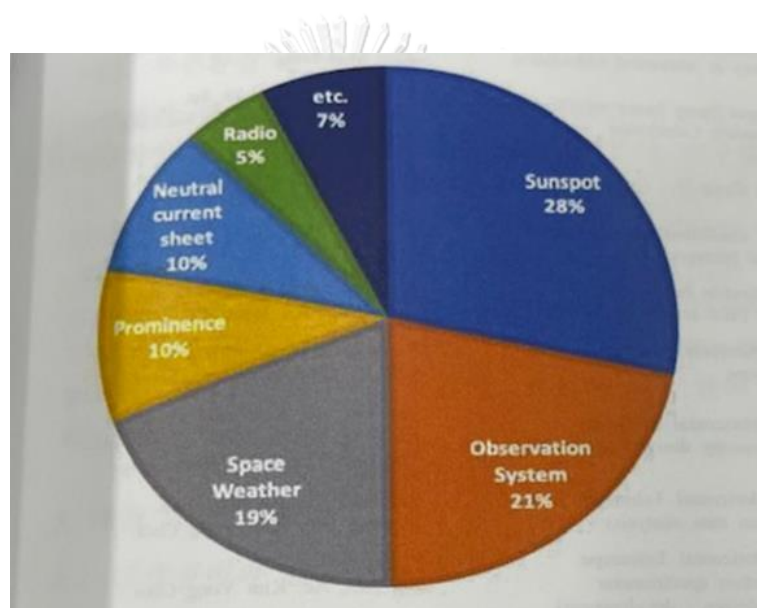


Figure 14 Distribution of papers by research subject on the solar astronomy and space whether in North Korea

Both Korea want to develop space technology because each state wants to balance power, although right now North Korea's space industry has not succeeded yet in launching satellites to orbit by its own despite USA being a great pioneer in the space industry, that would be obsolete in present space technology. South Korea is one state with gradually increasing economic growth, from the latency of South Korea this state is stepping up to a superpower state by being a leader in technology. As said in the action theory that explained about action and re-action between state, due to South Korea's alliance being the U.S., this point made North Korea distrust South Korea after the Korea states were divided. U.S. put North Korea in the U.S.'s

List of State Sponsors of Terrorism because of North Korea's withdraw from the Treaty on the Non-Proliferation of nuclear weapons since 1993 and experimental missiles, ballistic and nuclear weapons. Tension in the Korea peninsula forced both Koreas to develop technology for national security such as arms, nuclear weapons (North Korea) including space technology. This situation can be compared to a proxy war era through space race between North Korea and South Korea not fiercely than U.S. and Soviet Union.

For South Korea, Internal factors that featured

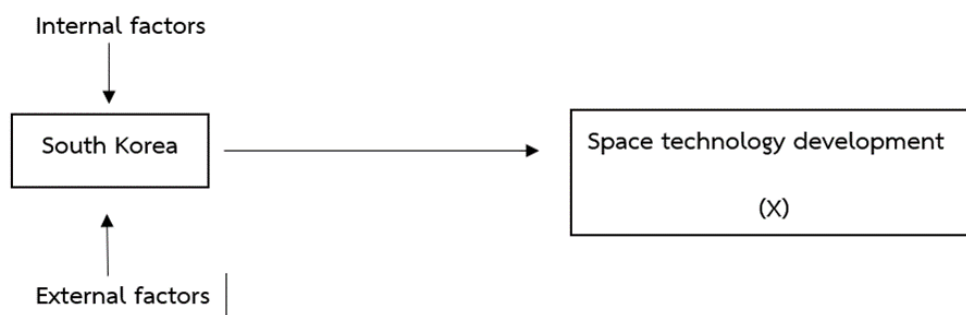
1. Want to develop the potential of its state – South Korea is interested in technology and wants to be a leader in technology this makes South Korea more developed and decreases the import of technology from others.
2. Want to develop technology and meliorate existing technologies such as communication, arms, military technology.
3. Want to find new technologies to be a pioneer in finding some new things.
4. If South Korea can produce advanced technology that means South Korea can be a technology leader.
5. Space technology development can be applied to develop other technologies and that is a South Korean requirement in developing space technology.

External factors

1. The Anxious Korean peninsula situation, although North Korea and South Korea made a Korean Armistice Agreement but both Koreas distrust each other, The space technology development can show the latency and create a good image for the state.
2. Space technology development is high technology that most use co-operation with alliance others state. From co-operation that use good

relationship. U.S. is one of the supporters that support South Korea to develop space technology.

3. At the present time there are some countries that are successful at launching space vehicles, South Korea wants to be one of the successful states.
4. South Korea wants to preserve national security from enemies, space technology can further help to develop military technology.



Balance of power theory: this theory explained that the world has many states. Hence, there is a power polarity group of states. When there are many powers polarity groups, balance of power becomes important for peace. Because of the situation between state a and state b that effects to the other states. The action from a state cause of 2 critical things

1. Preserving its power and security
2. Want to get more power and influence,

In this case, it can be said that North Korea and South Korea have a love-hate relationship because of the different regimes, Although, right now the relationship of North Korea and South Korea is getting better than in the past, but polarity and state relationships of North Korea and South Korea were rather fragile and can change following a new leader's policy. In 2018 North Korean leader Kim Jong Un and Moon Jae In (the previous South Korea president) met in three summits in Pyongyang. All of the three meetings came as a diplomatic effort to get North Korea to discharge its nuclear weapons and ballistic missiles. North Korea's development of nuclear

technology had become one point that encouraged South Korea to develop space technology to use in the military section and to build a relation with alliances. Both Korea wants to counterbalance each other. After dividing the state, North Korea and South Korea always competed on every aspect – Economic, technology, facilities, and living. South Korea has a famous soft power such as food, culture, K-pop but in comparison between North Korea and South Korea, South Korea soft power have little effect on North Korea because North Korea is not accepting pop culture from others states anymore. South Korea also has hard power that is developed to defend the state because of North Korea's still developing nuclear technology until today, So, South Korea used developing space technology for balance to power with North Korea like a space race situation. In May 2022, South Korea elected a new leader "Yoon Seok Yeol" (윤석열) his leadership policy is conservative which is completely different from Moon Jae In (the previous leader). From the three meetings between North Korea and South Korea in 2017 after South Korea changed its leader, the relation of both Koreas had an estrangement. On August 15th, 2022, South Korea Leader Yoon Suk Yeol , made an offer to exchange a denuclearization with North Korea, but Kim Yo Jung sister of North Korean's leader responded to South Korea, North Korea rejected South Korea's denuclearization due the U.S holding a firm alliance with South Korea, denuclearization plan is a pipe dream (impossible dream) . As mentioned above, I can see both Koreas trying to balance the power between each other and compete against each other.

Realism Theory

Each country that concerned about forbidding from war, cyberattack, pandemic, biological weapon so, many countries finding a way for protect own country. Because of present situation, the conflict will usually have happened so, each state or country could prepare plan to protect own sovereign power and retort for the worst situation, from history, North Korea and South Korea were distracting each other because South Korea concerned about nuclear development and North Korea concerned about intervening by foreign country. North Korea coexisting developed nuclear technology and space technology in defensive way because want

to completely retort South Korea and foreign but others agree with South Korea that nuclear technology of North Korea that offensive and dangerous so, each state want to find the way for security warranty such as South Korea and Japan locate nearby North Korea that want to develop about Terminal High Altitude Area Defense (THAAD) this technology is from U.S. so, South Korea essential associated with U.S. about space project for national security benefit. North Korea also have alliance is China and Russia through both countries didn't express that support about North Korea nuclear development but for China is alliance with North Korea so, China might support some technology investment in North Korea for balance political power with U.S. and South Korea. Space technology can indicate the wealthy and express the power of state

3.4 Space technology development vision of South Korea

From above, the main point that South Korea develop space technology because South Korea want to develop own advance technology and applied for use with others technology and want to preserve national security but the vision of South Korea for space technology development. The development of South Korea's space technology depends on the leader and policy. This event is loosened by the United States in the Space Race era. Space business is very booming, the United States can develop technology until being able to send Apollo 11 and astronauts to step on the moon but at present times, such as in the Barack Obama period, the budget for research in this field has been greatly cut from 4% to 0.4% due to the budget to spend more health care. Therefore, the process of developing South Korea's space technology is no different, such as in the era of Moon Jae-in, although there was an international connection policy was New Southern Policy that focuses on connecting with other regions, but in the space affairs of South Korea there was nothing outstanding during that time. In terms of internal politics in this era, it is an era that South Korea and North Korea is quite good relationship with South Korean leader, Moon Jae-in had met, discussed and shake hands with North Korean leader Kim Jong-Un in 2017, which is very different from the current era. The current leader of South Korea Yoon Seok Yeol took the position of South Korea's space astronauts

that seems to flourish again and successful to send space vehicles in the KSLV-II project “Nuri” into low earth orbit.

At the same time, the relationship between North Korea and South Korea in the Yoon Seok Yeol era is not good because North Korea were more launching 6 missile trials in this year. South Korea responded by maneuvers with the United States. Causing the situation in the Korean Peninsula better earlier come back to tension situation.

Since Cold war era that U.S. and Soviet Union were competition about political ideology and space race. From then to now the political polarity can divide 2 big part -Liberalism (U.S.) and Socialism (Soviet Union). In addition to South Korea that is have democracy in political system so, indubitably the alliance of South Korea is U.S.. For international system when South Korea develop space technology as U.S. is alliance with South Korea, U.S. support about prototype technology and budgets. In international level, South Korea expected to be a superpower state. For space technology development that have Outer space technology treaty. This treaty is on Principles Governing the Activities of States in the Exploration and Use of Outer Space, this treaty that develop from of intercontinental ballistic missiles (ICBMs) and develop to the National Laws Governing Space Activities.

“Article 1 (Purpose) The purpose of act is to promote the peaceful use and scientific exploration of outer space, to ensure national security, to further develop the national economy, and to raise the national standard of living through the systematic promotion of space development and the effective to management of space objects.” The Korean government shall establish a basic for promoting space development and for using and managing space objects. South Korea space issue was a burgeoning issue after space organizations were founded in South Korea, the government continued to develop space technology and have a co-operation with others in many space projects. Sub- international for this case is systems theory is the relation between South Korea and alliance or enemy and National system, South

Korea external politics issue. From the co-operation space project that push forward to South Korea could develop space technology more than past but when South Korea cooperate with others in space project, it looks seems like this is a usefulness for South Korea so, the more alliance, the better for benefit. For enemy South Korea that have anxiety about relation with North Korea. In some era when South Korea that have progressive leader, South Korea would be a negotiation policy with North Korea such as in Moon Jae In era the relation between South Korea and North Korea had better direction but when the era that South Korea have conservative leader such as in this year Yoon Seok Yeol era (started May 2022) although, he took a president recently but his policy that emphasized a nationalism and have conservative direction include harsh action for nuclear development of North Korea so, North Korea respond harsh reaction for South Korea, the sister of North Korea leader she make a speech to rejected discharge nuclear plan and told “shut your mouth” for South Korea leader.

Because the unstable situation between North Korea and South Korea so, both Korea were inevitably competition many issue include space technology issue. For Sub-international system is about South Korea internal politics, South Korea have been passed about many political incidents and have different policy in each era but at the present in Yoon Seok Yoon era South Korea successful in launching KSLV-II (Korean Space Launch Vehicle-II) or Known “Nuri” rocket to the orbit in 21 June 2022 and became the seventh country in the world that have ability to put a satellite weighing a ton and successful launching to low-earth orbit, after developed this project since 2010 South Korea that can develop first own space vehicle technology and succeed to launching. Since 1970 century until now, the most advanced space technology that lead by U.S. because U.S. have ever been to success in launching space vehicle Apollo-11 that contain 3 astronomers and can safe landing at the moon moreover, 2 astronomers can step onto the moon surface, after that until now no one can successful like U.S. South Korea continues to develop space project both big project and small project since Naro project, Nuri project and KSR project that have a successful project and failed project so, both of successful project and failed

project effected to many sides. The failed project can affect to annual government statement of expenditure because government could share this budget to space development project that have use more than a billion US dollar that make many people disagree to use many budgets for space development. The successful project, through this is desirable for space developing but this thing that make the others anxiety such as before South Korea success to launched Naro project in 2013, in December 2012 North Korea can succeed to launching Unha-3 that make South Korea feel anxious and hurriedly to develop Naro project, South Korea can success to launching Naro project in 3rd time in 2013. When South Korea successful in Naro project that make North Korea have a plan about third nuclear weapon test. From this chapter that show that, South Korea wants to develop space technology because at first want to competition that the states under different political ideology, which states will have more progress? Second, South Korea anxious about North Korea nuclear development so, South Korea develop space technology for nation stability and use to resist with North Korea nuclear in military side. At the present time, North Korea threat still exist but South Korea more provident than contrast with North Korea because South Korea is one that want to be a lead of space technology so, South Korea pay attention to develop space technology more than military side.

CHAPTER IV

INTERNATUONAL POLITICAL BENEFIT AND POLITICAL CONFLICT IN ASTRONOMTY ACTIVITY COOPERATION BETWEEN INTERNATIONAL AND SOUTH KOREA

.Currently the world is entering a new phase of the Space Age, it is an essential gateway for the country to securely develop space technology and foster the space industry to solidify a position as one of the space industries. Many factors have pushed forward the South Korea developed of space technology such the urge to become a technology leader, Economic, politics and others national interest. Although, South Korea has potential that to develop space technology, but all of the satellites developed in South Korea have been launched using foreign space launch vehicles and space technology development is a delicate issue because space technology development for some states impact a wide-range of other countries. So, we need an international space law to regulate space related activity and to avoid conflict. The Outer space treaty emphasized the “Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies” that means space technology development and space activity must be for only explorational purposes. Besides, space development directly effects the environment. When a country launches a space vehicle that uses a large amount of fuel it will certainly affect the environment. Moreover, when all of space vehicles are decommission these space vehicles won’t be different from electronic waste, How to manage this problem safely? A good example is the NASA Skylap case that was an international space station that decommission in 1979. NASA had no idea of how to manage it .So, NASA shot NASA Skylap down to the earth and it fell in the Indian Ocean near Australia .Although, no one got injured but was an electronic waste which is hard to dispose. We can obviously see that space technology is inapplicable and it has many issues involved. However, for this thesis emphasizes about space technology development that effects international politics.

This chapter mentions about International political benefit and Political conflict in Astronomy activity and also cooperation internationally done with South Korea.

KARI has developed rocket design and manufacturing capabilities by KARI technology and were risen by developing single-stage solid propulsion science rockets (KSR-I, 1993), double-stage solid propulsion mid-sized science rocket (KSR-II, 1998), and developing first liquid propulsion science rocket (KSR-UUU, 2002) that acquired space launch vehicle's that developed from Naro project (successfully launched in 2013), the double-stage space launch vehicle consists of a first-stage liquid engine and a second-stage solid engine, through international cooperation with Russia. Currently South Korea is developing a 3rd-stage Korean launch vehicle (Nuri) with domestic technology to launch a 1.5t-class application satellite into a solar-synchronous orbit at an altitude of 600~800km.

4.1 The co-operation of space technology project

Although, South Korea had latency to develop space technology but when it comes the process of advancing technologies, South Korea remains the user of other technologies because South Korea cannot produce advanced technologies by itself, the co-operation of space projects and the exchange of technology with others is therefore a thing that we can see in the space society. The countries in the world that are superpowers in the space society consist of only the U.S. and Russia because of they were a major part of Space technology development since the proxy war. Although at that moment U.S. and Soviet (Russia) are developing space technology because of competition but both created great history and technology.

At the present is the golden age of space technology many countries want to develop technology, but each country has different potentials and limitations of develop such as latency, budgets, or political polarity. Although, South Korea has a technological potential, but we cannot decline that South Korea remains supported by others. South Korea has a plan to develop a space project .Many Korean space organizations were founded over the years and South Korea succussed when doing many space project such as space vehicle ,sounding rockets, KSLV-I,KSLV-II, Lunar

orbiter project and also military technologies , but in this thesis I will mention only big space projects which are the Naro project, Nuri project, and Lunar orbiter project because this 3 projects indicated that the co-operation in space between South Korea and others worked.

However, right now governments are not the only organizations that are involved in space technology development, many private sectors have the potential to establish technology companies and they may be able to develop their own space technologies. The purposes of space projects ran for a state's purpose and private sector's purpose are very different when it comes to developing space technologies. Right now there are many private companies that develop space technology such as Space X company, Blue Origin company, Virgin Galactic company, Relativity Space company, Boeing, United launch alliance, Dynatic. Each company has a different purpose in developing its own space program. Space X company hopes to bring humans to inhabit on Mars. Blue Origin has a purpose to establish a space station for tourism. Virgin galactic develops space technology for tourism who plan to go to outer space. Relativity space company and impulse company collaborate to invent space vehicles similary drone for launching to Mars in 2024.

4.1.1. KSLV-I Naro-1 project

Naro (KSLV-I) is a space launch vehicle development project implemented according to the National Space Development Plan. It was the first carrier vehicle of a Korean space satellite developed by KARI and foreign technology that used propellant. Naro rocket is a double stage launch vehicle that consists of a liquid engine in the 1st stage and a solid kick motor in the upper stage that purpose is to place a 100 kg satellite into low earth orbit. It was designed as a launch vehicle weighing up to 140 tons, propellant included, with length of 33 m, diameter of 3 m, and 1st-stage thrust of 170 tons. The satellite's orbit was designed for a 300×1,500 km elliptical orbit. The 1st stage consisted of a liquid propellant engine with kerosene as fuel and liquid oxygen (LOX). The propellant was supplied to the combustor through a turbo pump. The 2nd stage consisted of a solid propellant (hydroxyl-terminated polybutadiene,

HTPB) kick motor. Russia was the developer of the 1st stage, this project was started development in 1992. Its first launch was in 2009 but it failed due to the fairing of rocket not separating. The second launching took place in 2010 which also resulted in failure because 137 seconds after launching the rocket lost its signal. The third launching was in 2013, this was the first time that South Korea successful to launched KSLV-I to Earth's orbit. This rocket was capable of inserting a 100-kg small sized satellite. The 1st stage rocket used a liquid propellant rocket modified by Russian Angara URM. Naro project was the foundation of South Korea's space vehicle development.



Figure 15 KSLV-I Naro-1 rocket

4.1.2 KSLV-II Nuri project

Nuri project was the first project in which the entire process was carried out independently in South Korea from designing to production, testing, and South Korea successfully launched KSLV-II on the 21st of July 2022. South Korea started to develop and invest in this project since 2010 it was invested and developed by 500 people in the Korea Aerospace Research Institute (KARI) and by 300 South Korea companies including Hanwha Aerospace, which made the engine, and Hyundai Heavy Industries, which made the launch pad. Nuri project use budget approximately

2 trillion won (\$1.6 billion) as of 2010. Nuri is a second Korean space vehicle, the satellite contained three stages ,with a total weight of 1500 kilograms and payload to low-earth orbit and use dummy satellite. The first launch was in 2021 and it failed to reach orbit, because the third stage shut down 46 seconds early. The second launch was in July of 2022, this time it was successful, by successfully put all of the satellites onto the 700 km Sun-synchronous orbit (SSO). KARI make an improvement in the helium tank by strengthening the anchor on the lower support and reinforcing the thickness of the manhole cover allowed the Nuri rocket to fly rapidly. The criteria to determine the success of the launch will be decided by whether the satellite carried by the rocket is placed into orbit successfully and whether the ground station succeeds in communicating with the satellite. Due to the success of this project, South Korea became the 7th country to be able to put a satellite weighing a ton and heavier into orbit. This project allowed South Korea to become the 10th country capable of sending a satellite into orbit with its own technology and the seventh to deliver a satellite weighing more than 1 ton into orbit. Nuri space rocket was launched on a launching pad at the Naro Space Center in Goheung, South Jeolla Province, South Korea. Nuri project is the second successfully launched vehicle of the South Korean after the Naro project. This project started in 2010 that developed from KRE-007, KRE-075, the overall design and target was to develop a new expendable medium-lift launch vehicle that would be entirely developed with internal technology from South Korea and use a budget of approximately US\$1.5 billion. After South Korea achieved success in the Nuri project, South Korea planed for a Moon exploration mission, to send orbiters and lander and to create co-operation with other space projects in the future. South Korea expects to secure space transportation and space exploration-related technologies. The Nuri is a space transportation vehicle which is essential for South Korea to become a space industry powerhouse and it is the key vehicle for stable space development. KARI plans to launch a domestically developed satellite using the Nuri between 2022 and 2027. With the Nuri development project. Nuri projects carry out the mission of launching domestically developed satellites from 2022 to 2027.



Figure 16 Korean Space Launch Vehicle-II (KSLV-II), Nuri project



Figure 17 KRE-075 engine, prototype engine in Nuri project



Figure 18 KSR-I, Korea Sounding rocket-I

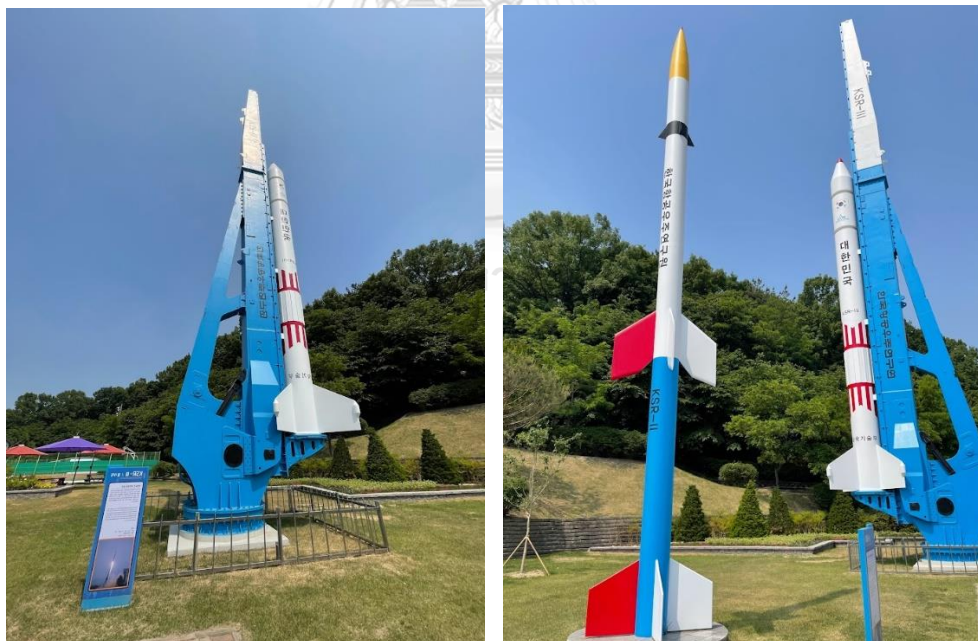


Figure 19 KSR-II, Korea Sounding rocket-II

4.1.3 South Korea space vehicle

Table 8 Compared table of South Korea space vehicle

Space Vehicle	KSR-I	KSR-II	KSR-III
Purpose	Single-stage satellite that develops for observation the ozone layer upper Korean Peninsula	Double-stage solid satellite that develops for observation	Small liquid propulsion satellite that develops on security base
Development section	1990.7 ~ 1993.10	1993.11 ~ 1998.6	1997.12 ~ 2003.2
Development budgets (KRW 100 million)	28.5	52	780
Length (m)	6.7	11.1	14.0
Diameter (m)	0.42	0.42	1.0
Weight (kg)	1,268	2,048	6,000
Launch date Unit1 (1 st launching)	1993.6.4	1997.7.9	2002.11.28
Unit2 (2 nd launching)	1993.9.1	1998.6.11	2002.11.28
Unit3 (3 rd launching)	-	-	2002.11.28
Features	Single-stage solid propulsion science rocket	Double-stage solid propulsion science rocket	First liquid propulsion rocket independently developed in Korea

Space Vehicle	Naro-I (KSLV-I)	Korean Launch Vehicle (KSLV-II) Nuri project
Purpose	100kg-satellite that develops by independently technology and can access to low-earth orbit.	1.5-ton satellite develops by Securing technology into low-orbit and can access to low-earth orbit.
Development section	2002.8 ~ 2013.4	2010.3 ~ 2022.3
Development cost (KRW 100 million)	5,025	19,572
Length (m)	33.0	47.2
Diameter (m)	2.9	3.5
Weight (kg)	140,000	200,000
Launch date Unit1 (1st launching)	2009.8.25	2021.10.21
Unit 2 (2 nd launching)	2010.6.10	2022.07.21
Unit 3 (3 rd launching)	2013.1.30	-
Features	<ul style="list-style-type: none"> - Development of Korea's first satellite launch vehicle - Joint development by Korea and Russia 	<ul style="list-style-type: none"> Development of Korea's first application satellite launch vehicle - Independent domestic development - Developed 75 ton-class liquid engine

4.1.4. Lunar exploration: Korea Pathfinder Lunar Orbiter(KLPO) or Danuri **다누리**

After South Korea was successful in the development of space technology in many projects , South Korea planned future space projects such as Korea Pathfinder Lunar Orbiter. In the first step, South Korea have a plan to launch the prototype of

the lunar orbiter by 2022, and then make its first landing onto the Moon in 2030. Nevertheless, Korea is planning to do research on asteroids, with samples collected by spaceship of KARI which is cooperating with NASA to produce a lunar orbiter to feasibility study. That collaborated with one science instrument payload, telecommunications, navigation, and design mission. The Korean Lunar Exploration Program (KLEP) is divided two phases. Phase 1 launching and operating of KPLO. South Korea develops technological capabilities and produces the first lunar probe vehicle related to map natural resources in orbit. The purpose of the KPLO orbiter is to explore lunar resources, investigation of lunar geology and space environment, and the testing of future space technology that will assist human activities in the future on the Moon. Phase 2 includes a lunar orbiter, a lunar lander, and a 20 kg rover which is to be launched together on a KSLV-2 South Korean launch vehicle from the Naro Space Center in 2025. The Danuri orbiter is carry six scientific instruments, including a hypersensitive optical camera, Shadow Cam that provided by NASA and a “space internet” demonstrator developed by South Korea’s Electronics and Telecommunications Research Institute, which will validate an interplanetary internet connection using delay-disruption tolerant networking. KARI technology uses secure deep-space communication technologies such as establishing a large deep-space antenna capable of tracking and communicating with the orbiter to overcome signal sensitivity deterioration due to the distance between the Earth and Moon; technology for developing an orbiter applying a light-weight satellite design, large capacity propulsion system technology; and technology for navigation to the Moon and achieved weight reduction (from over 80 to 50kg) of electronic units including the onboard computer, power controller, power distributor, mounted data processor, and harness of the test lunar orbiter. The lightweight design and usage of space technology SpaceX (reuse rocket) can help reduce the consumption of energy from 110W to 65W. The orbiter was working normally and traveling on a planned trajectory and NASA is supporting deep-space communication and navigation technology to the moon and South Korea is using NASA’s Shadow Cam to map permanently shadowed regions on the surface of the Moon, to find the evidence of water.

Korea Pathfinder Lunar Orbiter (KPLO) or Danuri in Korean, launched on a SpaceX Falcon 9 rocket from Cape Canaveral Space Force Station's Launch Complex 40, Florida, United State, on the 4th of August 2022. After the test launching the lunar orbiter (KPLO) shot towards the Moon using the lunar orbit transfer method (BLT/WSB), that approaches lunar orbit by using the nearby astrophysical gravity of the Sun and Earth. The purpose of testing the lunar orbiter (KPLO) is expected to commence lunar surface filming after entry into lunar orbit. The total budget is KRW 233.3 billion which is an increase of KRW 35.5 billion from KRW 197.8 billion. KARI is undergoing the development of deep-space Internet protocol design, landing device design & landing technology development, lunar exploration rover, and nuclear batteries.

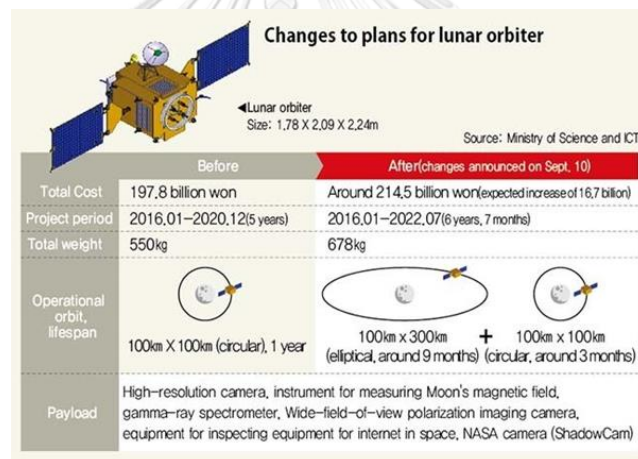


Figure 20 Korea Pathfinder Lunar Orbiter (KLPO)

This project is an international co-operation between KARI (South Korea) and NASA (United states), but South Korea also brought the internal technologies of others to use in this project, such as the polarized camera developed by the KASI used to film the image of the entire lunar surface and capture polarized images of areas except for the polar region. In addition, it can also designate a proposed landing site for the lunar probe by using the filmed images and examine the types of materials and particle sizes on the surface of the Moon. Kyunghee University is developing a lunar magnetic field measuring instrument, a magnetometer for

measuring the magnetic force 100km above the surface of the Moon. The Electronics & Telecommunications Research Institute (ETRI) has been developing the space Internet test equipment.

4.1.5 Lunar Orbit Exploration project

Table 9 Technologies use in Lunar Orbit Exploration

Classification	Details
Mission/ System	<ul style="list-style-type: none"> - System concept - System operation concept - Moon characteristics related to lunar science mission, payload, landing zone - Orbit analysis/optimization - Launch vehicle connection
Main body	<ul style="list-style-type: none"> - Main body system - Navigation & guided control about autonomous navigation and altitude control technology, - Power system - Structure system of design, propulsion system mounting, propulsion system and separation mechanism - Thermal control (lunar orbit/lunar surface thermal analysis technology, active high-efficiency thermal control technology, electronic unit thermal.
Classification	Details
Payload	<ul style="list-style-type: none"> - Science payload & technology test payload - INL payload
ILN	<ul style="list-style-type: none"> - Communication WG (frequency selection, communication protocol)
Ground station	<ul style="list-style-type: none"> - Large antenna development - Lunar mission operating software development - Lunar mission operation

From the technologies mentioned above, South Korea has a potential to development its own space technology. It would be a great benefit if South Korea were able to develop these technologies from the start to the finish as seen in the Korean Lunar exploration project, South Korea used the main body rocket from SpaceX because SpaceX can produce reusable rockets that economize budget and reduce objective risk.

4.2 The affection of co-operation project

4.2.1 Technology benefit

When South Korea co-operation on space projects with others, South Korea will get many benefits and they will have an advantage over others. Although, South Korea wants to develop space technology, but South Korea is not a superpower state that can do anything and not without supporter and shareholder or without observation from alliance, enemy and superpower states ,so if South Korea wants to develop space technology but each South Korea space project could collaborate with others such as Russia, U.S., Japan The co-operation project provides benefit to South Korea and creates advanced technology: In 2004 South Korea company, SK telecom was collaboration with Japanese Mobile Broadcasting Company to produced MBSat 1 (Mobile Broadcasting Satellite) named “Hanbyul” that meant “Cornet” this satellite made South Korea step from analog systems to digital systems. In the economic sector, space technology development is a dilemma in the economic situation because, space technology is advanced technology and rarely used to develop by own technology, if a state wants to use this technology but cannot produce it they must buy or rent the technology from others. Moreover, investment in technological develop must be done over a long time before you get profits . Most people have their own opinions of investment in technological sectors and some say that it was not worth it because the government should divide this part of budgets to use in more necessary parts such as education or public health, this issue is also related to internal political. Technology development that can make our lives easier are such as in 2019 that we had a Covid-19 pandemic, student cannot go to school so studying applied to online system more than in the past,

Hence, the space technology in broadcasting an internet system is dominant role at this time. South Korea can develop and produced space technology with supporting from alliance so, South Korea can sell and make a profit with this technology such as KARI successful to develop “Bandi” a small four-seater aircraft with domestic technology that have 18 core components for civil and military use as to be applied to the Korean Helicopter Program (KHP) for helicopter technology. The successful in this project made Korea the 11th country in the world to develop helicopters. Related technologies were also derived for the development of military and civil helicopters. In addition to KARI were develop a high-efficiency aviation technologies such as personal air vehicle (PAV) that bring transportation innovation in the future through the convergence of advanced UAVs, aviation technology, and information and communication technology (ICT) KARI developed a medium-sized aerostat system and an LTA (Lighter Than Air) aircraft system with long endurance and unmanned aerial vehicles (UAVs) , initially for use in military side but their application want expanded to private sectors such as science and technology, transportation, communication, logistics, rescue, aerial photography, and agriculture, South Korea set target to rank among the top 5 of UAV industrial countries in 2023 and among the top 3 in 2027. South Korea successful, the aims that make open the aviation technology market and can added value South Korea technology.

4.2.2 Political benefit

Since South Korea develop space technology that can use many benefits from space technology whether communication, economic technology and political. In this past, researcher will explain about political benefits. Certainly, in technical way South Korea have independent to develop space technology because South Korea is one that readiness in technology, budget, and supporter but in real situation South Korea cannot develop space technology in indulge way, South Korea must be developed space technology related with Space development agreement, country or state that was for peace, responsibility, and sustainability

For external politics, South Korea has an alliance with a superpower such U.S. and it has a surveillance neighborhood like North Korea. South Korea focused more about national security because North Korea was developing missiles and ballistic technologies, through South Korea cannot develop missiles because of various treaties. South Korea therefore wants to develop space technology instead, to balance power with North Korea. When North Korea develops and experiments with missiles and nuclear it becomes a major world politic issue. South Korea must preserve national security but it cannot directly develop missiles or ballistic weapons to balance power with North Korea , space technology development when used in the military side can be used to fight with North Korea's missile technology. Korea peninsula tensions depend on the directions of both Korean leaders and intervention from superpower states. When it comes to political issues, South Korea has an important alliance with countries such as U.S. When North Korea and U.S. have conflicts, South Korea is usually one of the factors other than the external political factors from U.S. and North Korea that pushed forward South Korea in the development of space technology. Internal politics in South Korea is one factors such as the direction of each South Korean policy leader, If South Korea has a liberal leader, space technology development will be emphasized , new technology for an easier life will be invented in the future . But if South Korea has a conservative leader , the priority is mostly national security, space technology development was be emphasized in only military issues and national security situations in the Korean peninsula which is more concerning , space technology development is assured for South Korea both internal politics and external politic. Nevertheless, the Korean peninsula situation is being watched both internal and internationally. Space technology development in South Korea hid connotation reasons resulted to missile and ballistic development in North Korea. The direction of North Korea is change according to leaders and the intervening from superpower states in the Korean peninsula. Not only is South Korea concerned about missile development, but North Korea is also concerned about superpower intervention through South Korea international relations. From this issue, researcher will analyze by using the realism theory .South Korea and North Korea had concerned each other, South Korea and its

allies are concerned about missile development in North Korea while North Korea was concern of getting intervened from South Korea and its allies . After the Korean war, South Korea's alliance especially with the U.S. has caused the U.S. to send many US army personals to be stationed in South Korea in ranks such as Commander Fleet Activities Chinhae, Kunsan Air Base, Osan Air Base, MCI Camp Mujuk.



Figure 21 U.S. army base in South Korea



Figure 22 Commander Fleet Activities Chinhae: South Korea



Figure 23 Pacific Air Forces - Kansan AB, Osan AB: South Korea



Figure 24 MCI Camp Mujuk

The many U.S. army-based stations in South Korea can inevitably bring tension to the Korean peninsula. The realism theory can explain about the thing that each state is doing; Why South Korea focused on space technology development? Why North Korea developed missiles and ballistic technologies? Why others states wants to intervene in the situation in the Korean peninsula? Every answer and reason is beneficial. North and South Korea both claimed about national security to make people believe that they are the righteous ones. South Korea and U.S. had a co-operation project before South Korea started space development but most of co-operation projects are military co-operation project. The political benefit that South Korea gets from space technology development was more unilateral alliance to stay

safe from North Korea and for internal political stability, South Koreans are proud of their Korean nationality and the potential of Korean people.

4.3 Intention: How the space technology development effect to South Korea politic role in international level?

From above that mentioned the one reason that South Korea want to develop space technology because want to preserve national security. Since South Korea develop space technology, this action has an effect to South Korea image especially in international stage. South Korea space development being watched and get support because of North Korea nuclear development. North Korea is unwilling state for U.S. and others so, South Korea space technology development is the main character to play a role with North Korea nuclear development. When South Korea develop space technology that have many states lend a hand to South Korea. Space technology development makes South Korea can develop potencies of technology and human. In economic issue when others see South Korea is state that have a latency so, South Korea is interesting for foreign investors. Space development that makes South Korea have a good image. In the other hand for political issue, space technology is a big project that not anyone can invest in this project. Moreover, in space market technology that monopolized by some state such as U.S., Russia, Japan so, South Korea unavoidably to find investment alliance and used their technology. The reason that South Korea develop space technology is ambiguous because South Korea stated to develop space technology in 1970s era but both Korea just finished Korean war So, both Korea was damaged and want to develop living life of people get better, For South Korea related to Five-years economic development Plans of Korea in this plan emphasized to develop facilities and utilities so, space technology has inapplicable with South Korea. I think the one reason that want to develop space technology is alliance such U.S. because after Korean war, South Korea want to rehabilitate and develop people living life so, budgets from foreign aid were important economic development in South Korea. Although, that name is aid but nothing comes free so, most of foreign subvention come with condition. The reason that South Korea develop space technology

because of South Korea wish or alliance wish. If some state anxious about North Korea nuclear development, South Korea is main variable to resist with North Korea nuclear. So, space technology development effect to South Korea international politic role in a good side South Korea look seems like have a latency to develop technology and worth for investment. South Korea is good image for big technology company such as Samsung, Hyundai, LG. The space co-operation projects that make many working capitals in South Korea economic and exchange technology knowledge. For that I mentioned that look seems like South Korea can get many benefits from co-operation project but in political issue I think South Korea might be forced to develop space technology because of conflict in Korean peninsula so, it indicated that not only South Korea feel anxious about Korean peninsula situation but others that be concerned about North Korea nuclear development. For international political, South Korea forced to resist with North Korea because of alliance consolation. The others see South Korea is one state that interesting for investment and bumper state so, space technology development in South Korea intervened by others, alliance and superpower state. For South Korea case, alliance and superpower state is U.S. that have advance space technology so, U.S. also supported in many South Korea space project and have many spaces co-operation projects that U.S. co-operated with South Korea. From above that mentioned, South Korea cannot develop space technology as they wish to. Because of limitation in space development that from many factors such as internal, external, law, political.

North Korea and South Korea have a conflict about political, space technology bring to use to retort in competition like space race between Soviet Union and U.S. so situation both Korea did not different because North Korea and South Korea that use for frightening another. At the present time, North Korea still develop ballistic technology for national security but sometimes that use retort South Korea and U.S. maneuver event. Although, North Korea be concentrated in missile and nuclear technology development but space technology for explore outer space or produced space vehicle such as Kwagmyyoungsong-1 satellite project, most of satellite that North Korea were developed are communication satellite and

exploration satellite. South Korea use space technology and alliance relationship to balance influence with North Korea, through space technology of North Korea cannot compete with South Korea so, North Korea emphasize to develop missile technology more than others type of space technology. Due to the Limitations of space development come from many factors like internal factors, external factors, laws, and the political situation.

4.4 Limitation of South Korea space development

If we talked about the potential of South Korea space technology, South Korea is the one that have many latencies to develop technology sectors include space technology although, cannot get a support from others. Moreover, technology potential is not problem to South Korea because of each space project, South Korea government used co-operation from many internal technology companies, but internal factors is not only one factors for South Korea space projects. Although, South Korea want to participate in space co-operation project or not but, if were alliance space co-operation project, because of international relation effect issue South Korea cannot declined. Space technology development can affect to many sides but the three big point that researcher realized about space development effect is 1. Environment 2. Security 3. Political. For many sectors concerned environmental issue because in launching space vehicle use a lot of fuel energy and pollute persecution include space debris. Security, in this issue that contained internal security and international security. For internal security, some technology is new technology that below average so, that have a risk for people life and property. For external security, space development look seems like cause of great impact because many inventions from space technologies make dangerous effect such as chemicals and dangerous good Spill, explosion, reconnaissance from enemy, this is thing that many countries are concerned so, if neighborhood state that develops space technology, the nearby states and country must concern about national security in own state South Korea space development, foreigner supporting and leader policy have inversed variation with North Korea nuclear development and reunification. Since new South Korea leader, Yoon Seok Yeol inaugural to South

Korea president as though reaction of North Korea might be aggressive more than previous leader. In this year 2022, North Korea launched ballistic missile 29 times according from CNN count because North Korea want to warned to South Korea and U.S. “that the United States and South Korea would pay, the most horrible price in history” for any military action against Pyongyang” The North Korea declaration T in weapons testing and rhetoric has sparked alarm in East Asia region. U.S, South Korea and Japan responding with North Korea missile launches and forced to joint military exercises. Although, this conflict issue between North Korea and South Korea but most of conflict in this region, others want to intervene conflict issue in this region.

Some era, South Korea also have conservative or aggressive dictatorship leader such as Park Jung Hee. era. In 1960 Park Jung Hee government launched Five-years Economic Social Development Plans because government want support heavy industry, internal investment, infrastructure and human resources. From Park Jung Hee policy, South Korea after 1970s era economic was continue growth. Park Jung Hee policy emphasized to develop human potential such as support people can appreciate education. In addition to nationalism ideology, Park Jung Hee assured about South Korea people potential. From previous chapter that I mentioned, South Korea started to develop space technology in 1970s era during that time South Korea economic tend to continue improved and had plan to the fullest develop space technology in military for resist with North Korea nuclear development but U.S. not agreed in this issue. After Yoon Seok Yeol is president of South Korea, North Korea look seems like more aggressive. In this month (November 2022), North Korea launch testing intercontinental ballistic missile (ICBM) for warn U.S. and South Korea. Although, North Korea was failed in testing launch missile can be consider North Korea want to start a war so, U.S and South Korea joint exercise “Vigilant Storm”. From the political trick that North Korea responded South Korea meant under conservative policy, both Korea be suspicious each other. The direction of space technology development in South Korea related from government policy or international situation that depend on South Korea leader so, limitation of South Korea space development that both from external and internal.

Conclusion

Although, human also know about space technology long time ago but look seems like this technology remain a new thing and each country that develop in this technology been suspicious each other and found the space group because divided polarity. Before proxy war, space technology group divided 5 groups U.S. and Soviet Union. Since Soviet Union were collapse, U.S. is the leader of space technology but at the present time U.S. might not a space technology leader because that have many countries develop space technology include private sector. Since trade war between U.S. and China that compete fiercely, China is a one that also develop space technology but was different group from U.S. One country wants to develop space technology that do under space law not enough moreover, must joint in space group because find an alliance and connection. In addition to geopolitics that make South Korea must develop space technology perforce. I noticed something from in this research, although North Korea and South Korea were different in politic, economic, society but after end of Korean war North Korea and South Korea had been not attack each other directly, that have only a few responding. Most of reason that North Korea cite to nuclear development is the superpower country try to intervene Korean peninsula conflict for gets a benefits. Although, South Korea have many reasons that want to develop space technology but cannot decline the one reason that is defend with North Korea weapon so, South Korea develop space technology under U.S suggestion.

CHAPTER V

CONCLUSION

At the present time, Space technology is advance more than past such as satellite, space vehicle moreover, space technology brings to use in many technologies whether it be communication technology, aviation technology, explore, military so, space technology development will make some benefit more than the state which not develop space technology and depend on What state want to emphasize space technology in others issue such as communication, natural explore, aviation, space explore or military. Nowadays, not only government sector can invest in space technology but also many private sectors can develop and invest own space technology such as SpaceX, Blue origin, Virgin Galactic but mostly private sector company that develop space technology have a different reason from government sector, some company develop space technology for intended space travelling but some company invest space technology for mars explore. Space technology tends to keep going and progressing because of advanced technology that make mankind dream to space exploration, immigration to others planet come true. Through space technology is not a new thing but space law issue or political issue could be argued because sometimes space technology used for dangerous purpose such as frighten others state so, space technology can get many benefits meanwhile, can get bad effect.

5.1 Summary

South Korea is one state develop space technology, for South Korea this investment be worth because South Korea can apply space technology for use with others technology such as develop communication technology, geography, broadcasting, while South Korea also bring space technology to use in military for battle with North Korea nuclear technology. North Korea claimed that develop nuclear technology because been anxious of foreign intervene, but North Korea nuclear development also make others be anxious because In November, North

Korea launched nuclear ballistic weapon more than 7 times and have launching plan in the future that makes others fill anxious for this situation. 14

November 2022, U.S. and China consult about North Korea issue because China is one alliance of North Korea so, in this region China have the most powerful to negotiate with North Korea attitude. However, North Korea situation unpredictable because it depends on international political and internal so, Space development of South Korea is assurance for South Korea national security and can attract foreign country to be alliance, this action might South Korea have handicap more than North Korea.

Space technology must be use high amount of investment so, South Korea might be find partners for invest and develop technology. Since South Korea started to develop space technology in each project that have different partner and different purpose be it Russia, Japan and U.S., the purpose that have communication, technology and military depends on South Korea government at that time. At the present time because of economic growth, South Korea have many space project both internal project and co-operation project. After Kim Jong Un step up to North Korea leader, North Korea was even more strongly restrict foreign country so, North Korea intimidate others by developing and launching nuclear weapons, that is make others be anxious about situation. The more U.S. have strongly relation with South Korea and Japan, North Korea more fiercely retort by nuclear launching.

From researcher opinion that think. South Korea is the one state success in develop space technology whether communication, space vehicle, space project because of potential of South Korea can be a main role in space technology but because of space technology that monopolized by U.S. Although U.S. space technology is not the most ultramodern but U.S. can have monopolized by law and space aggregation, some state cannot joint in U.S. space group such as China. From that researcher mentioned, South Korea might be developing space technology under suggestion of U.S. ,However, political polarity can be changeable, from that researcher to study that under trade war between U.S, and China situation, and

tension between U.S., South Korea and North Korea. In this week (10-18 November 2022) North Korea launched ICBM and others ballistic more than 3 times. In the future I think South Korea might develop space technology for use in military more than this day for balance hard power with North Korea. South Korea is state that develop hard power and soft power simultaneously so North Korea will use hard power for flight with South Korea and push others out. Finally, South Korea will continue to develop space technology until distrust about North Korea for national benefits, however, cannot be a leader of space technology recently because of security and politics.



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จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

VITA

NAME	NUTNARIN UEASUKPAKDEE
DATE OF BIRTH	15 October 1997
PLACE OF BIRTH	Udonthani
HOME ADDRESS	10/104 หมู่บ้านสินทรัพย์นครกาเดิน ถนนกาญจนาภิเษก แขวงบาง แค เขตบางแค กรุงเทพมหานคร 10160

