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Indonesia Space Program : Future Soft Power

Murdi Primbani[1], Eman Hermawan[2]
[1]Indonesian Diplomat, Ministry of Foreign Affairs, Republic of Indonesia (this article is a personal opinion and does not reflect the policy of MOFA Indonesia)
[2]American Studies Program, School of Strategic and Global Studies, Universitas Indonesia
Email: murdip@yahoo.com, eman.hermawan21@ui.ac.id

ABSTRACT
This paper discusses Indonesia's space / aerospace industry program as the nation's future Soft Power. The term 'soft power', coined by Joseph S. Nye of Harvard University in the United States, is the ability of a country to influence another country not through coercive means but through attractiveness or reputation. This research uses a literature research approach, which is a method by collecting data by understanding and studying theories from various literature related to research There are four stages of literature study in research. Space, or simply space, is the expanse that exists beyond the Earth and between celestial bodies. Space isn't completely empty it's a hard vacuum containing low particle densities, especially hydrogen and helium plasma, as well as electromagnetic radiation, magnetic fields, neutrinos, dust, and cosmic rays. Recent developments show that in the future, not only professional astronauts can go into space but also all citizens of the world can afford to pay.

Keyword: space, space program, future

INTRODUCTION
This paper discusses Indonesia's space program / aerospace industry as future Soft Power of the nation. The term Soft Power', which was coined by Joseph S. Nye from Harvard University in the United States, is the ability of a country to influence other countries not through coercive means but through attraction or reputation.

Indonesia has abundant Soft Power that has contributed in making a fragrant name for the nation internationally, making it respected, such as the Foreign Policy of Free and Active in maintaining world peace, Indonesia's status as the 3rd largest democracy in the world, the largest democracy in the Islamic world, Indonesia's popular culture such as culinary, dances, traditional sports and the natural beauty, flora and fauna of Indonesia.

From so many elements of Soft Power that Indonesia has, there are still many more Soft Power potentials that can be developed, among them is the space program / aerospace industry (Fahim & Islam, 2023).

Why can the space program / aerospace industry be one element of Soft Power? Some arguments have been presented, one of which is the thesis from Major Rob Chambers, US Air Force officer entitled "China's Space Program: A New Tool for PRC's Soft Power in International Relations", which describes China's efforts to attract developing countries by establishing cooperation in the field of space technology and also make use of Chinese-made space technologies that support the needs of these developing countries. By entering into spacefaring

nations, a country can bolster its prestige and reputation among other countries. This is also a part of Soft Power.

In addition to building a powerful Soft Power, mastery of space technology particularly the science of rocketry is also very important for Indonesia based on the 4 (four) following reasons: to ensure the sustainability of Indonesian humanity if the earth cannot sustain life anymore; to participate in space mining; to launch Indonesia's own satellite along with its Indonesian-made space launchers for national independency; and to support capable Indonesian defense.

Indonesia has always been destined to be a great country. This is the nature of Indonesian people since our nation has a very long and glorious civilization. The greatness is always in our blood. Therefore, in history, Indonesians always want to achieve something bigger, among others in the field of aerospace technology. No wonder after independence, the First President of Indonesia Haji Akhmad Soekarno founded LAPAN (The National Institute of Aeronautics and Space) in 1963 to help achieve this goal. Nevertheless, until now Indonesia has not entered elite space club nations. In this regard, this paper tries to raise awareness about future Indonesia's space program / space industry and discuss the Indonesia's plans to enter the spacefaring nation (Suryaatmadja et al., 2020).

RESEARCH METHODS

This research uses a library research approach, which is a method by collecting data by understanding and studying theories from various literature related to the research There are four stages of literature study in research, namely preparing the necessary equipment equipment, preparing work bibliographies, organizing time and reading or recording research materials The data collection uses how to find sources and construct from various sources such as books, journals and research that has been done. Literature material obtained from various references is analyzed critically and must be in-depth in order to support its propositions and ideas

RESULTS AND DISCUSSION

Space

Outer space, or just space, is the expanse that exists beyond the Earth and between celestial bodies (Dallas et al., 2020). Outer space is not completely empty it is a hard vacuum containing a low density of particles, predominantly a plasma of hydrogen and helium, as well as electromagnetic radiation, magnetic fields, neutrinos, dust, and cosmic rays.

Aerospace

The human effort in science, engineering, and business to fly in the atmosphere of Earth (aeronautics) and surrounding space (astronautics) (Gulani et al., 2023). Aerospace organizations research, design, manufacture, operate, or maintain aircraft or spacecraft. Aerospace activity is very diverse, with a multitude of commercial, industrial and military applications.

Rocket

From Italian rocchetto ("bobbin") is a missile, spacecraft, aircraft or other vehicle that obtains thrust from a rocket engine. Rocket engine exhaust is formed entirely from propellant carried within the rocket before use. Rocket engines work by action and reaction and push rockets forward simply by expelling their exhaust in the opposite direction at high speed, and can therefore work in the vacuum of space.

Orbit

In physics, an orbit is the gravitationally curved trajectory of an object, such as the trajectory of a planet around a star or a natural satellite around a planet. Normally, orbit refers to a regularly

repeating trajectory, although it may also refer to a non-repeating trajectory. To a close approximation, planets and satellites follow elliptic orbits, with the central mass being orbited at a focal point of the ellipse, as described by Kepler's laws of planetary motion.

Satellite

In the context of spaceflight, a satellite is an artificial object which has been intentionally placed into orbit. Such objects are sometimes called artificial satellites to distinguish them from natural satellites such as Earth's Moon (Tsiolkovsky, n.d.).

Remote Sensing

Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to on-site observation, especially the Earth. Remote sensing is used in numerous fields, including geography, land surveying and most Earth Science disciplines (for example, hydrology, ecology, meteorology, oceanography, glaciology, geology); it also has military, intelligence, commercial, economic, planning, and humanitarian applications.

Transfer of Technology

Technology transfer, also called transfer of technology (TOT), is the process of transferring (disseminating) technology from the places of its origination to wider distribution among more people and places. Often it occurs by concerted effort to share skills, knowledge, technologies, methods of manufacturing, samples of manufacturing, and facilities among governments or universities and other institutions to ensure that scientific and technological developments are accessible to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials, or services. It is closely related to (and may arguably be considered a subset of) knowledge transfer.

Indonesia’s Space Program Among Major World Powers

The End of the World Scenario

In November 2014, the acclaimed filmmaker Christopher Nolan who is also popular around the globe with The Dark Knight Trilogy, released his masterpiece, Academy Award winning “Interstellar”, a story about four US astronauts who are dispatched by NASA to find another possible inhabited planet since our beloved planet is dying, meanwhile the scientists on Earth fighting desperately to implement gravitational propulsion theory to propel a mass exodus of humanity from Earth. A very moving film about the last days of the Earth that is very likely to happen in the near future if we do not take good care of our planet.

In the real world, scientists develop some scenarios about the end of the world. One of the most scientific theories is the increasingly intense heat of sunlight which will eventually destroy all life on Earth.

Scientist estimate the sun's age will reach 10 billion years before it dies, while today the sun has lived almost half of its age: 4.6 billion years. One of the scientists, Jillian Scudder from the University of Sussex estimates that in the next 6.4 billion years, all good things finally end. The sun will burn its last hydrogen and start burning helium instead. As the sun sheds its outer layers, its mass will decrease, loosening its gravitational hold on all of the planets, so all of the planets orbiting the sun will drift a little farther away. When the sun becomes a full-blown red giant, its core will get extremely hot and dense while its outer layer expands a lot. Its atmosphere will stretch out to Mars' current orbit, swallowing Mercury and Venus.

Although the sun's atmosphere will reach Mars' orbit, Mars will escape, as it will have wandered past the reach of the sun's expanding atmosphere. Earth, on the other hand, has two options - either escape the expanding sun or be consumed by it. But even if Earth slips out of the

sun's reach, the intense temperatures will burn it to a sad, dead crisp. Then, for the next 150 million years, the temperature of the sun will fall again, because helium contained in its core has run out. The weight or mass of the sun will continue to decrease. And a million years later, the sun continues to shrink in size, until the light dims and finally disappears altogether.

Humans are now racing with time. We still have a chance. Some scientists believe that in the next 6 billion years, humans would have been able to invent high technology to launch mass exodus from Earth to colonize other planets or build space stations for humanity to live in. By then, humans will be able to watch the dead sun; as a black star surrounded by scorched planets. When that time arrives, will Indonesian people be saved? Or, what if 'another the end of Planet Earth' scenario occurs, even sooner? Will Indonesian leaders depend on other country to save its own people?

Concise History of Aviation, Rocketry & Space Program

Humans' dream of being able to fly like a bird might be as long as human history itself. The first recorded human to try to fly was Muslim scientist Abu al-Qasim Abbas Ibn Firnas Al Takurini who lived in the 9th century in the Emirate of Cordova, Spain. Ibn Firnas' flying experiment using his own designed glider triggered western scientists to create a variety of tools so that humans could really fly.

There was also an opinion that the protection provided by the Ababil bird to the Kaabah in 7th century Mecca by dropping burning stones on King Abraha's army inspired the creation of fighting aeroplanes.

Many western scientists have been experimenting with flying using their own designed gliders until finally in the 20th century the American brothers from Ohio Oliver and Wilbur Wright became the first humans to create gliders (with engine) that could be climbed and flown for 59 seconds. Since then the various innovations have continued to be carried out until the first war utilizing aircraft occurred in World War I (1914 - 1918) and World War II (1939 - 1945) with far more sophisticated aircraft technology.

Along with the development of aviation science, it was recorded 4 (four) persons to be considered the father of rocketry and spaceflight: Konstantin Eduardovich Tsiolkovsky from Russia (1857 – 1935), Robert Hutchings Goddard from the United States (1882 – 1945), Robert Esnault – Pelterie from France (1881 – 1957) and Hermann Julius Oberth from Germany (1894 – 1989), plus 2 (two) geniuses behind the space program in the US and Russia: Wernher von Braun (1912 – 1977) and Sergey Pavlovich Korolev (1907 – 1966). Wernher von Braun is the main architect behind the successful landing of Apollo XI in the moon, and if Sergey Korolev had not died sooner, then Russia would overtake the US to land on that Earth's satellite.

Konstantin Tsiolkovsky is considered to be one of the first who envisioned the space travel and mapped out the theoretical basis for space travel and paved the way for Robert Goddard. As a youth, Tsiolkovsky spent most of his time in the library studying science journals, learning Newton's laws of motion, and applying them to space travel. His dream was to travel to the Moon and Mars. In 1903, he published his famous rocket equation with the conclusion that enormous amounts of fuel are needed to give an extra boost in speed of the rocket to escape gravity of the Earth. Meanwhile, Goddard is the pioneer in introducing liquid fuel rocket. In this regard, his very important innovations were to introduce multistage rocket serves as a place for backup fuel which is needed for far travel in space, and gyroscopes that function to maintain the direction of the rocket in space.

Human nature is indeed never satisfied. After mastering the realm of land, sea and air, humans have ambition to master the fourth realm, space. Only less than 50 years after the first

creation of airplane, humans have succeeded in launching satellites into space, the Soviet Union's Sputnik 1. The 20th century was marked by competition between two world's superpowers, the United States and the Soviet Union to dominate space. The Soviet Union became the first country to send human into space, Yuri Gagarin in April 12, 1961, followed by its competitor, the US by putting its first man into space, Alan Shepard in May 5, 1961. Finally, with the Apollo program, the US successfully landed the first and the second man in history of humankind to the Moon, Neil Armstrong and Buzz Aldrin in July 16, 1969.

In 1971, the Soviet Union launched Salyut 1 Space Station and in 1986 it launched Mir Space Station. Mir Space Station worked for the period of 10 years (1986 – 1996) and in 1998 was replaced by the International Space Station (ISS). The ISS Program is a joint project between five participating space agencies: NASA (US), Roscosmos (Russia), JAXA (Japan), ESA (Europe) and CSA (Canada). The ISS has been continuously occupied for almost 19 years since the arrival of Expedition 1 on November 2000. This is the longest continuous human presence in Low Earth orbit (LEO), having surpassed the previous record of 9 years and 357 days held by Mir. The ISS has been visited by astronauts, cosmonauts and space tourists from various nations. After the American Space Shuttle program ended in 2011, Soyuz rockets became the only provider of transport for astronauts at the ISS.

Since 1970 and above, space technology is not only monopolized by western countries but also successfully mastered by Asian countries. Following is the table of countries that have successfully entered the spacefaring nations by launching satellite from their own space launchers:

No.	Country	Date	Satellite	Launch Platform / Launcher	Launcher Site
1.	The Soviet Union	October 4, 1957	Sputnik 1	Modified R-7 ICBM	Tyuratam (Baikonur)
2.	The United States	January 31, 1958	Explorer 1	Juno (modified Jupiter C)	Cape Canaveral
3.	France	November 26, 1965	Asterix – 1	Modified Diamant-A	Hammaguir, Algeria
4.	Japan	Februari 11, 1970	Ohsumi – 1	Lambda-4S	Kagoshima Space Center
5.	China, People's Republic of	April 24, 1970	Dong Fong Hong 1	Long March 1	Jiuquan Launch Site
6.	Great Britain	October 28, 1971	Black Knight 1	Black Arrow	Woomera, Australia
7.	European Space Agency (ESA)	December 24, 1979	CAT	Ariane	Kourou, French Guiana
8.	India	July 18, 1980	Rohini 1	Satellite Launch Vehicle 3	Sriharicota Island

9.	Israel	September 19, 1988	Ofeq 1	Shavit	Palmachim Air Force Base, Israel
10.	Iran	February 2, 2009	Omid 1	Safir 2	Semnan Space Center (Imam Khomeini Space Launch Terminal)
11.	North Korea (DPRK)	December 12, 2012	Kwang Myong Song 3	Unha 3	Sohae Satellite Launching Station
12.	South Korea (ROK)	January 30, 2013	STSAT – 2C	Korea Satellite Launch Vehicle (KSLV-1) (part Korea, part Russia)	Naro Space Center

In Arab region, the visionary leaders of the United Arab Emirates (UAE) has proposed in 2008 to establish a Pan-Arab Space Agency, similar to the European Space Agency (ESA). However, little progress to establish the regional agency was made after the proposal was submitted. Finally, the UAE decided to go ahead alone with its plan. The UAE Space Agency was subsequently established in 2014 by Presidential Decree of Sheikh Khalifa bin Zayed Al Nahyan, and in 2015 it formed a partnership with the space agencies of France and the United Kingdom. The UAE Space Agency is the first space agency in the Gulf region. During 2017 World Government Summit in Dubai, Vice President and Prime Minister of the UAE Sheikh Mohammed bin Rashid Al Maktoum announced his country will colonize Mars in 2117 by building human settlement there. In 2020, the UAE became the second country in the world after India who successfully enter Mars' orbit in the first try, which was coincides with the 50th year anniversary of the founding of the country. The UAE probe named Hope was successfully launched to Mars with JAXA H - IIA rocket from Tanegashima Space Center in Japan.

Sheikh Mohammed linked the Mars mission to Arab and Islamic civilization leading role in advancing scientific knowledge for mankind. He said: "Our great-grandfathers explored the stars when sailing. Because our dreams are great, and our ambitions begin in the skies, once again we look at the stars to build our glories."

The Establishment of International Space Law Regime

Since the Soviet Union succeeded in sending the first humans into space, world leaders and law experts began to think about how space exploitation was aimed at the common prosperity of mankind. Through the UN Resolution 1721 (XVI) "International Co-operation in the Peaceful Uses of Outer Space" (December 20, 1961), the UN General 7Assembly was agreed to apply the principle of International Law as well as UN Charter that space is the common property of mankind

and is prohibited from being an object of ownership. Before that, the UN Resolution No. 1348 (XIII) "Question of the Peaceful Uses of Outer Space" (December 13, 1958) was accepted and became a legal basis to the establishment of The UN Committee on Peaceful Uses of Outer Space (UNCOPUOS). In 1967, the Outer Space Treaty was completed, which has been a Magna Charta for space exploration and exploitation. Indonesia is a member of UNCOPUOS since 1975 and Indonesian delegation were active in negotiation such as in the issue of remote sensing by satellites. The UNCOPUOS also foresee the implementation of subsequent agreements related to the activities in space.

Indonesia's Space Program and its Regulation

After Indonesian independence, particularly in the 1960s, the attention of the Indonesian Government to the world of aerospace was increasingly prominent. This was marked by President Soekarno's visit to the Kremlin in order to explore cooperation in aerospace. In addition to meeting President Leonid Breznev, President Soekarno also met Yuri Gagarin, the first man on space. In May 1962, Ir. H. Djuanda (Chairman of the Indonesian Aviation Council) and Air Marshall RJ. Salatun (Secretary of the Indonesian Aviation Council) formed the Astronautics Committee. In September 1962 a Scientific and Military Rocket Project was formed affiliated with the Indonesian Air Force and Bandung Institute of Technology (ITB). As a result, Kartika I and Kartika II rockets were launched in August 1964 and August 1965 respectively. These launches made Indonesia to become the second country in Asia and Africa after Japan, which succeeded in launching rockets up to the height of orbit.

In 1963, President Soekarno issued Presidential Decree No. 236 to establish LAPAN (Lembaga Penerbangan dan Antariksa Nasional / The National Institute for Aeronautics and Space). As an institution responsible directly to the President, LAPAN has a vision of "Realizing Indonesian Independency in Aeronautics and Space Science and Technology to Improve Nation Life." LAPAN's achievement among others are the launching of satellites INASAT-1, LAPAN-TUBSAT (LAPAN-A1), LAPAN-A2, LAPAN-A3, Lapan Surveillance UAV (LSU). With its satellite technology, currently LAPAN is able to provide high-resolution remote sensing data.

For rocket technology, Chairman of LAPAN Dr. Thomas Djamaluddin told reporters on April 27, 2019 that LAPAN would focus on developing rocket coverage that has been incorporated into the National Priority Program for the next five years. So far, LAPAN has succeeded in creating a rocket which is the embryo of the orbiting satellite rocket, the RX 420 which was successfully tested on July 2, 2009. The RX 420 rocket has a range of 100 km and speeds of 4,400 km / h or 4.4 times the speed of sound (4.4 Mach) The success of the RX 420 rocket received coverages in The Straits Times (Singapore) and The Sidney Morning Herald (Australia). LAPAN also succeeded in producing RX 1220 rocket used by the Indonesian marine corps. This fighter rocket has a range of 20-30 km, with a length of around 3,230 m, and RX 1210 fighter rocket that reaches 14 km so that it can be carried by military cars. This rocket is used by the Indonesian Navy and the Indonesian Army.

In December 2018, LAPAN tested RX 450 / R-Han 450 rocket with a maximum range of almost 100 km. This rocket was produced by the National Rocket Consortium consisting of PT Dahana, LAPAN, Indonesian Ministry of Defense, PT Dirgantara Indonesia and PT PINDAD. Director of Technology and Development of PT Dahana Heri Heriswan said this rocket has been tested several times to achieve maximum results. A series of improvements are still being carried out, so it is expected that this ground-to-ground rocket for terrain artillery can reach the ideal distance of 100 km. The R-Han 450 is a ballistic type rocket with a total length of 7.2 meters, a diameter of 46 cm, a total mass of 1,750 kg, a propellant mass of 750 kg, with a maximum range

of more than 100 km and a maximum speed of 3,300 km per hour. It is hoped that by the increase in capability, this ballistic rocket can be produced immediately for the benefit of domestic defense and commercial (for export).

Indonesia is a party of Outer Space Treaty 1967. With the enactment of Law No. 21 Year 2013 regarding Space, LAPAN has a legal basis that underlies its tasks, specifically regulated in Article 7 where LAPAN's responsibilities include space science, remote sensing, mastery of space technology, launching, and commercial activities. Before the enactment of Law No. 21 Year 2013, President of the Republic of Indonesia issued Presidential Instruction No. 6 Year 2012 regarding Supply, Use, Quality Control, Processing, and Distribution of High-Resolution Remote Sensing Satellite Data.

Under President Joko Widodo, Presidential Regulation No. 45 Year 2017 regarding Master Plan for Space Program Year 2016 - 2040 (Rencana Induk Penyelenggaraan Keantariksaan Tahun 2016 – 2040) was issued. This visionary Regulation specifies 2 big targets by 2040, which are 1) Indonesia must have the ability to serve domestic and foreign launch services up to Low Earth Orbit (LEO) by using its own satellite orbit rocket from a launch station or space station in the Indonesian territory. 2) Indonesia must have the ability to provide satellite communication services through national communication satellite.

If this visionary target is achieved, Indonesia's space program / space industry can be one of instruments of soft power of the country, that is a space program or space industry mainly aimed for peaceful purposes and to facilitate the need of other countries as well. The most important goal is, Indonesia will join the spacefaring nations in 2040 by being able to launch its own rocket to LEO (around the altitude of 2,000 km) from its own space station in the territory of the Republic of Indonesia.

The Chairman of LAPAN Dr. Thomas Djamaluddin said that LAPAN aspires to make Indonesia a nation that has strong space technology capabilities. Gradually LAPAN is building capabilities for Indonesia's advanced space missions, including manned missions. International cooperation is the way to make it happen.

Future Trends of Aerospace Industry

Major world power will continue to develop their aerospace technology / industry since it is not only beneficial for gaining national income but also useful for military defense and other military interests. Observers estimate that majority of the activities in space are for military purposes. . However, with the discovery of the potential of mining materials on celestial bodies as in the moon and asteroids can provide an alternative to countries with high aerospace technology to be able to exploit them. Besides, the Outer Space Treaty allows the space exploration for "peaceful purposes". In 2015 President Barack Obama signed "The Space Law" that allows companies in the US to exploit space mining if they get the technology to move and exploit the bodies rich in minerals such as platinum, gold, iron or water. It is estimated that some asteroids could contain all the platinum and have a market price of hundreds of billions of dollars. It is also presumed that some contain iron, nickel or cobalt in sufficient quantity to cover the needs of the Earth for 3,000 years. Some high-profile private companies such as Virgin Galactic, SpaceX, Deep Space Industries, Mars One, Planetary Resources and so forth have shown interest. China and the UAE also expressed interest in space mining.

The three major sectors of the space industry are: satellite manufacturing, support ground equipment manufacturing, and the launch industry. The satellite manufacturing sector is composed of satellite and their subsystems manufacturers. The ground equipment sector is composed of manufacturing items like mobile terminals, gateways, control stations, VSATs, direct broadcast

satellite dishes, and other specialized equipment. The launch sector is composed of launch services, vehicle manufacturing and subsystem manufacturing. The 2017 State of the Satellite Industry Report that the revenue of these industries reach hundred billion dollars.

With more satellites planned, space debris removal will also be a major business interest, as well as many more infrastructures needed for deep space explorations. Between 2020 and 2021, the global space economy value rose 9% to USD 469 billion. It will exceed USD 1 trillion by 2040, according to Mackenzie Holland in her article published on 30 November 2022 in techtarget.com: "A Rising Space Industry Will Create New Jobs and Products" based on the Space Foundation report.

Recent developments show that in the future, not only professional astronauts will be able to go into space but also all citizens of the world who can afford to pay. In the future, space tourism will be able to offer cheaper prices to tourists, especially if the transportation equipment used can be mass produced. To achieve "Indonesia' Space Independence" as mandated by Presidential Regulation No. 45 Year 2017, the strong will of Indonesian Government and the support of all components of Indonesian people are needed to achieve the Indonesian Government's great vision to make Indonesia a Spacefaring Nation by 2040.

CONCLUSION

Recent developments show that in the future, not only professional astronauts will be able to go into space but also all citizens of the world who can afford to pay. In the future, space tourism will be able to offer cheaper prices to tourists, especially if the transportation equipment used can be mass produced. To achieve "Indonesia' Space Independence" as mandated by Presidential Regulation No. 45 Year 2017, the strong will of Indonesian Government and the support of all components of Indonesian people are needed to achieve the Indonesian Government's great vision to make Indonesia a Spacefaring Nation by 2040.

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