

# Mitigation Policy Scenario of Space Debris Threat Related with National Security

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**Abstract:** The development of air space recently entered a new phase, when the space issues correlated with the future of a country. In past time, the space authorization was related with advancing technology by many space mission and various satellite launchings, or it could be said that who ruled technology will rule the space. Therefore, the numerous satellites in the space could be a threat for the countries which are mainly located in the path of the satellite, especially in the equatorial region including Indonesia. This study aims to create a policy scenario in mitigating the threat of space debris. The results showed that although space debris was not threatened national security for now, but the potential and its impact on the future potentially harmful. The threats of orbit circulation for some experts considered as a threat for national security, because its danger potential which caused by space debris could significantly damage the affected areas. However, until now Indonesia has no comprehensive mitigation strategy for space matters although it has been ratified by the United Nations Convention.

**Keywords:** satellite, space debris, mitigation, policy scenario, national security.

## 1. Introduction

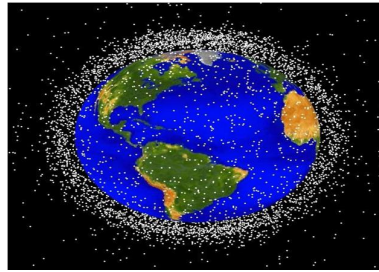
The issue of space development has entered a new stage where it correlated with the future of a country. Developed countries are competed to explore the space for each interest. Developed countries advanced far above Indonesia such as landing mission (United States, Russia, and China), space exploration for science, defence and security (America, China, India, Europe, Japan) and the utilization of space energy (Japan). However, despite the potential and mysteries which still under covered, the space debris threat potential is also concerned recently [1].

The increasing number of space objects such as satellites that circulate around its orbit either still active or have become space debris caused the high possibility of crash between them. It is different with other space objects such as meteor and etc, in addition this study is only focused on object that made by human beings and in this case is satellite. Space debris is a type of space object which has expired and space object in the form of fragment / flake / piece / dust as result of collisions between space objects [2]

This potential threat is going bigger when flake / piece / fragments fell to the earth's surface. It caused damage to plants, animals, soil, water, air, and humans from radiation of radioactive materials inside the satellite. Therefore, the threat of space debris that circulates around the orbit regarded as definite potential threat to a country [3]. In Indonesia, according to Herdiansyah [4] research findings showed that the Indonesian public perception assumes space debris as one definite threat in the future.

In 2010, there were nearly 1100 spacecrafts and rockets near GSO where the operated one was only about a third of them. According to data from the European Space Agency (ESA), during the world satellite era, there were total of 6.000 satellites launched into space and 1.000 of them are still operated till now and the rest them become debris[5].





Picture 1.Space debris on the Earth's orbit

([http://www.nasa.gov/mission\\_pages/station/news/orbital\\_debris.html#.UrDBgScQQ-B](http://www.nasa.gov/mission_pages/station/news/orbital_debris.html#.UrDBgScQQ-B))

The geographical of Indonesia has dangerous potential as the opportunity of space object falling is very high. Until now, the space objects were felt down in several times at some regions of Indonesia, even not caused significant losses and human life. Based on the data, there are three falling space objects and could identified as part of COSMOS-3M rocket motor which felt on March 26<sup>th</sup> 1981 in Gorontalo. The others are part of Soyuz A-2 rocket motors which felt on April 16<sup>th</sup> 1988 in Lampung and the broken of CZ-3 PRC rocket which felt on October 13<sup>th</sup> 2003 in Bengkulu [6]

## 2. Theoretical Review

Space Debris can be defined as all human-made objects that orbiting on the space of earth and had no benefit for human. Space debris is moved in orbit with certain speed before finally entering (re-entry) the Earth's atmosphere [7] [8]. Space debris are in form of falling objects such as satellite, a former rocket, or satellite either rocket fragments. Commonly, space debris is threatened for its collision effect with atmosphere and / or with surface of the Earth that consist harmful material such as nuclear radiation [9].

Moreover, in 2011, the significant increasing of solar activity affected in the increasing of space debris number that felt to the Earth. Theoretically, the correlation between solar activity and the amount of falling debris could be easily seen if we only considered with the former satellite and rocket (ignoring the small-sized flakes) [10]

Because of many space debris felt as increasing of solar activity since 2009, the amount of space debris on the orbit was decrease in year 2011. This trend will continue to 2013 if there is no explosion of satellites or used rockets in large numbers. It will increase after 2013 and become threat for the countries in equatorial region.

The issue of space debris becomes part of the national security threat since the development of international relation where strengthened in one side but weaken in the other side. At first, the national security which related to the relationship between states was considered too focused on studies of high political, intelligence, and natural resources competition. It means that the national security in international relation dimension is concentrating on state, people, international system, and reciprocity contribution [11]

After the end of Cold War, national security was transformed on the issues that have no big impact directly. Hence in conceptually, national security in the former was known as militaristic approach and dominated with issues of defence, security dilemma, arm race, nuclear, weapons, etc. Recently, the national security threat changes the characteristic of threat to become more complicated. Therefore, the security problem becomes more comprehensive because involving other aspects such as economy, social-culture, environment, and even public health issue [12]

Security in simple traditional concept could be defined as a state security that could be threatened by another military power and should be defended by its own military strength [13] [14]. One of those points is the development of satellite orbit that threatens the majority of countries which are not the owner of those satellites. Therefore, the national security which related with satellite orbit is basically trying to discuss how a country faced the threat of space debris.

## 3. Methodology

This study design followed the working of mixed method approach that proposed by Creswell [15], where the research will be accomplished by quantitative and qualitative approaches sequentially.

Although used mixed method, this research also used various methods that adapted with the purpose of research in its implementation. Quantitative approach is used to test the existing construction, while qualitative approach is used to explain and describe the phenomenon of the theme.

The type of this research is descriptive analytic in form of research that provide picture or description of phenomenon without any treatment to the object which is studied analytically according to the factual findings on the field. However, intervention is done by modelling and specific explanation of data, hence it will create an applicative model that could explain the theme.

The populations on this study are the stakeholders in the issue of satellite orbit circulation as well as space debris, such as government, satellite private user, NGOs, academia, and the satellite user community. The criteria of informant are determined by factors such as its expertise, involving, and having strong track record. The qualitative informant consists of regulators in this case of Communication and Information Ministry and National Institute of Aeronautics and Space (LAPAN). Private sector consists of several telecommunication companies that have their own satellite. The working steps are starting by gathering relevant data, formulating the problems, carrying out preliminary studies and theoretical framework, collecting data, carrying out intensive interview, and arranging scenario. The next are interpreting and analyzing data, formulating model, concluding and arranging final model or alternative policy related to the threat of satellite orbit.

The methodology of this study is started by collecting secondary data related to the study and goal of the research. Then researcher will formulate the problems and correlated it with the objectives of study. In supporting the analysis, the researcher will conduct former study and literature review. The next step is collecting data by two methods. Those are intensive interview and focus group discussion (FGD). Then the researcher will make interpretation and analyze the data. After that, the model could be formulated based on data analysis. Finally, researcher will make conclusion of the study and final model of alternative policy based on the analysis of this study.

On the other hand, the informant of this study will describe on the table below.

No	Institutions	Informant criteria
1	LAPAN director of space affairs	LAPAN leader whose has duty in space objects affairs
2	LAPAN researcher of space affairs	Government researcher in space affairs and focused on science and space objects
3	Academician in satellite study	Academician in satellite objects and master in operating and building of satellite
4	Academician in system thinking expert	Academician who focused on dynamic system modelling
5	Academician in national security matters	Academician in national defence and security and experienced in national security issue
6	Regulator of satellite arrangement	Representation of government who has authority on satellite operation in Indonesian space orbit territory
7	Kominfo researcher about frequency	Representation of government researcher

This study is descriptive analytic study in form of research to describe about object without any analytic execution of the object accordance with factual field findings. Qualitative approach method is used to explain and describe the theme phenomenon. Data resources of this study are in form of primary data and secondary data. Primary data was obtained by intensive interview as well as focus group discussion (FGD). Through compilation of those data resource, the result expectation is research result based on real phenomenon and oriented in applicative research. Hence the formulation of policy scenario is based on empirical and authentically facts [16].

#### 4. Results and discussions

In the context of national security, the principle of policy scenarios in facing threat can be carried out by : 1) diplomacy for finding allies and isolating threat, 2) using economic power to force cooperation, 3) maintaining the effective armed forces, 4) performing civil defence and emergency readiness, 5) ensuring rapid recovery and increasing critical infrastructure, 6) using intelligence services to detect, defeat, or avoid threat and espionage, as well as protect confidential information [17]. Therefore, in facing the circulation orbit threat, the national security system is not only based on

military force but also involving and integrating various non-military strength and institutional cooperation as well as responsive foreign policy. Indonesia which geographically located in the equatorial region along 1/8 of the earth, which is from 91 ° E to 141 ° E and width of 6 ° N to 11 ° S, is a highly strategic region for spacious activities. Refers to economic aspect, the launch of spacecraft would be more beneficial if carried out from the territory of Indonesia which is located just below the equator. This comparative advantage sometimes become target from developed or even developing countries which actively conduct spacious activity to conduct various spacious researches and launch spacecraft from the territory of Indonesia (for instance in Biak). However, its negative impact is relatively not to be thought [18].

The problem of space debris put national security issue as separate study. The context is the development of interaction between actors in management of satellite orbit such as damage potential and the compensation. In the development of national security issues, the classification of "security" definition is not only about militaristic and territorial invasion (traditional threats) but also getting complex due to satellite circulation orbit that threaten certain countries. In the definition of national security studies, impact and potential threat of non-traditional relationships in the region are caused by several problems such as vulnerability due to natural damage from space debris as well as linked with the wider social political economy interests.

The countries that have same possibility as location of the falling space debris could make this detriment issue as bargaining power with the owner of satellite and result in the higher of interaction of each countries as well as regional interaction. The expansion of national security threat is happened due to the danger and impact of the falling space debris is getting wider when it contains hazardous materials such as satellite Cosmos 954 with weight of 4.5 tons and contains radioactive substances that fall in Canadian sea on January 24<sup>th</sup> 1978. Its radioactive substance spread along 600 km from Great Slave Lake to Baker Lake [19].

The United Nation thru UNCOPOS (United Nations Office for Outer Space Affairs) has formulated mitigation guidelines for space debris which consist of [20]:

1. Restricting the release of space debris in normal operation.
2. Minimizing the pieces on space object operation. Therefore, since the beginning, it should be prepared a planned anticipation, such as: mechanism of energy abolition at space system (passivation) and disposal system,
3. Restricting the accidental collision in orbit for increasing of space debris volume and mass,
4. Avoiding intentional destruction of space object or other dangerous activities,
5. Minimizing the potential fragments that caused by the rest of energy after the end of space object operation,
6. Restricting long-term disruption in LEO and GEO orbits that caused by the end space object operation.

The scenario of threat mitigation policy is started from 3 approaches. First is hazard assessment approach. In this phase, the threat mitigation is needed to identify the potential damage and the level of threat that might be happened. In dealing with the threat of satellite orbit circulation, hazard assessment phase requires knowledge and high technology in order to map the worst possibility. The outcome of this phase is the data of regions that may affected by the circulation of satellite orbit [21].

The second phase is warning. This phase is happened when the threat of space debris has to be real. Then the process of mitigation operates in form of warnings based on available data. Mitigation process in this phase is done in quick and carefully ways to avoid victim. The third phase of mitigation process is called preparedness phase. In this phase, the knowledge of impacted area due to space debris and the knowledge of warning systems of evacuation and consolidation when the situation has already safe are highly required. Those three mitigation process are basically preventing and minimizing damage and victims.

LAPAN (National Institute of Aeronautics and Space) in 2009 has developed monitoring software of falling space objects which later became part of the information system and dissemination of falling space objects that developed in 2010. The device named "Track-it" recently is able to automatically display the trajectory objects that existed on USSPACECOM catalogue when it passes the territory of Indonesia with height of less than 200 km in one hour before and one hour after.

“Track-it” is a program to facilitate the monitoring of artificial objects that orbiting the Earth and potentially fall if its height is quite low. Generally, the object that less than 200 km height will fall in less than 2 days. In an altitude of 122 km is commonly considered as critical height of a falling space object. The objects that less than its critical height are usually expressed falls (atmospheric re-entry condition) even the crash site on the Earth's surface could not be known. Therefore the public is able to know the identity of object that had just fallen or will fall in Indonesia territory [22]. However until now, LAPAN (National Institute of Aeronautics and Space) has no mitigation guides and strategies about how to deal with the falling of space debris in Indonesia.

According to LAPAN informant, the numerous satellites in equator territory caused Indonesia in dangerous area refers to space debris. In addition, many developed countries ignored the compensation of resulted space debris. Therefore, the country that passing by its space debris such as Indonesia should has anticipation planning and steps. McCall et al [23] said that this situation called space situational awareness (SSA). It is important for any country which has concern military and economic well-being. SSA is the enabling of a description of the location and operation of space assets. SSA in US identifies the capabilities needed to keep US assets and destroy those kinds of the enemy. Kind of mission was conducted to destruct the space awareness but not violate the treaties or grounds for retaliation.

According to national security informant, the threat of space debris for national security is not just in real and definite threat. The impacts were not significantly happened now and therefore some of the countries ignored about this issue. However, Rusia and China have made special force for space as its great potential empowerment and the danger of space debris that increase during the increasing of new satellites and the old satellites which still exist in space till down to earth. McCall etc [24] said that threats from space debris objects or uncontrolled satellites are passive threat. The most important factor of SSA (space situational awareness) is always location. Orbital parameters can calculate its location measurement, therefore it can search the objects that can be dangerous to one country's space assets. It also generates warning at proper times to encourage defensive actions. Other passive threats are from high-energy particles and photons which caused by natural impacts such as solar storms or impacts of nuclear explosions in the atmosphere. Therefore, the detection and calculation in dealing with those space assets should be determined by characteristics and possible dangers of its threats.

## 5. Conclusion

It can be concluded that space debris which potentially fall down from the orbit to Indonesian territory could be a threat for Indonesian citizens or even become disaster that caused human victims. In wider perspective, as its potential of threat and its level of damage, space debris becomes part of national security threat and forced us to arrange policy scenario in facing it. One form of mitigation against the threat of space debris is how the mitigation system could avoid the fall of satellite or space debris and could avoid damage and victims. Although in the space matters context, the space threat mitigation is obligation of all countries especially the owner of satellite, but the countries which are located in equator and threatened area have higher interest rather than the countries beyond the equator. This mitigation process is important and became one of the objectives of this study. The scenario of threat mitigation policy is started from 3 approaches that the hazard assessment, warning action based, and preparedness phase. Those three mitigation process are basically aiming to minimize damage and victims caused by space debris fall down. Therefore, the policy scenario should be able to assess the danger (hazard assessment), to know when the warning is activated (warning), and to prepare the threat anticipation (phase of preparedness). Unfortunately until now, the developed countries as the largest satellite contributors in space are not much concerning with compensation of space debris that fall down into other countries, even though the policy level of United Nations has made guidance of space debris management.

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