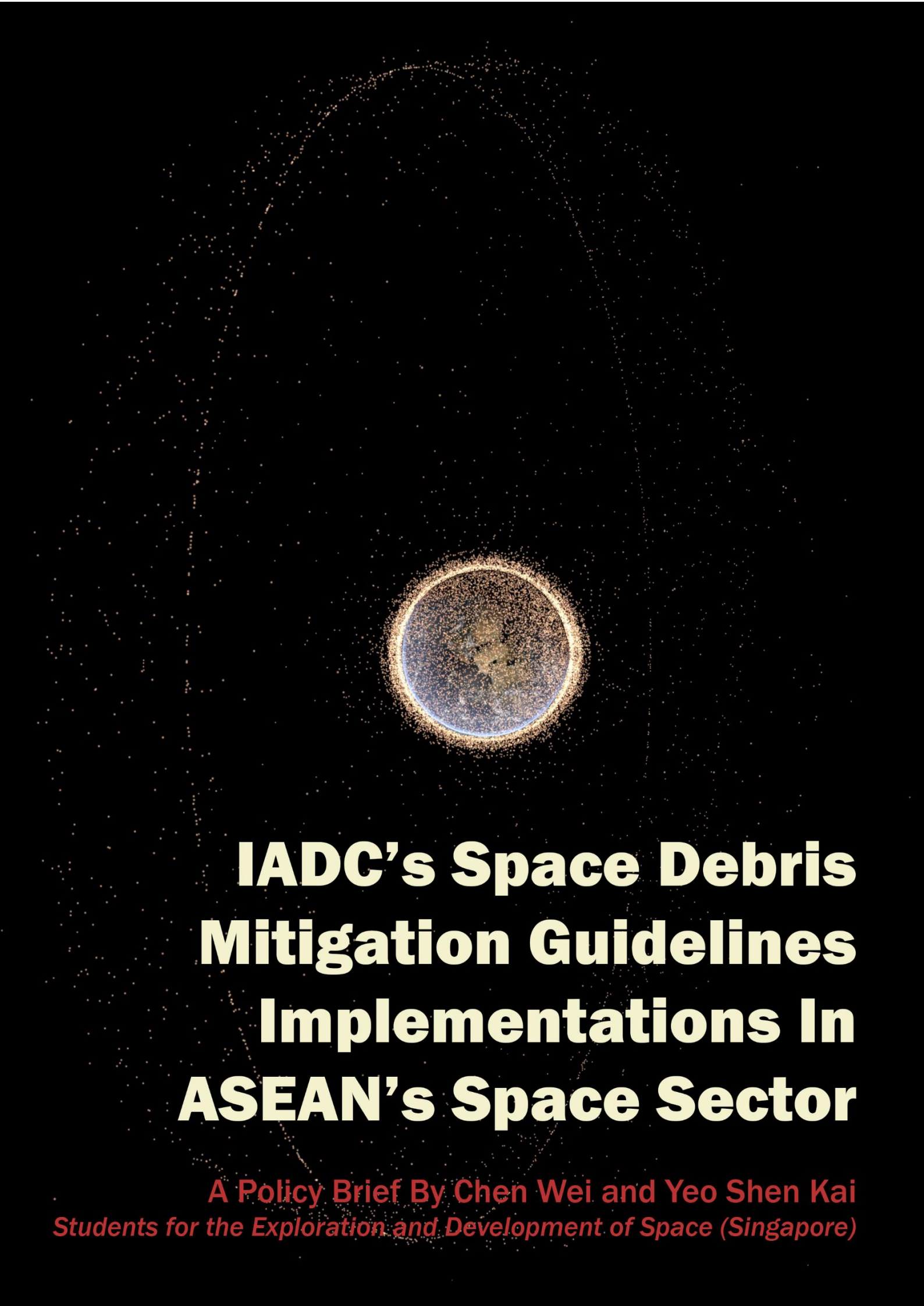

IADC's Space Debris Mitigation Guidelines Implementations In ASEAN's Space Sector

A Policy Brief By Chen Wei and Yeo Shen Kai

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Policy Brief

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Released in June 2021

Synopsis

The Inter-Agency Space Debris Coordination Committee (IADC) is a forum comprising multiple space agencies, aiming to coordinate efforts relating to space debris. The committee had released the latest version of the Space Debris Mitigation Guidelines in December 2019.

The IADC consists of multiple Working Groups. Working Group 4 covers mitigation efforts and had published a Support to the Space Debris Mitigation Guidelines.[1] That document provides a summary of recommendations introduced in the Guidelines, along with the purpose, feasibility, practices, and tailoring guide for each of them.

Introduction

The main contributors to space debris are the major spacefaring nations such as the United States (USA), Russia and the European Union (EU). The Association of Southeast Asian Nations (ASEAN) nations have a much lower number of space launches, and therefore have not introduced as many debris into low earth orbit (LEO). However, there are many signs showing that ASEAN is indeed catching up. As more rockets are launched either from ASEAN nations or have payloads developed regionally, the responsibility of mitigating space debris also increases. To ensure a sustainable space industry, ASEAN nations have to do their part in mitigating space debris as they conduct more launches.

This policy brief analyses the current spacefaring landscape in South-East Asia (SEA) and discusses the feasibility of applying these guidelines to countries in the region. The reasons for SEA's current lack of progress along with push factors for a space industry will also be described. Lastly, it will raise possible recommendations to further consider and apply these guidelines to ASEAN countries, or to ASEAN as a bloc.

Analysis

Currently, the IADC guidelines may be used by any organisation, but it would be more applicable to space agencies of major spacefaring nations, which oversee substantial numbers of space launches.

In contrast, SEA's spacefaring capabilities are a far cry from that of the IADC members. This is a result of various factors, which this brief will be discussing in later sections. Indonesia is the sole country in SEA that has spent at least USD 200 million on space programs in 2018[2], and is likely to be the frontrunner in the SEA space industry. In general, SEA hasn't been able to demonstrate consistent launching capabilities[3], which could be due to a variety of factors including geopolitical implications. For countries that have sent satellites to space, collaboration with space partners was required.

On the bright side, there are push factors for the development of the regional space industry. These are mostly driven by socio-economic pressures, in contrast to prestige driven missions like getting the first man on the moon. Firstly, communications satellites will help in improving connectivity, especially in rural areas. Cambodia is partnering with China to launch its first satellite, one aiming to improve

[1] *Support to the IADC Space Debris Mitigation Guidelines* (Working paper). (2019, December). Retrieved from https://www.iadc-home.org/documents_public/view/id/158#u
[2] Rapp, N., & O'Keefe, B. (2019, August 05). 50 Years After the Moon Landing, Money Races Into Space. Retrieved January 31, 2021, from https://fortune.com/longform/space-program-spending-by-country/
[3] Sarma, N. (2020, October 19). Southeast Asian space programmes: Capabilities, challenges and collaborations. Retrieved January 31, 2021, from https://www.orfonline.org/research/southeast-asian-space-programmes-capabilities-challenges-collaborations-48799/

broadband connectivity[4]. Secondly, for more technologically advanced countries such as Singapore, the pursuit of science may be a motivating factor towards launching satellites. Thirdly, various SEA countries are realising the potential of observation satellites to collect data on meteorological, agricultural and population changes. This is especially useful to archipelago countries such as Indonesia and Philippines to track various environmental factors. Last but not least, with the developments in the South China Sea, countries such as India and Vietnam are recognising the strategic importance of satellites for national security.[5]

Difficulties

Despite the increasing growth pressures for putting satellites into space, the fact remains that SEA has much catching up to do when compared to many other western countries.

1) Cost

With the exception of Indonesia, which is the only ASEAN nation with a gross domestic product (GDP) greater than USD 1 trillion, the other economies of SEA are going to be hard-pressed to be able to support the immense budgets typically required for a full-fledged space program. To put into perspective, NASA's budget for 2020 was in excess of USD 22 billion, a substantial amount when compared to smaller, yet technologically advanced countries such as Singapore or Malaysia, which both have nominal GDPs of around USD 340 billion.

A silver lining might come in the form of SEA's rapidly developing economies, which might open up capacity for space spending. In fact, SEA nations have indeed increased their expenditure on space related developments over the past few years[6].

2) Domestic issues take precedence

Political leaders might face pressure to shift expenditure from space to social programs. This is especially relevant in countries that have a low per capita GDP, such as Indonesia or Vietnam, but still have substantial expenditure for space programs. Other factors include domestic politics and lack of interest in space within the general populace.

3) Lack of development in space technology

SEA is host to countries of different levels of technological expertise, especially when it comes to space technology. On one hand, wealthier countries such as Singapore or Brunei possess a relatively high level of technology in general, with a higher population level of education. On the other hand, countries such as Indonesia and Philippines have a head start in space technology, as they were the earlier ones to start developments in that area. Unfortunately, countries that can do both consistently are rare.

[4] Goh, D. (2018, January 11). China to build and launch Cambodia's first satellite. Retrieved January 31, 2021, from https://www.spacetechasia.com/china-to-build-and-launch-cambodias-first-satellite/
[5] Chaudhury, D. (2018, July 12). New base: Satellite monitoring station in Vietnam to give India room in South China Sea region. Retrieved January 31, 2021, from https://economictimes.indiatimes.com/news/defence/new-base-satellite-monitoring-station-in-vietnam-to-give-india-room-in-south-china-sea-region/articleshow/50431099.cms
[6] Obe, M. (2019, December 02). Philippines, Malaysia and Indonesia bet on space as growth engine. Retrieved January 31, 2021, from https://asia.nikkei.com/Business/Aerospace-Defense/Philippines-Malaysia-and-Indonesia-bet-on-space-as-growth-engine

The gaps in technology, coupled with a disconnect in space goals of each individual ASEAN nation, makes advancement in space technology challenging. [7]

4) Difficulty in cooperation

The above three difficulties could be somewhat mitigated by regional cooperation, similar to ASEAN's work on transboundary haze. Countries with greater technological expertise can work with countries with the resources for rocket launches - such as land and infrastructure.

This has typically been the status quo for many SEA countries, although cooperation has mostly been with established space countries, such as Japan or India, and trends indicate it will remain this way for a while. The chance of ASEAN countries cooperating within the bloc appears to be rather low, due to the better alternatives mentioned above.

Application of guidelines for SEA nations

There are various ways that SEA nations can utilise the guidelines, and a few suggestions are listed below.

1. Major spacefaring SEA nations register their space agencies with IADC and utilise the Space Debris Mitigation Guidelines.
2. Major spacefaring SEA nations can adapt these guidelines into law, configuring the guidelines for their nation's own use, as regulation for private space companies
3. Adapt guidelines into ASEAN (SCOSA), provided all nations in the bloc ratify it.

[7] Rafikasari, A., Sumarlan, S., & Swastanto, Y. (2020). Challenges and Opportunities in Strengthening ASEAN Space Technology Cooperation. IKAT: The Indonesian Journal of Southeast Asian Studies, 3(2), 173-187. doi:10.22146/ikat.v3i2.54069

Analysis of Policy Recommendations

In this section, we will analyse two space debris mitigation policies suggested by IADC and suggest how they can be modified and applied to the regional context.

1) Avoidance of intentional destruction and other harmful activities

> This policy prescribes the avoidance of intentional spacecraft destruction or other activities that may significantly increase collision risks to other spacecrafts. Inevitable self-destructions should be conducted at a sufficiently low altitude, so the orbital fragments are short-lived.

This policy effectively targets the source of space debris generation by minimising the quantity and longevity of orbital fragments that contribute to the Kessler syndrome.

However, keeping destruct devices in-orbit increases the likelihood of an on-orbit explosion, risking high opportunity costs which might be unbearable for ASEAN countries with relatively smaller economies.

Additionally, it is challenging to control spacecraft destruction at low altitude because of the difficulty in altitude control and unfavourable environmental conditions such as aero heating. Given that ASEAN countries possess less advanced space capabilities, it will be more challenging to overcome the technological and material difficulties faced by such manoeuvres.

Given these challenges, ASEAN countries should consider collaborating with other space-faring countries, such as China, India and Japan, to improve spacecraft durability and low-altitude navigation. Currently, the Asia Pacific Space Cooperation Organisation (APSCO) promotes collaborative space programs. Other ASEAN countries not on board yet could consider joining APSCO to enhance their space technology capabilities.

2) Prevention of On-Orbit Collisions

This policy suggests that a spacecraft should include algorithms capable of estimating and limiting accidental collision probabilities in space. With reliable orbital data and significant collision risk, operators should consider launcher lift-off coordination or collision avoidance manoeuvres, best practices and protection measures.

(A) Avoidance of On-orbit Collision

Sensor operators from various agencies can monitor and predict close approaches between known objects, then recommend manoeuvre strategies for spacecraft operators. Information exchange between operators is also encouraged especially in considering collision probabilities in GEO.

This policy suggestion contains several limitations which weaken its feasibility and effectiveness. Firstly, the ideal basis of collision avoidance rests on the probabilistic approach, but this is not always practical. Furthermore, avoidance manoeuvres can be detrimental to satellite operations.

This policy is also heavily reliant on the availability of orbital data. However, most ASEAN countries do not necessarily possess orbital data on the appropriate space debris. Instead, the priority of harvesting space data for ASEAN countries rests on remote sensing and monitoring geological events related to agricultural development, forestry and natural disasters for natural resources management[8] [9].

The information exchange suggested is also inapplicable to ASEAN countries as they are not part of the current network of surveillance agencies (which consist of the United States Space Surveillance Network, the Russian Space Surveillance System, France and some other sensor operators), and none of the ASEAN countries currently possess space surveillance capabilities.

For this policy recommendation to be relevant regionally, ASEAN countries could consider forming national surveillance capabilities. However, given the high cost, it is ideal for ASEAN countries to collaborate to develop a network of orbital surveillance agencies with other regional space-faring countries. This collaboration would benefit all members involved as the data shared will provide valuable data, additional satellite information and precise collision risk assessment which are beneficial for countries seeking to develop their space sector, such as ASEAN. Currently, the Asia-Pacific Ground-Based Optical Satellite Observation System (APOSOS) project based on members of APSCO can track objects and space debris in LEO. However, it only consists of some, but not all ASEAN countries. For all ASEAN countries to benefit from this policy recommendation, they should consider joining APSCO and APOSOS.

[8] Asian Association on Remote Sensing | ACRS | AARS. (n.d.). Retrieved January 31, 2021, from https://a-a-r-s.org/

[9] Sarma, N. (2020, October 19). Southeast Asian space programmes: Capabilities, challenges and collaborations. Retrieved January 31, 2021, from https://www.orfonline.org/research/southeast-asian-space-programmes-capabilities-challenges-collaborations-48799/

(B) Avoidance of Collision with New Launch

Collision avoidance analysis for new launches can be conducted to establish safe launch windows and avoid collisions between ascending launch vehicles and manned systems.

While this policy risks delayed launches, it effectively reduces the generation of space debris from the onset of a spacecraft's useful life.

As ASEAN countries have limited capabilities in the collection of orbital data and hence collision avoidance analysis, current analysis networks such as APOSOS should be further developed to track objects and space debris in Medium Earth Orbit (MEO) and Geostationary Earth Orbit (GEO), for a collision avoidance early warning service in the future.[10]

More fundamentally, ASEAN countries do not typically launch spacecraft domestically, so this policy is inapplicable to the ASEAN context. Nonetheless, in the long term, as ASEAN's spacecraft launch activity continues to rise, it is in ASEAN's interest to eventually develop collision avoidance analysis systems.

(C) Best Practices for Longitude Drift Phases in the GEO Region

In the GEO region, spacecraft should avoid controlled longitude drifts with an altitude too close to GEO because it is packed densely with operational satellites, abandoned satellites and rocket bodies.

This policy recommendation reduces the necessity for standard collision avoidance processes close to the GEO altitude and coordination between operators, both of which can be ineffective and challenging.

This policy is suitable for spacecraft operators in ASEAN because it reduces the reliance on advanced space technology. In the short term, before further collaboration between ASEAN countries and other space-faring countries, this policy will also serve as an effective way to minimise collisions and the generation of space debris.

(D) Protection

Existing satellites should receive additional physical or technological protection to increase their durability against collisions or reduce the risk of collisions entirely.

These additions increase the complexity and cost of spacecraft, which are difficult to justify given their limited protection against space debris. As such, this recommendation should be further studied to discover its cost-efficiency.

In the regional context, ASEAN countries could begin researching and developing spacecraft protection strategies, especially in tertiary institutions. However, they may not reap economies of scale due to the relatively small space sectors. Hence, ASEAN countries should continue and intensify collaboration with other space-faring nations to enhance spacecraft protection, lowering long term maintenance and repair costs.

[10] ALIBERTI, M. (2013, February). Regionalisation of Space Activities in Asia? [PDF]. Austria: European Space Policy Institute, ESPI.

Conclusion

Billions of people on Earth rely on satellite data daily. However, the dense network of space debris creates a hazardous environment, threatening current and future missions. Like climate change, space debris has since evolved into a problem that warrants international cooperation and intervention.

While each ASEAN country has different priorities and interests in space technology development, the gaps in space capabilities among ASEAN nations signify plenty of room for more collaboration within the bloc. Overall, the benefits of cooperation range from increasing economies of scale to reducing destructive competition. Coordinating space knowledge will pave the way for more efficient research and technological breakthroughs.

If all goes to plan, ASEAN should see an increase in space launches soon. It would be good foresight to have space debris mitigation policies as guidelines or laws. In the long term, ASEAN will be one step closer to achieving its Sustainable Development Goals, boosting its position as a more qualified regional association.[11]

[11] Rafikasari, A., Sumarlan, S., & Swastanto, Y. (2020, January). Challenges and Opportunities in Strengthening ASEAN Space Technology Cooperation [PDF]. The Indonesian Journal of Southeast Asian Studies.