

Enhancing the Practice of Non-Functional Space Object Registration Utilizing SSA Data Lessons Learned from the Japanese Practice

Kazushi Kobata^{*}

Abstract

The purpose of my thesis is to evaluate how Japan has been enhancing the practice of non-functional space object registration utilizing the Space Situational Awareness (SSA) data, and to analyse how Japan has tried to align with principles of international space law to harmonize with the practice of other states capable of launching space vehicles. This practice should be significant today, taking into consideration that the attribution of a space object has important legal effect in terms of liability since the demonstration mission of active debris removal (ADR) and on-orbit service (OOS) will occur soon, which may have a negative impact to space objects which could be under jurisdiction and/or control of other nations. My thesis also covers the possible solution for the current challenges mentioned above. The practice of providing expanded registration information is encouraged in the Guideline A.5 of LTS guidelines, but the scope of “expanded registration information” is not clear yet. Like-minded states should start to develop the best practice compendium of “expanded registration” of non-functional space objects in collaboration with UNOOSA.

1. Introduction

For the safe, stable and sustainable use of outer space by all sectors including private ones, it is so important for each state to create the effective and internationally harmonized national mechanism for tracking and monitoring the space object and its registration in the national registry, in view of enabling the authorization and continuing supervision. Especially, states capable of launching space vehicle should be required responsible behaviour,

^{*} Japan Aerospace Exploration Agency (JAXA), Japan.

since their practice could form the de-facto international standards of cutting-edge space operations and utilization.

On the other hand, a part of these countries, such as Russia and China, do not have the practice of, for example, registering the “launch vehicle and parts thereof” which launches the space object, although this element is clearly included in the definition of the term “space object” in the Registration Convention. It would apparently cause the challenges to secure the safe, stable and sustainable use and realize transparency and confidence building measures (TCBM) in outer space.

The purpose of my thesis is to evaluate how Japan has been enhancing the practice of non-functional space object registration utilizing the SSA data, and to analyse how Japan has tried to align with principles of international space law to harmonize with the practice of other states capable of launching space vehicle. This indicates that identification of the upper stage and component parts of launch vehicles, including those of satellite for national security, by using SSA data such as Space-Track data has been working effectively, which has assisted their registration in the national registry. This practice should be significant today, taking into consideration that the attribution of space object has important legal effect in terms of liability since the demonstration mission of active debris removal (ADR) and on-orbit service (OOS) will occur soon, which may have negative impact to space object which could be under jurisdiction and/or control of other nations.

2. Is “Non-Functional Space Object” Subject to the Registration?

This section deals with the past arguments on whether “Non-Functional Space Object”, which includes space debris, should be subject to the registration in accordance with Registration Convention.

As Nakamura outlined,¹ some articles show cautious views on whether space debris should be subject to the registration, since space debris has many forms from a satellite that remains in operation to small fragments created by explosion or collision, while many articles support the view that space debris falls with the definition of a space object.

For example, B. Schmidt-Tedd et al.² states that the term “space object” includes its components parts, so that many common forms of space debris are included, therefore space debris fulfils the criteria of classification as a space object. Schmidt-Tedd et al. further notes that, however, the fact that the term “space object” includes component parts as well as the launch vehicle and parts thereof leaves a certain flexibility in either registering the

1 Kimitake Nakamura, Norm Formation in Space Law, Shinzansha Publisher Co.,Ltd. 2023, pp. 120-121.

2 S. Hobe, B. Schmidt-Tedd, and K.-U. Schrogl (eds.), Cologne Commentary on Space Law, Vol. 1, Carl Heymanns Verlag, 2009, pp. 512-517.

main object with reference to its fragmentation through a later notification or registering each fragmentation separately.

Therefore, there are not common theories nor unified practices whether at least later on-orbit fragmentation of a space object should be subject to the registration or not. This tendency is also shown in Guidelines for the Long-term Sustainability of Outer Space Activities (“LTS Guidelines”). Guideline A.5, paragraph 7 of LTS Guidelines just requires States and international intergovernmental organizations to “consider, acquire and develop shared positions with respect to providing information on any changes in space objects’ status of operations and in the orbital positions of space objects” and does not require the registration.³

By contrast, in the case of launch vehicle and parts thereof, there are practices among some states capable of launching space vehicle, such as United States, France, ESA, India, Japan and New Zealand, to register it after the launch. In 2022, there are totally 49 registration information of launch vehicle and parts thereof furnished to United Nations in accordance with Registration Convention: 19 objects in US, 17 objects in New Zealand, 7 objects in France, 5 objects in Japan, and 1 object in ESA.⁴

Japan has not registered information of launch vehicle and parts thereof until November 2018, but since Japan registered the past launched 76 rocket stages and their debris which were on orbit in November 2018, Japan has registered them in every launch.⁵

3. The Change of Japanese Standards on the Registration of Non-Functional Space Object

This section outlines the historical change of Japanese standards on the registration of non-functional objects.

3.1. A Memorandum for the National Implementation of Registration Convention

When Registration Convention was ratified in Japan in 1983, the official interpretations were prepared for the diet approval. Then it was summarized that the subject of registration should be limited to “satellite”, and not be expanded to other space objects by the following reasons:

- (1) Soviet and other states do not furnish registration information of space objects other than satellite, such as launch vehicle and thereof, to United Nations but there were not any claims by State Parties.

3 A/AC.105/2018/CRP.20.

4 UNOOSA HP, <https://www.unoosa.org/oosa/en/spaceobjectregister/submissions/years/2022.html>.

5 ST/SG/SER.E/869, UNOOSA HP, <https://www.unoosa.org/oosa/en/spaceobjectregister/submissions/japan.html>.

- (2) If any problems happen by such space objects, it is feasible to provide United Nations with additional information, in accordance with Article 4.2 of Registration Convention.
- (3) Japan does not have capacity to track space objects which does not emit radio waves, so cannot figure out their orbital element.

Based on such views, a memorandum for the national implementation of Registration Convention was agreed among Japanese ministries, as of March 23, 1983. This memorandum set forth that relevant ministry should write down launched “satellite” information in the national registry, and Ministry of Foreign Affairs should provide “satellite” information with Secretary-General of the United Nations.⁶

There were some arguments in the government whether to expand the registered information to launch vehicle and thereof, in the process of discussion of Space Activity Act in Japan, but this memorandum had been effective until the entry into force of Space Activity Act as of November 15, 2018.

3.2. Accident of ASTRO-H

In March 2016, JAXA’s X-ray Astronomy Satellite ASTRO-H “HITOMI” was found to be attitude anomaly and estimated to be broken up on orbit. JSpOC released the trajectory of the 11 objects on April 1, and it was confirmed that they were on almost the same trajectory as ASTRO-H, which showed that those objects are from ASTRO-H satellite.⁷

Following the accident, there were domestic discussions how Japan can take a responsible behavior to international community in light of international law. In terms of Registration Convention, it was attempted to provide United Nations with additional information concerning ASTRO-H in accordance with Article 4.2 of Registration Convention, but Japan has not yet completed the registration process of ASTRO-H in the national registry at that time because its launch was just one month before. Therefore, Japan was obliged to provide United Nations with both registration and anomaly information in one notification, as a result of coordination with Office of Outer Space Affairs (OOSA) in 2017.⁸ That means Japan did not find the path to register each fragmentation separately nor to provide timely additional information under Registration Convention. Instead, Japan made best efforts to provide the latest status of the accident to international fora, such as COPUOS, COSPAR and IADC, in accordance with Article 11 of Outer Space Treaty.

6 Space Law Data Book, Third Edition, Japan Aerospace Exploration Agency (JAXA).

7 Hitomi Experience Report - Handout for the Specialists advisory panel meeting called by MEXT, 8 June 2016, pp. 21-24.

8 ST/SG/SER.E/812.

This case would have been the first time Japan has faced with the critical difficulty of effective implementation of Registration Convention, and these lessons learned were to be fully considered in the process of formulation of the manual of space object registration in Japan in November 2018.

3.3. Political Movement Motivated by Commercial ADR/OOS Service Provider

In May 2018, Japanese ruling party established a working team for the legislation of space debris. This movement was motivated by lobbying activities by the Japanese leading company with the vision for the safe and sustainable development of space activities by ADR and OOS missions.

The business model this company conceived was not only End-of-Life (EOL) services targeted for private satellite operators but also ADR services targeted for the existing on-orbit large-scale debris, mainly originated from the government mission. In the latter case, one of the technically desirable candidates of targeted debris was the existing on-orbit 2nd or 3rd rocket stages. However, it was apparent that the removal of these objects may have many risks in the case it was not clear what states have their jurisdiction and/or control, which has important legal effect in terms of Liability Convention.

Taking this situation into consideration, an opinion was raised in the working team that the existing on-orbit rocket stages should be subject to registration in Japan.

At the time, the government had already plan that newly injected rocket stages after the launch of the entry into forth of Space Activity Act should be included to the subject of registration in addition to “satellite”. However, the policy was slightly changed that the existing on-orbit rocket stages was also added to the subject, affected by the opinion in the working team.

In reaction to this political movement, JAXA, Ministry of Education, Culture, Sports, Science and Technology (MEXT) and other stakeholders made many consultations, and the past launched 76 rocket stages and their debris were registered in the national registry in November 2018, by making use of the Space Situational Awareness (SSA) data effectively.

3.4. Development of the Manual of Space Object Registration

Almost at the same time as the above registration, the Cabinet Office published the manual of space object registration, developed in relation with the entry into forth of Space Activity Act as of November 15, 2018, which overrode a memorandum for the national implementation of Registration Convention.

It clearly specifies the subject of registration and submission deadline.⁹

The subject of registration is as follows:

- (a) satellite (including rover, planetary probe and transfer vehicle to ISS, etc.) as well as separated objects from satellite
- (b) objects injected on-orbit derived from launch vehicle for satellite (including rocket stages as well as satellite mount structure, etc.)

The change of owner or operators of space objects, termination of transmission and re-entry is also subject to the submission of space object registration.

In addition, the deadline of the submission of space object registration is determined as within 30 days from the date of occurrence of the above event. Since the development of this manual, totally 11 objects were registered in the category (b).

4. Benefit of Utilizing the SSA Data for the Registration of Non-Functional Space Objects

This section shows how SSA data, such as Space-Track data, is benefitable for the registration of non-functional space object.

United States Space Command (USSPACECOM) provides space surveillance data to registered users through the public website, known as “Space-Track”, www.space-track.org. The 18th Space Defense Squadron (18 SDS) routinely updates the website with positional data on more than 16,000 satellites in orbit around the Earth. Registered users can get Satellite Catalog (SATCAT) information, satellite decay and reentry predictions and so on from this website for free.¹⁰

SATCAT information provides satellite catalogue with its name, COSPAR international designator, type (payload or debris), attributed country, launch date, decayed date (if applicable), basic orbital parameters and so on. This list is periodically updated as more analyst objects that meet well-tracked criteria are identified.

This catalogue is beneficial, because almost all information required for space object registration is covered for space objects irrespectively functional or non-functional, and it is publicly released for all registered users. Especially, it provides important information source for non-functional space objects because they do not emit radio waves and their telemetry information is sometimes difficult to be received by their operators themselves.

⁹ Cabinet Office HP, https://www8.cao.go.jp/space/application/space_activity/documents/manual-spaceobjt.pdf.

¹⁰ <https://www.space-track.org/documentation#faq>.

For instance, launch providers may verify this website comparing with the telemetry information which it receives, and may check how many debris are generated by the launch, its COSPAR international designator, its latest basic orbital parameters and so on.

Japanese manual of space object registration recommends referring to this website, especially for the check of COSPAR international designator in the case of new submission of space objects registration.

In the Japanese experience, this website was also informative to register the past launched rocket stages and their debris in 2018. Especially, the launch provider does not usually publish information of the basic orbital parameters of satellite separation in the case of geostationary orbit satellite, so its information was truly essential for space object registration.

5. Analysis

Based on these facts and findings, this section evaluates the lessons learned gained from the transformation of Japanese standards on the registration of non-functional space object, which was enabled by utilizing the advantage of SSA data.

5.1. Increasing Advantages of Defining Jurisdiction and/or Control over Non-Functional Space Objects

Formerly, it was conceived that the registration of non-functional space objects does not create any legal advantages but just duties because the registration means the declaration of jurisdiction and/or control and to bring responsibilities to nations as launching states under Liability Convention.

However, appearances of commercial ADR/OOS service provider in Japan led to transform the above traditional position into the original concept of Registration Convention which aims to “assist in the identification of space objects” (Preamble of Registration Convention), including launch vehicles and parts thereof.

In the case of Japan, this transformation was mainly derived from commercial motivation, but theoretically it may be also derived from the context of national security. For example, a country which has intention of making ASAT tests on orbit may seek the similar approach. In addition, a country which aims to plot non-functional space objects in geo-stationary orbit not to lose its own orbital position may also seek the similar approach in the context of national interests.

Considering the recent crowded and congested environment of outer space, the clarification of jurisdiction and/or control of space objects may also provide “means of self-defence” in the case any loss or damage to space objects would happen on orbit, because a country may insist that the space objects under its jurisdiction and/or control did not involve such loss or damage and that it bears no responsibility if they are registered.

5.2. SSA Information as a Key Tool for Strengthening the Registration Convention

In the deliberation process of the Ad hoc Committee (“AHC”) on the Prevention of an Arms Race in Outer Space (“PAROS”) under Conference on Disarmament (“CD”) established from 1985 to 1994, the representative of Canada proposed in his statement that the Registration Convention should go beyond the requirement of disclosing the general function of space objects and provide more detailed and timely information for arms control purposes.¹¹ This proposal was supported by many delegations, but delegations cannot reach a consensus in AHC.

Japanese actions raised in Section 3.3 and 3.4 were, in a certain level, realization of the Canadian proposal to strengthen the Registration Convention in terms of the following points:

- (i) **Comprehensiveness:** Almost all space objects covered in Space-Track, except for fragmentations derived from ASTRO-H etc., were registered and identified as Japanese space objects in alliance with international space law.
- (ii) **Timeliness:** In the manual of space object registration, the deadline of the submission of space object registration is determined as within 30 days from the date of occurrence of the event.

The realization of the above (i) and (ii) was enabled by Space-Track information with its advantages of openness, wider coverage, frequent updates, and detail contents.

6. The Way forward

Taking this analysis into consideration, the Japanese practice deserves reference in launching states, especially for the countries which do not have the practice of registering the launch vehicle and parts thereof, such as Russia, China and Republic of Korea. It would be noteworthy if Japan shares the lessons learned from its practice widely to COPUOS member States as “best practice”.

The main remained issues are how States deal with later on-orbit fragmentation of a space object. As section 2 shows, there are not common theories nor unified practices for their registration and LTS Guidelines does not obligate anything – just describes that the provision of “expanded registration information” is encouraged in the Guideline A.5. However, the

11 Kazushi Kobata, *Evolving Norms on Pre-Launch Notifications of Space Launch Vehicles and Space Object Registration: A Historical Perspective in the Context of UNISPACE+50 Thematic Priority Three*, Proceedings of the International Institute of Space Law, 2018.

scope of “expanded registration information” is not discussed so remained unclear yet.

To find the practical solutions, it would be meaningful to collect national implementation to register, for example, later on-orbit separation from the main satellite. By accumulating such implementations, like-minded states are encouraged to start to develop the best practice compendium of “expanded registration” of non-functional space objects in collaboration with UNOOSA. This kind of efforts would be the first step to discuss future rulemaking of the registration of non-functional space objects.