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Political, Legal, Institutional and Economic Aspects of Space Debris Mitigation and Removal - STM Security (8-E9.1)

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SPACE SUSTAINABILITY: A CLASSIFICATION SYSTEM FOR THE INCENTIVISATION OF SUSTAINABLE SATELLITE DEVELOPMENT AND SPACE OPERATIONS

Abstract

Purpose: Launching technologies to space creates various risks and hazards that are difficult to identify and quantify. However, these can compound to significant environmental footprint or potentially result in impact events that may spiral into Kessler's syndrome and thus could cause massive damage. The lack of affordable satellite and mission-driven technology that is designed under a sustainable framework and has the capacity to remove its components entirely from the geostationary environment has made the classification of space sustainability an imperative. Driving innovative sustainable design solutions in commercial services and future space missions to the Moon, Mars and beyond entails the creation of technical requirements, and regulatory frameworks for space sustainability, as well as financial incentives as a protective environmental mechanism.

Methodology: In this paper, we propose to design a classification tool for space sustainability along with an incentive structure mechanism to promote sustainable practices in satellite development, deployment, and decommissioning. The classification tool is used to identify the life cycle sustainability assessment (LCSA), and potential risks of space operations, satellite activities and its components. To drive good sustainable practices, incentives to encourage good behaviour should be implemented. By evaluating an array of space operations, their environmental footprint, the expected life span of satellites, sustainable ratings for materials and services, on-orbit-servicing, deorbiting/end-of-life strategies, and other parameters, we standardised a tool with a minimum criteria to achieve sustainable operations. More importantly, we argue that governments, space agencies and other regulatory bodies and organisations should implement an incentive policy framework that complements the sustainability metrics.

To demonstrate the tool's utility, as a proof of concept, we identify the core risk components for the International Space Station and the proposed sustainability requirements for the Lunar Gateway mission. In addition, we explore the classification for deploying satellite communications and imaging equipment (such as the PHL-Microsat-1) and propose policy recommendations for public-private satellite synergies.

Results and Conclusions: A classification tool for space sustainability will identify which activities are sustainable and under which circumstances multi-stakeholder platforms and interagency missions can

design their de-risking space activities with minimal space footprint. Overall, the tool is designed to enable an international dialogue on space sustainability requirements, risks and classifications in order to diminish deleterious space activities, and increase accountability and inclusivity of space actors. Moreover, the proposed classification system constitutes a guide for both private and public satellite developers to consider the sustainability of creating, launching, and decommissioning satellites.