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ORBITAL DEBRIS: FROM VICIOUS CIRCLES TO CIRCULAR ECONOMY THROUGH  
COMPLIANCE AND FINANCIAL SUSTAINABILITY

**Abstract**

The purpose of this presentation is to present a set of solutions aiming to break the vicious circle caused by space debris, which pose a serious threat to the orbital environment due to the exponentially growing amount of clutter. The proposed solutions come at a time - 1) when there is a significant concern over environmental issues, both on Earth (e.g., climate change) and in space (e.g., overcrowded orbits), and the focus is on sustainability (e.g., UN 2030 Agenda on sustainable goals); - 2) when authorities think of a variety of ex ante incentivizing and compliance measures to help shape behavior and norms that meet sustainability (e.g., European Green Deal); and - 3) when ex post sanctions are predictable, fair, proportional and deterring. The contribution of this presentation is to bring together all of the above-mentioned elements and create a holistic framework destined to mitigate space debris. For instance, sustainable finance instruments can be structured as incentivizing measures to encourage greener space architecture (e.g., reusable technology, modularity, resilient-based design, etc.) and circular economy business models. To be efficient and successful, such incentive instruments must be based on a widely-accepted taxonomy, with clear cut metrics and key performance indicators, in all transparency. The incentive measures can be operationalized through a series of instruments, at different levels, such as the levels of regulation, procurement, contracts, financing, and insurance. An introductory example of taxonomy can be derived from - 1) the IADC; - 2) the MIT's Space Sustainability Rating (SSR) Index; and - 3) from the higher ethical principles of space law (HEPOSLs), namely equality of access to space, freedom of use and exploration, non-interference and due regard. These broad principles, enacted through treaty law (Outer Space Treaty of 1967) are binding as customary international law, but their broad range is difficult to implement constraints. Therefore, they could be further developed and activated in a space-debris mitigation context and figure at the top of the taxonomy list. From this ethical perspective, more concrete measures can follow through multiple additional layers evolving around compliance and incentivizing measures. The transparency and resulting predictability through time of this taxonomy would have the high potential of encouraging sustainable and/or circular economy business models since standardization would bring confidence among industrial stakeholders. Furthermore, the taxonomy would have to be standardized in order to reflect a certain amount of harmonization and coherence throughout the instruments it appears on. It could be drafted at the national level as a start, and tested with new projects in the space sector which could have a significant incidence on space debris (e.g., mega-constellations). For example, a use case can be explored with e-space's new plans of a 300 000+ sats mega-constellation project, to be built in France. However, to mitigate the risk of forum shopping (e.g., driving the companies away), a certain balance of incentives and international harmonization must be achieved. This presentation explores these instruments and proposes practical examples to better illustrate the proposed framework.