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Assuring a Safe, Secure, and Sustainable Space Environment for Space Activities (4)

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RESILIENT AND SUSTAINABLE SPACE ACTIVITY

Abstract

This paper suggests activities to extend, amplify, and execute recommends of the UNCOPUOUS study of the Long Term Sustainability of Space Activity recently concluded. The first tsk is to make more concrete what capabilities and enterprises should be sustained and what environments foster economic and societal progress. The scientific method of defining an initial state, predicting its evolution under different assumptions, and recommending actions based on sound analysis with quantified uncertainty must be applied. The LTSSA has spurred the current thrust for resiliency in the space enterprise. Resiliency has been defined and pursued in many venues, particularly ecology and psychology. In all of these resilience is the ability of a self-organizing system to recover sufficient functionality after disruption. It is not invulnerability. It is not retaining complete, undisturbed functionality. Nonetheless, policy makers are enamored of massive redundancy, expensive backups, and complete resistance to disruption. We will review terrestrial resiliency concepts and suggest how these my be applied in space. There are levels of disruption from which systems cannot recover. Queen Elizabeth's deforestation of northern England to build ships for engagement with Spanish Armadas is a good example. Timberline is now far lower than was sustained for millennia. There are thresholds from which sufficient capability can be recovered, but such systems experience hysteresis. System resources must be restored above the levels that were disruptive. We will give examples in ecology and extrapolate them to space activity. We have concrete analysis of these principles with regard to space debris. There will always be space debris just as there will always be diseases that compromise humankind. But there are sustainable populations despite these disruptions. We will show absolutely analogous phenomena for space debris. There will always be debris, but there are launch rates, orbit architectures, and spacecraft characteristics that lead to a sustainable and productive cohort while experiencing inevitable collisions and disruptions. It is impossible to eliminate debris, and it is infeasible to allow as many satellites or whatever type as any party would wish. We use these concepts to suggest measures for sustainability such as international consideration of launch rate constraints. In principle, this is comparable to allocating spectrum or rights to many natural resources.