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SPACE PRODUCT DEVELOPMENT PROCESS: INTEGRATING A SUSTAINABILITY
PERSPECTIVE IN DESIGN AND PRODUCTION OF SPACECRAFT**Abstract**

Technological advancements and the growing demand for global connectivity is leading to an explosive growth of satellites being launched into space. Additionally, the lower cost to launch satellites into orbit makes it possible for new players to participate and to gain access to space. Decreasing launch prices and the miniaturization of payloads enables satellites being build faster and overall cheaper. In addition, instead of large satellites being launched into higher orbits, a trend towards satellite mega constellations in low-earth orbit can be observed. With this increase of new satellites already being launched and planned to be launched soon on one side, and defunct or decommissioned satellites and other space debris from collisions on the other side, concern related orbital capacity limits is being raised. Space sustainability gets more global attention and related research projects are conducted with a variety of stakeholders. This attention is needed and important but as the re-use and the recycling of satellite materials are not yet commercially viable or available, space sustainability primarely focuses on a more environmental perspective, with areas like space situational awareness and space transportation management.

This paper investigates another option: the integration of a sustainability perspective during product design and in the production process as an alternative to the environmental perspective after launching satellites into orbit. The aim is to understand whether implementing design for sustainability and a sustainability perspective for an optimized production can support long-term space sustainability and with this, has measurable impact on the value chain for spacecraft. The research examines state-of-the-art of product design and development processes and how the space industry design and product processes are set up in comparison. Further investigation about life cycle costs variations related to a sustainability perspective, calculation approaches, and how space industry operates compared to other industries. The research will attempt to provide a top-level model for product developers with recommended procedures, activities, and the life cycle costs with options to integrate a sustainability perspective during the product design and development processes. In addition, drivers for product and production innovation through the sustainability perspective are suggested.