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MESSA: A METHODOLOGY FOR EVALUATING THE SUSTAINABILITY OF SPACE APPLICATIONS

Abstract

Sustainability, which is the pursuit of advancements without compromising future generations' development, has become a consistent fixture in all major industries in recent years, including the space sector. To assess space missions, the concepts of footprint and handprint have been defined to quantify the negative and positive impacts respectively. There are two main gaps in the industry. Firstly, there is currently a lack of methodologies evaluating the downstream segment of space missions. The downstream segment comprises space-derived applications or platforms. Secondly, current methodologies have an emphasis on negative environmental impacts, such as the life cycle assessment (LCA), and only recently have some footprint analysis methodologies been developed to include the social and economic aspects, such as the socio-economic assessment and the life cycle cost assessment.

To assess the aforementioned gaps, we developed a methodology in collaboration with the European Space Agency (ESA) and Airbus Defence and Space (AD). Our methodology quantifies the handprints of the downstream segment of space missions and analyzes them according to the three pillars of sustainability: environmental, social, and economic. Although a footprint is predominantly categorized from the environmental perspective, our methodology expands the handprints to also encompass the other two dimensions. Both quantitative and qualitative results are obtained, as not everything can be assessed quantitatively. This is especially true in the case of societal handprints, which are harder to measure, such as happiness.

Our methodology takes into account an existing methodology developed by ESA, which addresses the emitted and avoided greenhouse gas (GHG) emissions of space missions. Key performance indicators (KPIs) are determined according to the evaluated application to assess the impacts on defined frameworks like the Sustainable Development Goals (SDGs) or the European Green Deal. These are achieved by obtaining midpoint indicators that can be equated to KPI units by using an equivalence system, i.e. methane to carbon dioxide equivalent (CO2e). The quantitative results compare trade-offs between different indicators graphically, through methods such as bar charts or heatmaps. The limits and risks associated to these conversions and to the assumptions made are specified. Finally, to evaluate the applicability of our methodology, a practical case study on a space mission's application was performed. Overall, our methodology can be of major help to the space industry to prioritize missions and understand the outcome of the applications they develop.