The Strathclyde Space Systems Database (SSSD)

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Abstract. An increasing number of space industry stakeholders are expressing an interest in quantifying the environmental footprint and sustainability of their space activities. However, the lack of publically available tools has limited the ability of the space sector to achieve this. To address this issue, the world's first space-specific process Life Cycle Sustainability Assessment (LCSA) database and Life Cycle Engineering (LCE) tool has been developed at the University of Strathclyde. Named the Strathclyde Space Systems Database (SSSD), the purpose of this tool is to provide the space industry sector with a robust, fully functioning and validated means to determine the life cycle sustainability impacts of a variety of space systems. This paper will present the capabilities of the SSSD and compare it against existing space LCA tools. It will also present the findings of a survey which was distributed to SSSD end-users to gauge the overall opinion and satisfaction of the tool. Overall, the paper highlights the prudent and unique capabilities of the SSSD, with the survey findings providing evidence on the satisfaction of its end-users, particularly concerning usability.

Keywords: First Keyword, Second Keyword, Third Keyword.

1 Introduction

The Strathclyde Space Systems Database (SSSD) is a new process-based tool developed at the University of Strathclyde to determine the life cycle sustainability impacts of space systems. Validated at ESA through a collaborative project in late 2018, the SSSD has already been used by multiple stakeholders in the design of several space system concepts. The database of more than 250 unique foreground space-specific life cycle sustainability datasets, which each contain environmental, costing and social data (based on Ecoinvent and ELCD background inventories). The SSSD also includes several impact categories at midpoint-level. This is a problem-oriented approach that quantifies and translates the life cycle impacts into themes such as climate change, ozone depletion, acidification, human toxicity, social performance, costs, etc. Additionally, the SSSD aligns closely with a variety of widely accepted international standards and norms, which are used as a coordinated, overarching framework [1]. The purpose of the tool is to identify sustainability hotspots quantitatively and scientifically as part of the space mission design process, and use this information to lower adverse environmental, social and economic life cycle impacts. This is achieved through a process-based methodology which relies on physical activity data to develop a product tree derived from assessing all the known inputs of a particular process and calculating the direct impacts associated with the outputs of that process. In addition to this, the inclusion of multi-criteria decision analysis (MCDA) within the framework allows criticality of each sustainability dimension to be determined. The approach is therefore capable of generating a single relative score which simplifies the decision-making process, thereby reducing the learning curve for other engineers. This is particularly useful when integrating the SSSD into the concurrent engineering process [2].

2 Methodology& Findings

Firstly, the content and methodology of the SSSD will be described to give visibility to its capabilities, providing an overview ofdatabase logistics. It will describe the process by which the SSSD implements the new space LCSA framework conceived in [3], based on the development of new environmental life cycle datasets and impact assessment methods which integrates social and economic criteria. Secondly, a comparative review of current space LCA databases will be made to gauge the advantages and disadvantages of the SSSD. This was outlined using a SWOT analysis can be used to highlight its strengths, weaknesses, opportunities and threats. Lastly, a questionnaire was sent to SSSD end-users to gauge theirimpressionsof the tool. In addition to confirming the overall positive experience of end-users, the results also sought to collect information on end-user requirements and missing datasets/functionalities. This information will be used to upgrade the SSSD in future releases.

3 Conclusion

The intended goal of the SSSD is not to compete with or duplicate similar tools such as those developed by the European Space Agency (ESA). Instead, it aims to advance the space LCA methodology towards more comprehensive space LCSA applications. As a secondary objective, it also seeks to bridge the gap between the lack of process-based life cycle databases for space systems and the public dissemination of ESA space LCA tools to Member States. To achieve this, the SSSD has been made publically available upon request to all stakeholders (with a valid Ecoinvent license) regardless of location.

References

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