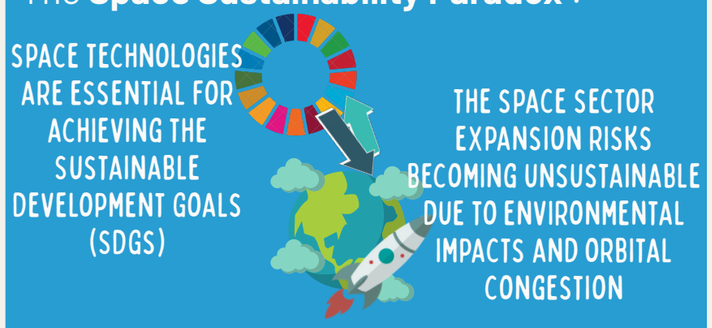
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LIFE CYCLE COSTING & LIFE CYCLE ASSESSMENT FOR SPACE SYSTEMS

*Integrating **Design-to-Cost** & **Ecodesign** for more sustainable space missions*

Background

The **Space Sustainability Paradox**[1]:



The space sector must follow sustainable development principles, balancing three key dimensions:

- economic → Life Cycle Costing (LCC)
- environmental → Life Cycle Assessment (LCA)
- social → Social LCA (S-LCA) [2].

Currently, sustainability is perceived as a financial burden in space missions.

Objective

WHAT?

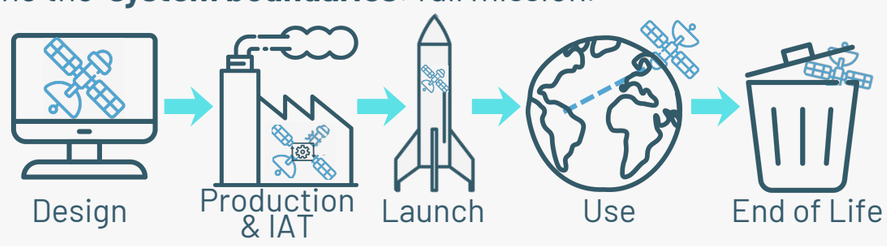
To develop a novel tool combining ***cost & environmental impact*** estimations supporting evidence-based decision-making for preliminary space mission design.

Method

HOW?

*Integrate Cost Estimating Relationships (**CERs**) into a space-specific simplified LCA database[3]:*

1. Define the **system boundaries**: full mission.



2. Develop a **parametric cost model** for each process:

Secondary sources: CERs in literature

Primary sources:
- **collect costs** (down to equipment) from space industry → create a cost database
- develop the mathematical relations: e.g.

$$y = a * x^{b}$$

(y: cost; x: space mission parameter (mass, power,...))

3. **Integrate** in the same tool (Excel) the CERs (consistency checks: currency, economic condition) and the environmental impacts models from the space-specific simplified LCA database[3].

4. **Test & validate** the models (e.g. case studies from universities projects).

5. Develop the user interface allowing the use of the tool during space missions **concurrent design studies.**

Research Impact

WHY?

- To integrate both cost & environmental impacts as **criteria** during space mission design.
- To support space industry navigate environmental-cost trade-offs:

DESIGN-TO-COST IMPACTS: HOW DOES THIS COST REDUCTION STRATEGY INFLUENCE THE ENVIRONMENTAL IMPACT OF THE SPACE MISSION?

ECODESIGN IMPACTS: WILL ADOPTING THIS ECODESIGN TECHNOLOGY INCREASE THE COST OF THE SPACE MISSION?

TO SHIFT THE NARRATIVE OF SUSTAINABLE SPACE MISSIONS FROM A COST BURDEN TO A VALUE DRIVER

References

[1] A. Wilson, M. Vasile, 2021, *Space Sustainability for the Next Century*
[2] Purvis, B. et al, 2019, *Three pillars of sustainability*
[3] A. Wilson, 2019, *Advanced Methods of Life Cycle Assessment for Space* Systems

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