

AEROSPACE ENGINEERING

MUR DM 117/CIRA - Study and analysis of sustainable space transportation systems

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Context of the research activity	<p>The research topic deals with the study of potential new architectures aimed at the development of partially or completely reusable space transport systems, taking into account the reuse of both the stages and the payload to increase the competitiveness and the sustainability of future space transportation systems.</p> <p>Progetto finanziato nell'ambito del PNRR – DM 117/2023 - CUP E14D23001970004</p>
Objectives	<p>The flourishing of alternatives to access to and re-entry from space together with the reduction of development, manufacturing and maintenance costs of the assets undoubtedly constitute the key element for accessing the infinite potential offered by the boom of the New Space Economy, which faces a growth forecast of the global market by 2040 of 1 trillion dollars (source Morgan Stanley) with an ever-greater increase in the annual frequency of launches. In this context, the development of reusable transport systems seems to be the only way to guarantee both sustainability and competitiveness.</p> <p>The research topic deals with the study of potential new architectures aimed at the development of partially or completely reusable space transport systems, taking into account the reuse of both the stages and the payload. The definition of these innovative architectures will be based on mission analysis and system design through multi-disciplinary digital methodologies and tools for conceptual and preliminary design, which allow to perform trade-off analyses between alternative configurations. The selected solutions will then be optimized using multi-objective techniques.</p> <p>The critical technologies and subsystems will be identified to proceed with the preliminary design and the development of technological roadmaps. The identification of these critical technologies will also be guided by</p>

competitiveness and sustainability criteria, for example: i) totally reusable ceramic materials based on low-cost production processes for thermal protection systems; ii) green propulsion based on methane and liquid oxygen; iii) topologically optimized metal structures obtainable by additive layer manufacturing, etc. The system design activity will be complemented by the scenario and market analysis aimed at supporting the architectural and technological choices.

The proposed theme therefore fits perfectly within the PNRR Mission 4C2 "From Research to Business", Investment 3.3, responding to the needs of CIRA in the field of designing innovative and sustainable space transport systems. Furthermore, the proposed theme is in line both with Mission 1 of the PNRR "Digitalisation, Innovation and Competitiveness in the Production System", contributing to the increase of competitiveness in a strategic sector, and indirectly with Mission 2 "Green Revolution and Ecological Transition", due to the drastic reduction in the number of launchers to be produced and the adoption of so-called "green" propulsion based on Oxygen-Methane.

Skills and competencies for the development of the activity

Reusable and expendable space transportation systems. Conceptual and preliminary design methodologies. Environmental sustainability.