Cost estimation methodology and tool for future Reusable Access To Space Systems

Roberta Fusaro [a*], Nicole Viola [b], Davide Ferretto [c], Valeria Vercella [d]

[a] *Department of Mechanical and Aerospace Engineering, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Turin, Italy,* roberta.fusaro@polito.it
[b] *Department of Mechanical and Aerospace Engineering, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Turin, Italy,* nicole.viola@polito.it
[c] *Department of Mechanical and Aerospace Engineering, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Turin, Italy,* davide.ferretto@polito.it
[d] *Department of Mechanical and Aerospace Engineering, Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Turin, Italy,* valeria.vercella@polito.it
* Corresponding Author

Abstract

This paper aims at presenting the latest upgrades to HyCost Methodology and Tool, developed by Politecnico di Torino under funding and supervision of the European Space Agency (ESA), to support Life Cycle Cost (LCC) estimation of reusable access to space vehicles. The main idea is to support engineers in cost estimation activities during conceptual and preliminary design phases, allowing for the evaluation of Research, Development, Test and Evaluation (RDTE) Costs, Production Costs, as well as Direct and Indirect Operating Costs (DOC and IOC), for a wide set of high-speed aerospace systems. Politecnico di Torino has already disclosed a LCC methodology and tool specifically tailored to air-breathing high-speed transportation systems. Complementary, this paper discloses the methodology upgrades to extend the methodology and tool capabilities to future Reusable Access to Space Vehicles. At first, the applicability of already existing parametric cost estimation relationships (CERs) to the peculiarities of Reusable Access to Space Vehicles is assessed and then, when necessary, new parametric equations are defined. Specifically, the new set of equations is considered fundamental to capture the impact of different vehicle configurations (e.g. staging strategy, staging Mach number, parallel or series configuration, etc…) onto costs, as well as the impact of the most promising propulsive solutions, ranging from scramjet and combined cycle engines to rocket engines. Ultimately, the upgraded methodology is validated against the available SpaceX Starship cost data.

Keywords: Cost Estimation Relationship, Reusable Access to Space Vehicles, Life Cycle Cost,