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REUSABILITY ARCHITECTURES IN A CONSTANT DEMAND ENVIRONMENT

Abstract

Reusing rocket stages or rocket engines is a topic which has fed numerous debates within the space community. This issue seems to have evolved from a purely technical and cost-efficiency analysis to an ideological vision of the future of spaceflight. Several projects and studies have implemented total or partial reusability, but most of those projects assume an increase in launch demand, to match the increased launch rate of a reusable vehicle. Current market analysis and historical trends points on the contrary toward a relatively stable commercial and institutional demand for the foreseeable future. Several reusability architectures are being planned by different actors of the space sector, Space X, Blue Origin, United Launch Alliance and Arianespace. This paper offers to study the potential cost savings of those architectures in today's market conditions, using publicly available data regarding production, operation and planned refurbishment costs, to assess their economic viability. The study assumes that, in a constant demand environment, if production costs start raising because of a needed investment in production capability, there may be a business case in reusing launch systems, if refurbishment costs are low enough. This would avoid a costly investment in new capacities of production, or even lead to the decrease of those capacities. On the other hand, if production capacities are underused, or the investment needed to produce more launchers is lower than refurbishment costs, there is no business case for reusability. Worse, reusing launch systems would increase the cost of the system, since underused production capacities would be even more underused. Moreover, some reusability projects also aim at enabling forward-looking technological tests, such as rocket-powered atmospheric descent and landing, useful in the context of human exploration. Media exposure of such tests reinforces public enthusiasm for those goals, further reinforcing the justification for those technological developments. Under these assumptions, American reusability architecture have a discernable logic, even if their economic return is not guaranteed under current market conditions. European reusability projects currently lack this logic, and would likely increase the launch cost of those systems rather than reducing them if reusability were to be implemented.