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SPACE SYSTEM ARCHITECTING FOR COMMERCIAL SUITABILITY: A CASE STUDY IN
CISLUNAR SPACE TRANSPORTATION**Abstract**

This paper integrates quantitative and qualitative space system analysis techniques and demonstrates their value to government agencies interested in enabling broader participation in the space enterprise. The approach incorporates an assessment of “commercial suitability” into the evaluation of alternative system architectures. The paper leverages a case study to demonstrate that, when commercial suitability is considered during the architecting phase, the need for direct inducement (e.g., through favourable contracts) is minimized, fostering a mutually beneficial relationship between government and commercial players. First, the quantitative analysis method is developed using network-based space logistics optimization framework to perform multi-objective optimization of space exploration architectures against the value metrics (e.g., cost, benefit...) and enumerate the Pareto optimal architecture alternatives. Second, the qualitative method screens the elements of each Pareto optimal architecture, by evaluating their elements against a previously developed “commercial suitability” scorecard. (e.g., space and terrestrial market size, payback period, technical risk). The approach is applied to a case study architecting a cislunar space transportation mission. The results demonstrate the potential value of this approach. The case study illustrates that if government actors seek to broaden participation by non-traditional actors (and commercial entities in particular) explicitly considering their preferences during the upfront architecture selection process can alleviate the need for costly inducements later. The mixed qualitative and quantitative methods leverage the power of optimization without ignoring hard to quantify criteria associated with business decisions. As such, this research provides an important step to establish and pursue system-level space architecting for commercial suitability, without losing site of traditional measures of effectiveness.