

IAF SPACE SYSTEMS SYMPOSIUM (D1)  
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## CO-MANIFESTING PAYLOADS AND THE ADVANTAGES OF INTEGRATED SPACECRAFT

**Abstract**

As we enter the modern era of heavy lift launch vehicles, architects are assessing the benefits of utilizing these greater lift capabilities against the use of small-to-medium commercial launch vehicles. The effect of dividing large payloads into smaller elements that are later integrated on orbit can be significant; the division creates a series of in-space operations that include rendezvous, assembly and checkout. Larger elements, pre-integrated and checked on the ground are typically more reliable because there are fewer interfaces, much easier to deploy, and simpler due to less redundancy across elements. Striking the right balance between cost, complexity, and operational efficiency will be a critical task for architects of deep space missions.

Different approaches of integrated vs. separated payloads are assessed within this paper, with consideration to various figures of merit such as mission assurance and schedule, cost, and reliability risks. We compare different approaches taken by heritage spacecraft programs, such as Apollo, against current and future programs, such as Gateway. Ultimately, this paper presents a crewed Mars transit scenario, with a discussion of the differing integration approaches of spacecraft and payload elements. Here the resulting impacts to the overall mission are identified and explored, and related to a multiyear Crewed Mars campaign occurring in the 2030-40 time frame.