

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)  
Heavy lift launchers capabilities and new missions (8)

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A HEAVY LIFT LAUNCH VEHICLE CAPABILITY PROGRESSION TO ACHIEVE AN  
AFFORDABLE AND SUSTAINABLE PROGRAM FOR BEYOND EARTH DESTINATIONS

**Abstract**

In support of exploration within the next two decades to “extend human and robotic presence throughout the solar system,” the development of a Heavy Lift Launch Vehicle that can provide launch services to multiple customers for multiple reference missions at an economical sustainable posture will ensure its longevity. The HLLV Program can be initiated using existing technology to provide needed ascent heavy lift capability rapidly with minimal development cost. If the development would stop at that point, the goals and objectives of space exploration beyond Earth orbit would not be reached. If the HLLV Program deploys broadly-applied “cutting-edge” technology to develop a heavy lift launch vehicle, achieving first operational flight would not be possible by the end of this decade and reaching beyond Earth destinations by the next decade would have to survive numerous politic changes.

To achieve a balance of: 1) a reliable launch system capability, 2) operational status as soon as possible, and 3) at an economically affordable development and sustainable life cycle cost, the HLLV should be evolvable and configurable to meet new mission objectives. This can be achieved with a “Progressive Architecture” that employs a block-type vehicle evolution with increasing performance capability to satisfy new mission objectives, while the launch vehicle can still be configurable to a lesser performing, and less cost, launcher to fulfill heavy lift missions to low Earth destinations. The strategy for HLLV design and development enables a rapid and cost-effective implementation that provides incremental capability near-term. At specific transition points, new technologies can be applied when mature enough for acceptable risk to increase launcher capabilities and performance. This allows continuous, milestone driven development concurrent with operational capability, thus operations requirements driving development.

This paper will review the affordability and sustainability considerations of: 1) two different programmatic approaches: a direct capability vehicle using the destination-driven model and a progressive capability vehicle evolving to a pre-declared end-state using the capability-driven model, 2) a core stage concept that is standardized and configuration baselined to reduce vehicle manufacturing and production, infrastructure and processing life cycle cost growth, and 3) an evolving vehicle stack that employs an adjustable second or third stage configuration to meet customer mission requirements and objectives, resulting in tailored performance that enables satisfaction of mission goals. The paper will provide the trade space and evidence of the relative benefits, impacts, and drawbacks between early heavy lift launch capability versus final configuration capability.