

SPACE SYSTEMS SYMPOSIUM (D1)
Technologies to Enable Space Systems (3)

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NASA ADVANCED EXPLORATION SYSTEMS: INNOVATIVE, RAPID TECHNOLOGY
DEVELOPMENT FOR HUMAN SPACEFLIGHT

Abstract

NASA's Advanced Exploration Systems (AES) division was established in 2011 and has evolved into a key agency technology and risk reduction provider that delivers considerable flight hardware development and testing (in support of large programs like the International Space Station and Orion/Space Launch System), strategic planning, novel initiatives, and leadership of entire small spaceflight missions. AES represents an innovative approach to developing the enabling technologies and high-priority capabilities that are the building blocks for future space missions.

AES achieves affordable and rapid systems development, provides hands-on workforce experience, and pioneers technology development approaches and collaboration as a core objective and business strategy. This is possible through a vigorous process of building coalitions and synergy among NASA's technical projects, operating centers, and organizational mission directorates (Human Exploration and Operations, Space Technology, and Science). The work of AES to enable new flight and system capabilities for human exploration falls within three closely interdependent pillars: 1) strategic public-private partnerships, 2) lean project management, and 3) innovative methods to achieve technology breakthroughs. The first pillar leverages external technical progress, while the second pillar enables the efficient and cost-effective implementation of dynamic annual portfolio of approximately 30 leading technology and flight projects.

This paper will place particular attention on the third pillar, consisting of mission-critical technology milestones, innovations, and achievements that facilitate flight opportunities while maximizing government resources. This has resulted in a program that adjusts quickly to technical and budgetary challenges, and meets the requirements of cost-effective, rapidly developing missions and technology. AES technical contributions fall within the core focus areas of:

- Deep Space Habitation (integrated life support systems, radiation protection, fire safety, and systems to reduce logistics and the need for resupply missions);
- Vehicle Systems (advanced in-space propulsion, lander technology, modular power systems, and automated propellant loading);
- Foundational Systems (autonomous mission operations, in-situ resource utilization, in-space manufacturing, communication technologies, and synthetic biology applications); and
- Robotic Missions and Payloads (prospecting for lunar resources, Deep Space CubeSat missions, technology demonstrations to characterize Mars, and instrument development, research, and analysis).

We present the framework of models, systems, and projects utilized by AES to transform NASA's human exploration research and development landscape. We outline key results, including milestones

and achievements in AES capability areas, products from partnerships with the commercial sector, and models or standards to be leveraged or replicated in support of the next era of human space exploration.