Aviation Week

University of Maryland Program Management Symposium

Challenges in Human Spaceflight
An Industry Perspective

LOCKHEED MARTIN

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Discussion Topics

- General attributes of human spaceflight programs
- Orion today
- Space Shuttle comparison
- International Space Station comparison
- Management challenges and new tactics / best practices

Human Spaceflight Program Attributes

- Very long-term horizon
  - Space Shuttle flew for 30 years
  - ISS is 32 years since program initiation
  - Deep Space Exploration requires multiple multi-year missions
- Missions conducted in harsh, unforgiving environments
- Frequent and significant technology advances are required for success
- Political sustainability is often as challenging as the other programmatic challenges
  - Long programs tend to never be funded adequately upfront
  - Administration can change every four years; House changes every two years; one-third of Senate changes every two years
  - Congress only appropriates funds one year at a time

Space Shuttle Reflections

- Space Shuttles flew 135 missions over 30 years
- Both the tragic accidents had major impacts on the program
- NASA used the Space Shuttle to broaden international participation
- Significant technology advances were required for Shuttle
  - Ceramic tiles for the heatshield were a major challenge
  - Reusable solid rocket booster and main engines drove design and refurbishment challenges
  - Reusability presented challenges
  - Long-term sustainability of the supply chain drove cost issues

ISS Reflections

- Currently 32 years from 1984 authority to proceed date
- Described as requiring no new technologies like the Space Shuttle however scaling of systems was an issue
- ISS was international from the beginning, requiring new management, design, test and operations processes.
- Design and development of ISS was largely bilateral; while operations are by design multilateral
- Sharing resources among the partners is critical to the operation of the facility
- Successfully demonstrated that major components could be manufactured across the globe and successfully assembled in space

Orion Today

- Orion is a NASA competitively selected program
- Contract was initiated in 2006
- Obama administration proposed cancellation in 2010
- Congress reinstated the program in late 2010
- First abort flight test completed May 6, 2010
- Exploration Flight Test-1 completed December 5, 2014
- Next mission is planned for 2018, with crew in 2021
  - Exploration Mission (EM-1) in 2018 will be the first flight of the Space Launch System (SLS) and the first flight of the European Space Agency (ESA) provided Orion Service Module
- Orion is already international – NASA/ESA and LM/Airbus

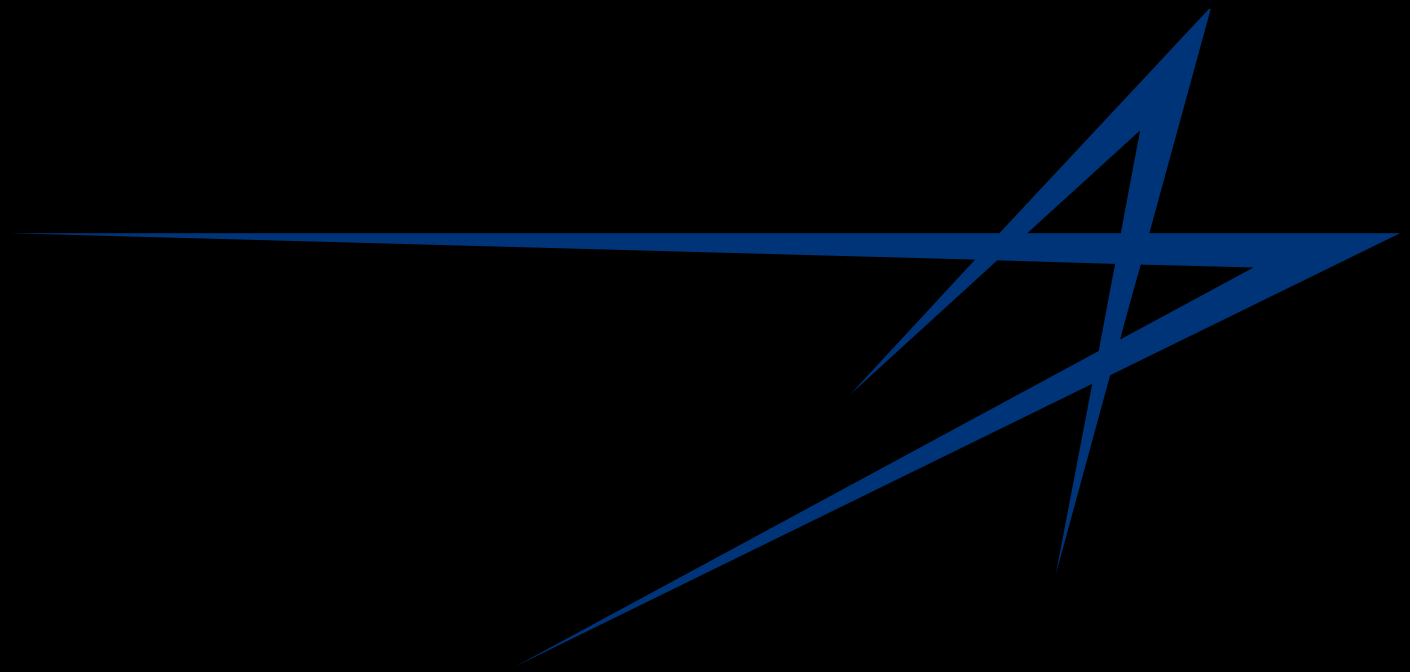
Management keys and issues

- Relationships and communications are critical
- Affordability has driven many aspects of Orion
  - Distributed teams
  - Spacecraft factory in Florida
  - Very flat integration structure
  - Close relationship with NASA
- Very aggressive schedule assumptions to deal with flat budget profiles.
- Integrated supply chain activities

Conclusions

- NASA's human spaceflight programs share a number of attributes
- Lessons learned from the past program regularly influence Orion today
- We are constantly driving new work processes for affordability
- Political engineering can be a difficult as technical engineering
- We are on the step of a vast new exploration program.

Questions?



www.nasa.gov/orion

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