Exploration:
The International Space Station (ISS) - Today’s Outpost

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Main topics

- Design for human assembly
- Development challenge
- Assembly lessons
- ISS Operations
- Programmatic
- Integrating the International Team
Design for human assembly

Early in the ISS (Freedom) development we made assumptions of huge amounts of human assembly.

The final vehicle as built has simplified SOME of them.

Even though we simplified many designs, we still require fluid, power and data connections to be made EVA.

We need to change configurations via EVA (remove keel fittings from launch).

Robotic operations offload some EVA but are time intensive in themselves.

Maintenance concept was a “remove and replace” with repair on the Earth.
Development Challenges

- The lunar outpost shares many of the ISS challenges.
- How much of an integrated design is required prior to separating individual elements. (standards, interfaces)
- The interface elements of ISS (connectors, latches, bolts, etc.) were all challenging development projects with significant cost overruns.
- ISS has already demonstrated over 5 years of many components.
- Some system components are exceeding lifetime predictions, some are not.
Learn where to optimize the human intervention. EVA has large overhead.

Are automated capture devices the best value?

What is the dust impact to making connections in the lunar environment?

Can we make use of tolerances to aid us.

Can we leverage ISS robotic experience as well as Mars robotic experience for tasks without crew intervention?

Will wireless technologies aid us?
ISS Operations

- The ISS is critically dependent on the ground mission control team for failure resolution, although most response times are not immediate.
- It has taken many years to learn how to simplify our operations to take advantage of that response time.
- The lunar environment demands a much greater evolution.
Programmatic

- Constellation is already demonstrating the ability to leverage expertise across NASA centers.
- ISS is now moving into full International Partner operations.
  - U.S., Russia and Canada have been very active.
  - The ESA Columbus Lab flies in December
  - The JAXA Kibo Lab flies early next year.
- While our relationships will certainly be different - we have a solid foundation of collaborative design, development, test and operations to support the Lunar outpost.
In Closing...

- ISS serves as a foundation for many of the tasks ahead.
- Much learned from what worked
- Rework needed in things that didn’t
- Much still to learn and do - looking forward to exploration.