

A full moon is visible in the upper left quadrant of a dark, starry sky. Below the moon, a bright, shimmering reflection of the moon's light extends down the center of the frame, appearing to be on a body of water. The overall scene is a serene, nocturnal celestial view.

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

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A full moon is visible in the upper left quadrant of the image, set against a dark, starry sky. Below the moon, a body of water reflects the moon's light, creating a shimmering path that leads towards the bottom center of the frame. The overall scene is serene and evokes a sense of space and exploration.

Main topics

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

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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.

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Assembly

- ☞ 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?

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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.

The background of the slide features a full moon in a dark, starry sky. The moon is positioned in the upper left quadrant. Below the moon, a body of water reflects the moon's light, creating a shimmering path that leads towards the bottom center of the frame. The overall scene is serene and evokes a sense of space exploration.

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.

A full moon is visible in the upper left quadrant of the image, set against a dark, starry night sky. Below the moon, a body of water reflects the moon's light, creating a shimmering path that leads towards the bottom center of the frame. The overall scene is serene and evocative of space exploration.

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.