Space Exploration Logistics Workshop

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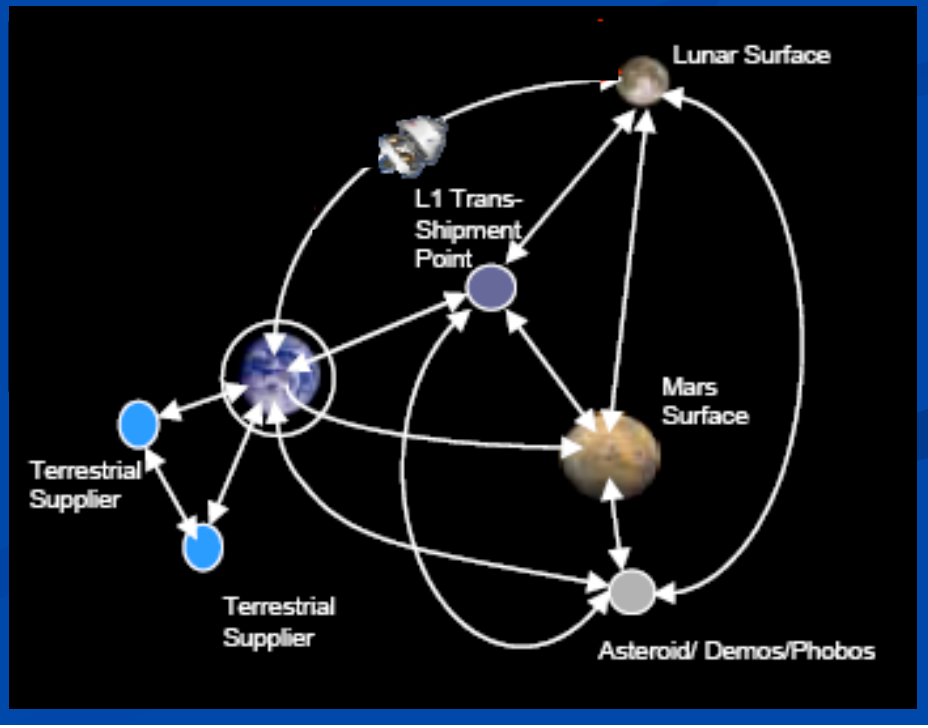
Omni Shoreham Hotel, Washington, DC

Group J

Space Depot Maintenance



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Session Overview

- Space Depot Maintenance Scope
  - Discussion expanded to include all space maintenance beyond Remove-and-Replace
- Goals
  - Identify and define the impact of space intermediate and depot-level maintenance issues on the three different exploration mission types
- Organization
  - Identify the important issues (starter list + attendee participation)
  - Pick the "top 3" issues/topics relevant to each exploration mission type
  - Discuss potential impacts, mitigations and opportunities, early tests/demonstrations, and interfaces to other systems

Discussion Points

- Identification of appropriate tasks and locations for in-space intermediate and depot-level maintenance
- Level-of-repair analysis
  - Analysis techniques for ORLA
  - Data sources
  - ISS experience
- Robotic versus human repair agents
  - Safety and risk issues
- Design for maintainability/serviceability
- Infrastructure and technology requirements for intermediate and depot-level maintenance
- ROI for in-space intermediate and depot-level maintenance

Issues –

Common to all Missions

1. *Issue:* Maintenance Policy is integrated into the Design Process
   Predicted Impact: A). Reduces logistics footprint, which reduces TOC, but costs are greater upfront
   B). Optimizes supportability and maintainability
   Potential Mitigation:
   Impact on Other Systems: Requires discipline in requirements articulation and acquisition processes
   Possible Solution(s):

2. *Issue:* The Need for Highly Common Spares
   Predicted Impact: Configuration management is critical
   Potential Mitigation: Common interface with equivalent or upgrade functionality
   Impact on Other Systems: A). Reduces overall cost requirements which allows for higher probability of funding
   B). Increase of box level cost
   C). Design to a common tool set
   Possible Solution(s): Reprogramming FPGAs for multiple functions

Issues –
Common to all Missions

3. *Issue:* Determination and Requirements for Levels of Repair
   Predicted Impact: Requires assessment of supporting infrastructure
   Potential Mitigation:
   Impact on Other Systems: Human factors (training, culture change, on-flight maintainers, environmental adjustments)
   Possible Solution(s): Small(?) carry-along manufacturing and repair facility

4. *Issue:* Reuse of "Un-needed" Modules
   Predicted Impact: Increased value for cannibalization; fuel storage/backup
   Potential Mitigation:
   Impact on Other Systems:
   Possible Solution(s): A). Dedicated lunar to CEV ascent capsules
   B). Land vs. crash allows for raw materials use for parts and storage

Issues –
Not Fully Developed

What are the requirements for a carry-on/depot facility?

- *How do you provision the raw materials?*
- *Is the technology fully mature?*
- *What are the needed capabilities?*
- *What are the size constraints?*

What can be done at a Space Depot?

- Logistics Activities:
  - Wire repair
  - Fire recovery/restoration
  - Circuit card replacement
  - Cannibalization
  - Seal Repair
  - Plumbing and hydraulic
  - Programming of FPGAs
  - Technology insertion and upgrades
  - Modification applications
  - Reconditioning (filters, batteries)
  - Calibration
  - Recertification/inspections e.g. NDI
  - Nuclear Refueling
  - Intervention Servicing
  - Refueling
  - Structural Repair (welding, sheet metal, polymer bonding)
  - Warehousing and distribution of spares, consumables

What can be done at a Space Depot?

- Non-Logistics Activities:
  - Pre-cursor development for future human missions
  - Research
  - Communications