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:**
   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