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UTILIZATION
DIVISION

# Space Station Freedom
# Baseline Operations Concept

**Presentation to the Evolution Symposium**
**6-8 August 1991**

**Granville Paules**
**Space Station Freedom Program**
**Operations Integration Branch**
**NASA Headquarters**

# Potential Applications of Computerized Adaptive Testing

David J. Weiss
Research Report 77-1
June 1977

Computerized Adaptive Testing Laboratory
Department of Psychology
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# FUNDAMENTAL MANNED BASE OPERATIONS REQUIREMENTS

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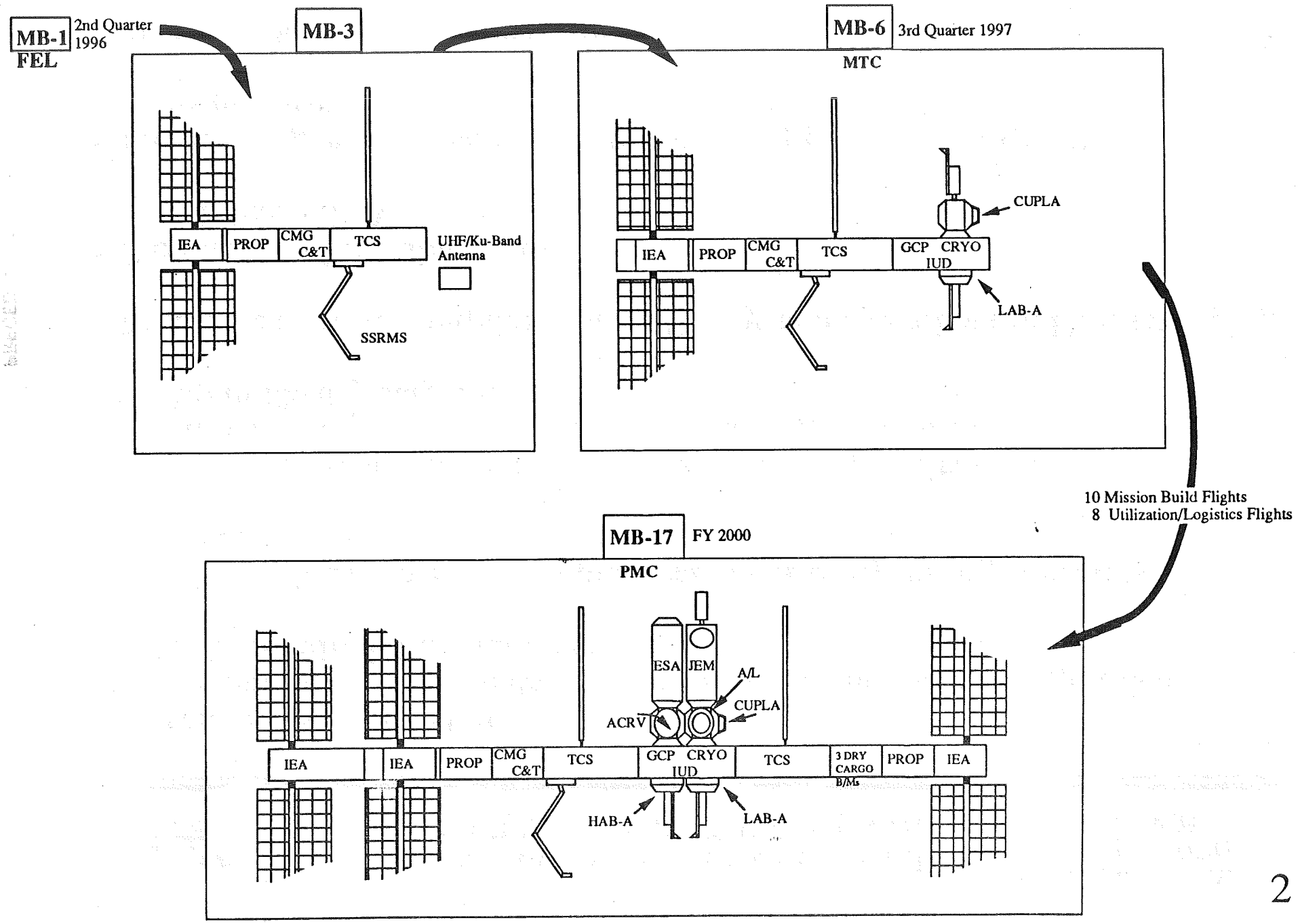
- Assemble using the Shuttle
  - Assemble in components with each stage left in a safe configuration
  - EVA required (but minimized)
- Conduct Utilization at earliest practical opportunity during Assembly
  - Operate and utilize man-tended for several visits
- Permanently man when Assured Crew Return Capability exists
  - Initially four crew, growing to eight as program allows
  - Up to 180 day stay times
- Minimize crew time required for routine system operations and housekeeping
- Provide on-orbit maintenance
  - minimize EVA
- Provide long term logistics and utilization support with four Shuttle visits per year
- Plan for a 30 year operational-life

# Representative Assembly Configurations



# OPERATIONS CONCEPT DEVELOPMENT



- Space Station Operations Task Force established in Fall 1986
  - -- Objective: Develop an operations framework for the international Space Station that provides:
    - Safe and user friendly operations
    - Supports participation of all partners
    - Addresses long-term operations cost issues
    - Allows for evolution
  - -- Expertise from manned and unmanned programs
  - -- Recommendations to Associate Administrator for Space Station in Summer 1987
  - -- Basic concept accepted for implementation
- Concept negotiated into Memoranda of Understanding with partners
- Documented Program requirements on flight hardware and software to meet concept
- Ground Systems Program Directive put ground infrastructure in place in May 1989

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# MANNED BASE OPERATIONS INFRASTRUCTURE

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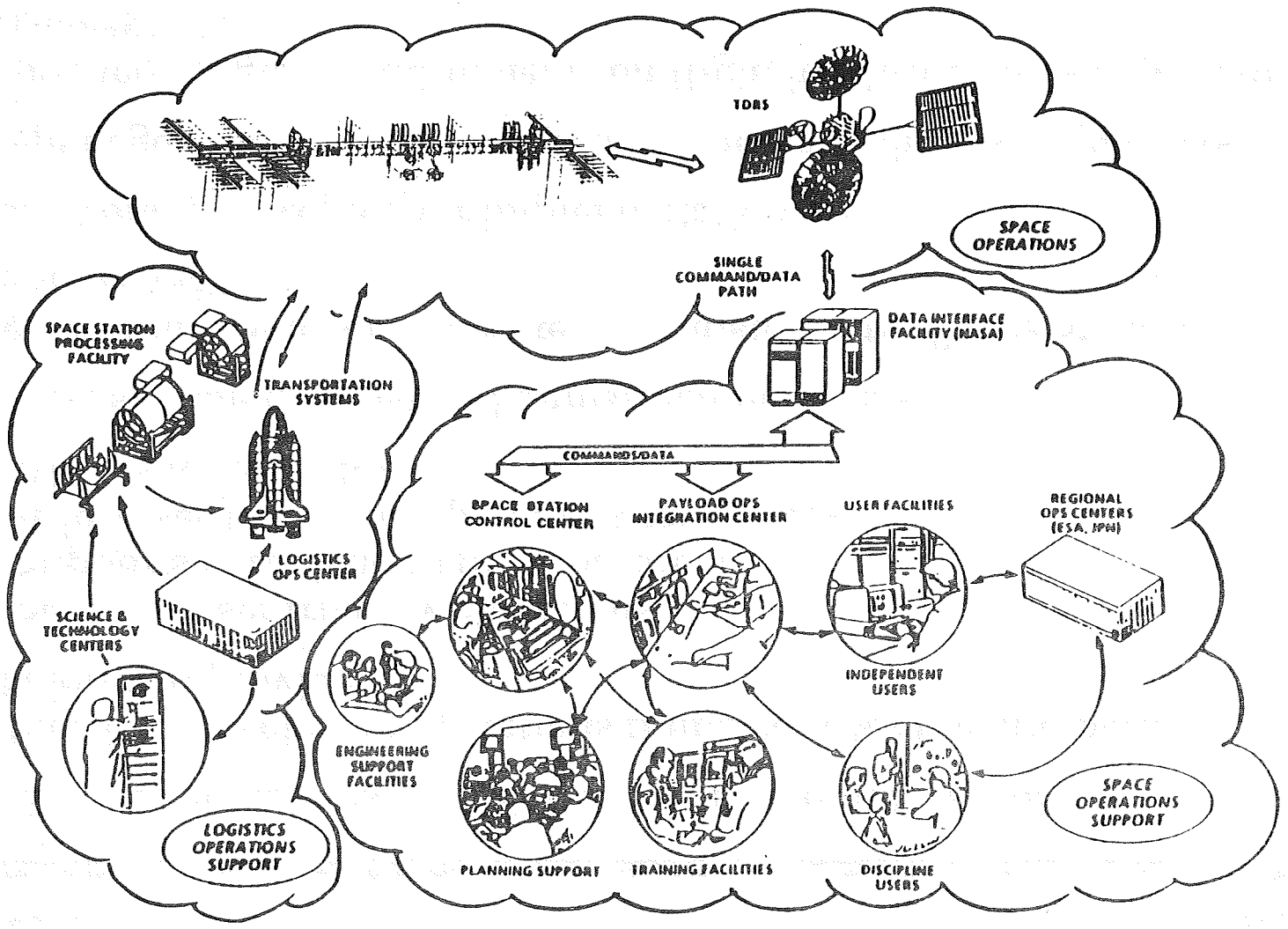


- All partners provide flight hardware and supporting ground elements
  - -- Exchange of partner element user space for U.S. provided resources such as power
- All partners participate in management of station
  - -- Manned base operated as an integrated unit
  - -- Free-flying elements operated more autonomously
- All partners provide crew
- All partners share operating costs

# OPERATIONS MANAGEMENT

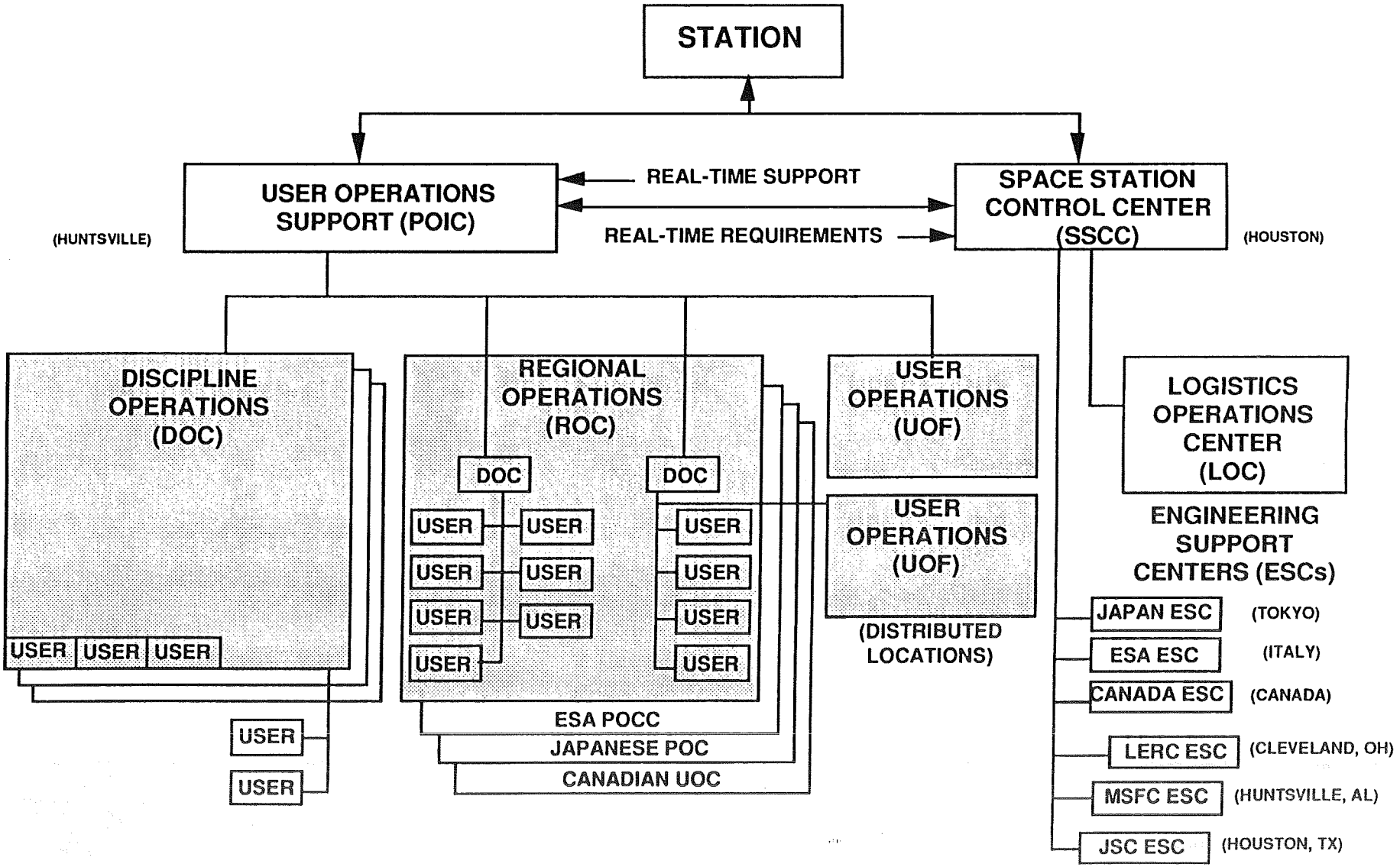


- Space Station Freedom is managed and operated as an integrated on-orbit facility
  - -- Focused systems operations
  - -- Focused integration of user operations
  - -- Crew members work as team with assignments throughout Station

- Management and implementation is hierarchical
  - -- Strategic (Policy) planning with 5-year horizon
    - Long term planning issues
  - -- Tactical (Integration) planning with 2-year horizon
    - Coordination across functions and operations centers
  - -- Execution planning and implementation
    - Detailed plans, real-time operations execution

# SPACE STATION OPERATIONS EXECUTION





## Space Operations

- All activities conducted on-board the Space Station Freedom manned base
  - Systems reconfiguration, monitoring, and control
  - Payload operations, monitoring, and control
  - On-board planning and replanning
  - Systems and payload maintenance and repair
  - Proximity operations
  - Communication with systems and payload controllers and users
  - Habitation activities

# Space Operations Support

- Systems planning, monitoring, and control by the Space Station Control Center (SSCC) at JSC
  - SSCC has prime responsibility for safety of the crew and integrity of the manned base
  - Supported by Engineering Support Centers (ESC) at all development sites
  - Systems training to be accomplished primarily at the Space Station Training Facility (SSTF) at JSC
    -- Additional training available at the international partner's training centers
  - Systems and payload activities integrated into common timelines

## Space Operations Support (cont.)

- User operations planning, monitoring, and control integrated at the Payload Operations Integration Center (POIC) at MSFC
  - Support to users located at user-developed operations centers, Discipline Operations Centers (DOC), Regional Operations Centers (ROC), and User Operations Facilities (UOF)

    -- Flexible architecture to expand with the needs of the user community
  - User operations planning is distributed, then integrated by POIC
  - User decision-making body is the Investigator Working Group (IWG)
  - Support to user commanding is transparent to the user

    -- Enable telescience while ensuring all commands are safe
  - Payload Training Center (PTC) at MSFC provides integrated payload training capability

## Logistics/Ground Operations Support

- Prime center of responsibility is KSC
  - Common logistics support for all programs at KSC being considered
- Space Station Processing Facility (SSPF) provides for physical integration:
  - Payloads-to-racks
  - Racks-to Logistics Modules
  - Logistics Modules and other flight hardware into Shuttle cargo elements
  - Logistics Module Maintenance
- Preflight integration of payload racks enabled at Payload Integration Center, domestic or international
- Logistics Support Analyses during DDT&E is basis for logistics requirements for spares, reliability, and maintenance
- Initial logistics operations support by the developer
  - KSC integrates resupply and sparing requirements
  - Logistics Operations Center at KSC after PMC
- Initial logistics information available via:
  - Distributed logistics databases at developer
  - Integrated Logistics Information Systems after PMC
- Logistics Module load planning using optimizing techniques

# Current Approach & Future Opportunities

| Management & Integration | Current Approach | Expert Systems/ Analytical Tools | Advance Information Systems |
|---|---|---|---|
| Program Management - Decision Support Systems | | | |
| Manifest Planning Systems | | | |
| Analytical Integration Support Tools (Systems & Payloads) | | | |
| Increment Plans Management - Decision Support Systems | | | |

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# Current Approach & Future Opportunities

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| Space Operations | Current Approach | Expert Systems/ Analytical Tools | Telescience/ Teleoperations | Advance Info. & Communications Systems | Robotics |
|---|---|---|---|---|---|
| Space Systems Operations<br>- Systems Reconfiguration & Load Management<br>- Contingency Management<br>- Equipment Operation | | | | | |
| Payload Operations<br>- Experiment Execution<br>- Resource Allocation<br>- Conflict Resolution | | | | | |
| Maintenance Operations (EVA / IVA)<br>- Diagnostic and Maintenance Procedures<br>- Repair/Replace/Reverification | | | | | |
| Crew Health Care & Medical Operations | | | | | |
| Crew Workload Scheduling | | | | | |

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# Current Approach & Future Opportunities

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| Space Operations Support | Current Approach | Expert Systems/ Analytical Tools | Telescience/ Teleoperations | Advance Info. & Comm. Systems | Robotics |
|---|---|---|---|---|---|
| Integrated Schedule Development<br>- Systems/Payloads/Resources | | | | | |
| Systems Performance Assessment & Diagnostic Support<br>- Sustaining Engineering | | | | | |
| Flight Software & Hardware Configuration Management | | | | | |
| Communication Systems Management<br>- Resource Allocation<br>- Scheduling | | | | | |
| Flight Techniques Development<br>- Training Techniques<br>- Training Equipment & Systems | | | | | |
| Trajectory Control | | | | | |
| Station/Shuttle Operations<br>- Proximity Operations Management<br>- Joint Activity Management | | | | | |

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# Current Approach & Future Opportunities

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| Logistics/Ground Operations Support | Current Approach | Expert Systems/ Analytical Tools | Advance Information & Communications Systems | Robotics |
|---|---|---|---|---|
| Transportation Services | | | | |
| Cargo Element Ground Processing<br>- Procedures<br>- Equipment | | | | |
| Payload Physical Integration | | | | |
| Prelaunch Acceptance Testing | | | | |
| Logistics Module Processing<br>- Load Planning/Module Reconfiguration<br>- Module Cleaning | | | | |
| Integrated Spares Inventory<br>- Stock Management | | | | |
| Ground Maintenance of Spares | | | | |

# SUMMARY



- The Baseline Operations Concept is designed to support the multiflight-multistage Assembly Sequence and the Post-PMC era
- Initial implementation of procedures and systems to support the concept are consistent with Shuttle and Spacelab experience
- Many opportunities exist to enhance the approaches initially being implemented
- Further insight during the Program's development phase and during early operations will help select and focus potential evolutionary paths