

***IVHM Does All Preflight, Visible Check Only Required
(Sensor/BIT Technology Incorporation)***

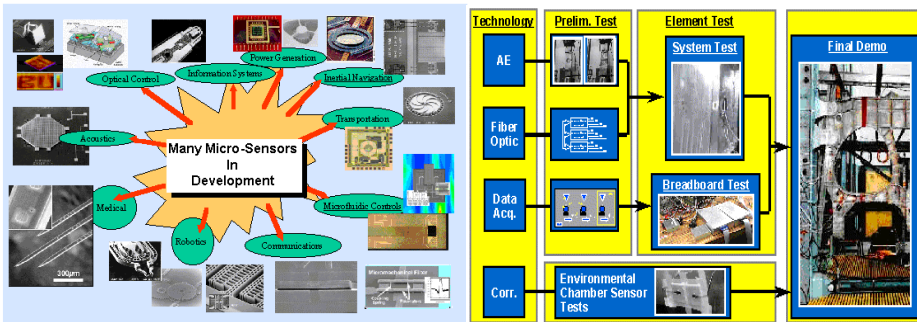
***Space Propulsion Technology
Assessment Workshop***

April 2001

IVHM Does All Preflight – Visible Check Only Required

Technology Required

- Integrated Sensors & Built-In-Test Required on Most Systems (TRL 3/4)
- Cost/Time To Mature Technology
 - Propulsion Subsystem: \$20M/3 Years



Safety & Reliability Preliminary Assessment

- Safety will Improve Based on Automated Informed Health Prompting/Reporting
- Mission & Basic Reliability - Could be Degraded Based on Poor Reliability of BIT and Sensor Technology
- Possible Increase in “Could Not Duplicate & Re-Test OK” Maintenance Actions Due to Faulty BIT & Sensors
- Selected Redundancy & Graceful Degradation for Sensors/ BIT are Recommended

Maintainability Preliminary Assessment

- Reduced RLV Turnaround Time Based on Less Time Required To Perform Manual Functional Checkout of Systems
- Reduced Maintenance Manhours Required Resulting in Fewer Maintenance Personnel Required to Launch
- Fewer Skill Levels Required
- Maintenance Concept -
 - Organizational Level - BIT & Sensor Repair in Place or R&R
 - Shop Level – BIT Repair on RLV Repairable Units. Sensors Discarded Locally
 - Depot Level – BIT Repaired at Contractor facility. Sensors Discarded Locally

Support System Preliminary Impact

- Support Equipment – Less Support Equipment Required to Perform System Checkout Due to Automated BIT & Sensors
- PHS&T – Less SE, Less PHS&T Cost
- Fewer Maintenance Manuals Required Due to Automated BIT/Sensor Health Check During Pre-Flight
- Less Training Required Due to Pre-Flight Automation
- Facilities - No impact.
- Provisioning – Possible Increase Due to Unreliable BIT & Sensors
- Software Supportability – Increased Software

Cost & Time to Mature IVHM Sensor/BIT Technology

**Cost to Mature
(\$M)**

5 M	
10M	
15M	
20M	
25M	
30M	
35M	

**Time to Mature
(Years)**

1	
2	
3	
4	
5	
6	
7	



***Provide Totally Integrated/Automated Functional Health
Verification for All Systems
(MBR/Intelligent Architecture Technology)***

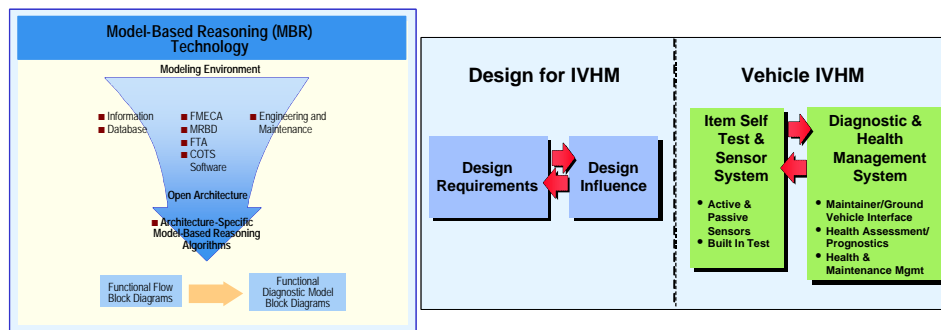
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Provide Totally Integrated/Automated Functional Health Verification for All Systems

Technology Required

- Modeled Based Reasoning (Storage/ICMs/Fuzzy/Logic/Neural Networks/Probabilistic Reasoning) & Intelligent Architecture Technologies (TRL 3/4)
- IVHM Development Process
- Cost/Time To Mature MBR Technology
 - Propulsion Subsystem: 20M/3 Years



Safety & Reliability Preliminary Assessment

- Safety will Improve Based on Enhanced Fault Isolation and Intelligent Management Control
- Mission & Basic Reliability - Will Improve Due to Better Fault Isolation and Intelligent Management Control
- Decrease in “Could Not Duplicate & Re-Test OK” Maintenance Actions Due to Enhanced Fault Isolation Capability
- Operational Software Reliability Should Not Be a Problem After Undergoing Comprehensive V&V Testing. However, Software R&D Presents a Challenge for IVHM

Maintainability Preliminary Assessment

- Reduced RLV Turnaround Time Based on Less Time Required To Perform Troubleshooting and Fault Isolation (Lower MTTR)
- Reduced Maintenance Manhours Required Due to Fewer CNDs/RTOKs and Lower MTTRs
- Maintenance Concept -
 - Organizational Level - Re-Load MBR Software/Ops Check/Fault Isolation & Checkout
 - Shop Level - Validate MBR Software in Laboratory
 - Depot Level - Modify/Update MBR Software by Contractor

Support System Preliminary Impact

- Support Equipment – Less Support Equipment Required to Perform System Checkout Due to Enhanced Troubleshooting and Fault Isolation Capability
- PHS&T – Less SE, Less PHS&T Cost
- Fewer Maintenance Procedures Required Due to Automated MBR Health Verification
- Less Training Required Due to Enhanced T/S & FI Capability
- Facilities - No impact.
- Provisioning – Decreased Spares Due to Enhanced T/S & FI Capability
- Software Supportability – Increased Software to Support For MBR Approach

Cost & Time to Mature IVHM Automated Health Verification

**Cost to Mature
(\$M)**

5 M	
10M	
15M	
20M	
25M	
30M	
35M	

**Time to Mature
(Years)**

1	
2	
3	
4	
5	
6	
7	

