Section 6

Technology Validation and Infusion Status
### Technology Validation Scorecard

<table>
<thead>
<tr>
<th>Technology</th>
<th>Tech Val completed?</th>
<th>Science Val Completed?</th>
<th>Primary Partner</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALI – MS/Pan</td>
<td>Yes – 6/01</td>
<td>Completed</td>
<td>Raytheon</td>
<td>Better than spec SNR’s</td>
</tr>
<tr>
<td>ALI – WFOV</td>
<td>Yes – 6/01</td>
<td>Completed</td>
<td>MIT/LL</td>
<td>Validated pushbroom technology</td>
</tr>
<tr>
<td>ALI – SiC optics</td>
<td>Yes – 8/01</td>
<td>Completed</td>
<td>SSG</td>
<td>Parallel lab mirror finish program successful</td>
</tr>
<tr>
<td>Hyperion</td>
<td>Yes – 6/01</td>
<td>Completed</td>
<td>TRW</td>
<td>First hyperspectral benchmark</td>
</tr>
<tr>
<td>LEISA Atm Corrector (WIS)</td>
<td>Yes – 6/01</td>
<td>Completed</td>
<td>Rockwell</td>
<td>Minor problems but validated WIS concept</td>
</tr>
<tr>
<td>WARP</td>
<td>Yes – 2/01</td>
<td>N/A</td>
<td>GSFC/NG</td>
<td>Over 6000 cycles, 3x original rqt</td>
</tr>
<tr>
<td>LFSA</td>
<td>Yes – 7/01</td>
<td>N/A</td>
<td>Lockheed Martin – Phillips Lab</td>
<td>Problem with CIS/harness interconnects</td>
</tr>
<tr>
<td>EFF – GSFC</td>
<td>Yes – 7/01</td>
<td>N/A</td>
<td>GSFC/al solutions</td>
<td>Fully successful</td>
</tr>
<tr>
<td>EFF - JPL</td>
<td>Yes – 8/01</td>
<td>N/A</td>
<td>JPL/al solutions</td>
<td>Successful</td>
</tr>
<tr>
<td>LAIL Thermal Coating</td>
<td>Yes – 6/01</td>
<td>N/A</td>
<td></td>
<td>Validated</td>
</tr>
<tr>
<td>PPT</td>
<td>Mostly – 1/02</td>
<td>N/A</td>
<td>GRC-Primex</td>
<td>Excellent performance</td>
</tr>
<tr>
<td>CCR</td>
<td>Yes – 6/01</td>
<td>N/A</td>
<td>BF-Goodrich</td>
<td>Excellent conductivity</td>
</tr>
<tr>
<td>XPAA</td>
<td>Yes – 7/01</td>
<td>N/A</td>
<td>Boeing</td>
<td>Exceeds Requirements</td>
</tr>
</tbody>
</table>
Technology Transfer Approach

- Technology Transfer Forums
  - Proceedings on CD-ROM provided including Tech Validation Reports

- Eo-1 Website, EO-1 Library, Publications, Reports, Conferences and Journal Articles
  - Most available on EO-1 Website/Library or via Technology Point of Contacts.

- Proactive technology and knowledge transfer into relevant missions – i.e., Landsat Data Continuity Mission

- Scientific and Application based use of Imagery
  - Science Validation Team
  - Broader User Community via USGS
Technology Transfer Forums

- **Multiple EO-1 Technology Transfer Forums held over last 18 months**
  - LDCM Workshop, USGS in Reston, VA -- January 2001
  - EO-1 ALI Technology Workshop, MIT/LL -- October 16-17, 2001
  - EO-1 ALI / Hyperion Data Users Workshop -- November 28-29, 2001
  - EO-1 Science Validation Team Results, IGARS Toronto -- June 25, 2002

- **The purpose of these Forums are to facilitate the transfer of EO-1 technologies into new applications and efficiently infuse them into future missions**

- **EO-1 developed as pathfinder for future Landsat missions, these technology forums are tightly coordinated with the LDCM Formulation Efforts and formulation activities**
**EO-1 Technology Documentation**

**EO-1 Papers Generated or to expected be generated (estimated as of 5/31/02):**

<table>
<thead>
<tr>
<th>Team/Technology</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science Validation Team</td>
<td>~100</td>
</tr>
<tr>
<td>Hyperion (TRW)</td>
<td>34</td>
</tr>
<tr>
<td>ALI (MIT/LL)</td>
<td>37</td>
</tr>
<tr>
<td>LEISA AC (GSFC)</td>
<td>5</td>
</tr>
<tr>
<td><strong>Technologies:</strong></td>
<td></td>
</tr>
<tr>
<td>- PPT</td>
<td>5</td>
</tr>
<tr>
<td>- EFF</td>
<td>12</td>
</tr>
<tr>
<td>- CCR</td>
<td>5</td>
</tr>
<tr>
<td>- XPAA</td>
<td>4</td>
</tr>
<tr>
<td>- WARP</td>
<td>3</td>
</tr>
<tr>
<td>- S/C Bus</td>
<td>10</td>
</tr>
<tr>
<td>- LFSA</td>
<td>3</td>
</tr>
<tr>
<td><strong>Others</strong></td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>233</td>
</tr>
</tbody>
</table>
ALI Publications:

Landsat Mission Background

- Landsat program has continually acquired synoptic images of the Earth’s land surfaces for almost 30 years.
  - At least one Landsat satellite has been acquiring data since the 1972 launch of Landsat 1
  - Landsats 5 & 7 are extending a 30 year record of the land surface

- Landsat has evolved to a global survey mission
  - Affording synoptic coverage of the Earth’s land mass on a seasonal basis
  - Providing multispectral digital image data with a moderate spatial resolution (~ 30 meters) for:
    - Assessment of land cover and land use change over time
    - Characterization of land ecosystem processes
    - Management of land resources
  - Serving Government (Federal, state, local, and foreign) as the largest customer, directly or indirectly, of Landsat data
In an effort to move towards a private sector supplier of Landsat-like data, LDCM has been framed around a data specification with data delivery starting March 2006.

- Gov’t specifies spectral, spatial and radiometric qualities of data.
- Maximizing Industry’s flexibility in systems for data acquisition
- Defining the data as the principal deliverable,
- Desiring to share cost, risk, and rewards, and
- Making available relevant new technologies, such as EO-1 sensor(s), to data providers.

Step 1 is Formulation (Phase A/B) with multiple contractors.
- Step 1 RFP released November, Awarded late March 2002
- DigitalGlobe and Resource21 selected as Formulation Phase Contractors.
  - Trade studies results by Aug 02’
  - System PDR in Nov 02’

Step 2 is Implementation with a single contractor (Phase C/D/E).
- Step 2 RFP release expected circa December, 2002, Award in May/June 03’
- Data Delivery begins March 2006

The data provider may use any reasonable means of producing the data, but the Government must validate:
- The approach, (business case included)
- The implementation, and
- The data.

The Government may provide milestone payments during system development for demonstrated progress.
LDCM-EO1 Technology Infusion

- **Candidate EO-1 Technology and “experiences” being infused into LDCM**
  
  - **Advanced Land Imager (ALI)**
    - WFOV, pushbroom scanner,
    - Focal plane (large number of detectors)
    - Pre and Post validate calibration/characterization and validation
    - On-board calibration (lunar, solar, stellar)
    - Data Processing (L0,L1R)
  
  - **WARP**
    - High rate data recording, data management, error correction, high rate downlink capabilities.
  
  - **RF (XPAA)**
    - Ability to work with diverse ground station.
    - High data rates
Intangible Benefits to LDCM from EO-1

- **EO-1 In-tangible payoff**
  - Science Validation Team – expert and broader user community have gained extensive experience in utilizing EO-1 data, understand processing and data product generation algorithms
  - Smart Buyer Staff – Transition of both L7 and EO-1 teams onto LDCM project.
  - Major Risks Retired – ALI has retired significant development and potential “data product “ problems.
  - LDCM able to better judge proposed technology
Mission Technologist Operations Lessons Learned

- Do not wage a two front war
- Make sure its working in the lab before you commit to flight validating it (TRL 6 minimum)
- Avoid nested technologies
- Test as though you will have a launch failure
  - Good experience (ALI – excellent pre-launch characterization)
  - Bad experience (PPT - not fully testing EMI/EMC almost postponed validation indefinitely)
- Keep an eye on the easy stuff
- Validate as you will operate the target mission
- Do not bypass Engineering Test Units
- More proactive risk management and mitigation
Summary

- **EO-1 technology results are well publicized and are being infused into future mission proposals and architectures**
- **EO-1 Hyperion and LAC data are first benchmark for non-DoD hyperspectral data**
- **EO-1 (and L7) experience and lessons learned enables LDCM mission to proceed as a data buy mission with improved confidence**
  - *Retired major risks in moving from ETM+ to pushbroom technology*