A Systems Engineering Approach to Planetary Data Archive Development

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Archive System Planning

• Data returned from NASA Planetary missions are the scientific legacy of these endeavors.

• NASA requires all missions to archive raw and calibrated scientific instrument data and encourages derived data products.
  • Missions have used many methods to fulfill this requirement.

• A systems engineering approach looks at the archive as an integral part of the complete mission system.
  • Includes the archive-lifecycle development from proposal through delivery.
  • Integrates archive development into mission planning and operations
  • Ensures the archive is developed in coordination with mission requirements, mission operation objectives, and the ground data-processing system
Archive Scientist

• Appoint a Mission Archive Scientist to be responsible for archive planning and development.

• Act as interface between the project, instrument teams, ground data system and PDS.

• Inform and enforce mission-wide metadata standards or spatial data infrastructures.

• Reduce risks through end-to-end mission planning.
Level-1 and Level-2 science requirements are developed to address the scientific objectives of the mission. Level-2 science requirement satisfying data products are often derived products that require input or analysis of lower-level products. Use a traceability matrix to map the derived Level-2 products to the lower level products. Use the tractability matrix to develop the DMP.
Data Product Traceability Matrix

<table>
<thead>
<tr>
<th>Req Number</th>
<th>Level-2 Science Requirement</th>
<th>Level-2 Mission Requirements Meeting Data Product</th>
<th>Input Products</th>
<th>Processing Environment</th>
<th>Working Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRD -1</td>
<td>For a 3-sigma error ellipse around each candidate landing zone, produce a topographic map at spatial and vertical resolution of &lt;50cm</td>
<td>Local Digital Terrain Model</td>
<td>Altimeter Raw Data</td>
<td>LIDAR Cal Processing</td>
<td>LIDAR Instrument Team</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Altimeter Reduced Data</td>
<td>LIDAR Cal Processing</td>
<td>LIDAR Instrument Team</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Altimeter Calibrated Data</td>
<td>LIDAR Cal Processing</td>
<td>LIDAR Instrument Team</td>
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<td></td>
<td></td>
<td></td>
<td>Object mass</td>
<td>RS Mass Calc.</td>
<td>Radio Science Team</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Object gravity</td>
<td>RS Gravity Calc.</td>
<td>Radio Science Team</td>
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<td></td>
<td></td>
<td></td>
<td>SPICE Kernels</td>
<td>SPICE</td>
<td>Mission Team</td>
</tr>
</tbody>
</table>

- Identifies the links from high-level derived to the lower level data products
- Links to the mission observation plan.
- Identifies interfaces between software processing environments
- Identifies interfaces between mission working groups or instrument teams
The Data Management Plan

- Contains a top-level description of the mission data processing elements, their roles and responsibilities, and relationship to one another.
  - This includes the data processing required to produce the data products that meet the mission Level-2 science requirements.
- Outlines the relationship between the mission and the PDS.
  - Early and regular communication between the mission and PDS aids archive development
  - Includes archive development, peer review and delivery schedules
Archive System Development

- Identify product formats and develop your prototype products.
  - Develop draft archive documentation
- Initial review is used to make sure the plan is reasonable before getting too far down the development path.
  - Useful with the change from PDS3 to PDS4 Standards
  - Identify any holes in planned products, metadata, or ancillary information.
• Develop an automated data processing pipeline.
  • With the pipeline, develop a CM plan with your Node
• With planning and reviews/testing completed prior to nominal data collection, the delivery review should go smoothly, allowing for the archive to be made public rapidly.
Summary

• A systems-engineering approach sees the archive as an integral part of the mission system.
• Mission science requirements inform archive design.
• Early planning and review results in a comprehensive, scientifically useful archive.
• Communication between the mission and the PDS is essential.