

**Charting the Course:
Life Cycle Management of
Mars Mission Digital Information**

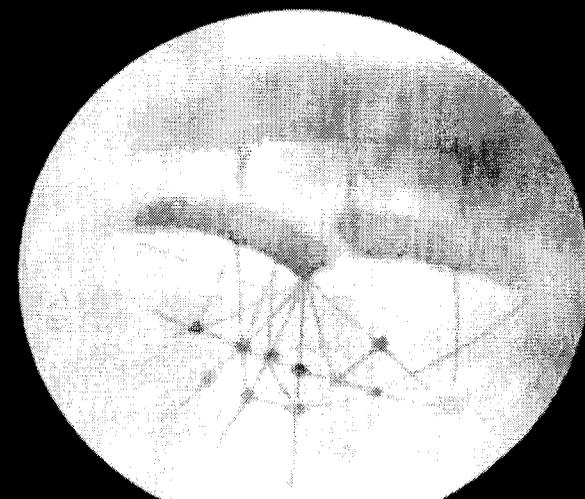
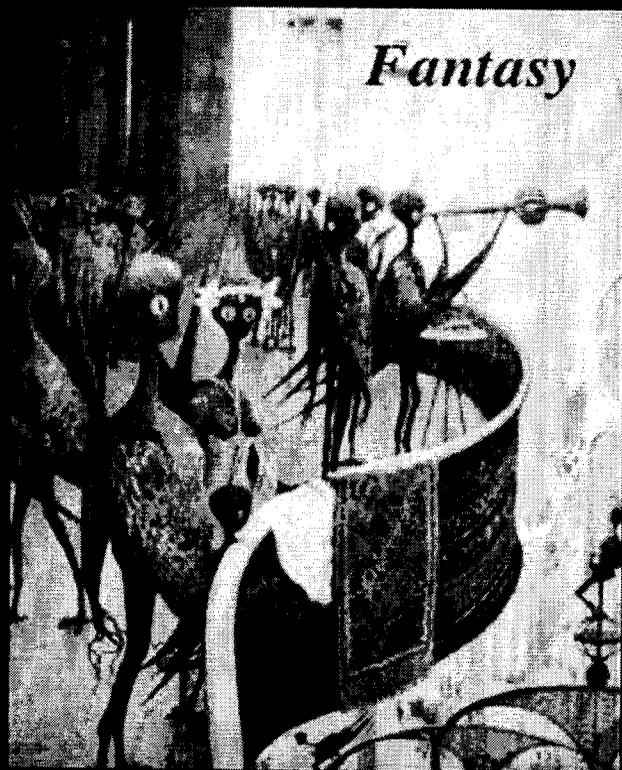
Julie M. Reiz, CA

**Mars Exploration Rover Project
Jet Propulsion Laboratory
California Institute of Technology**

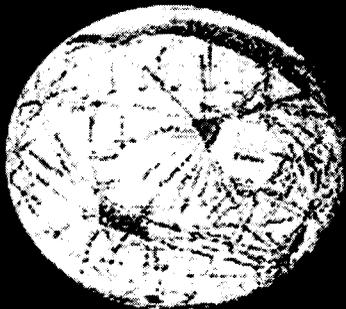
***Society of American Archivists Annual Meeting
Los Angeles, CA***

August 22, 2003

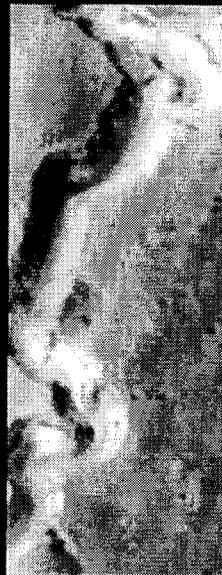
JPL



Science
Fiction



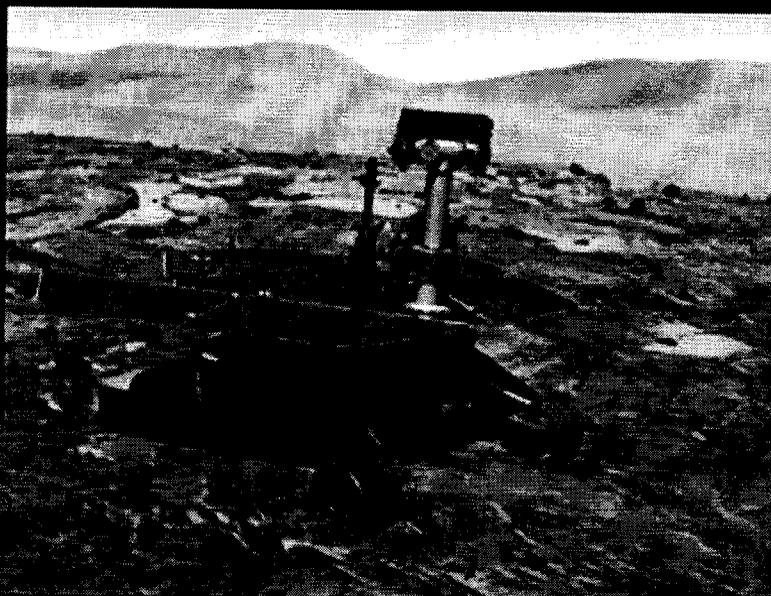
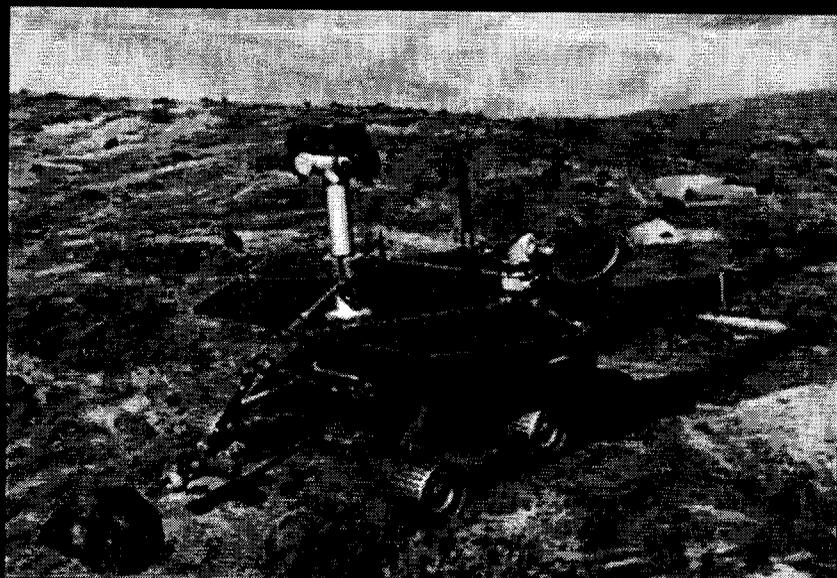
Science Fact
Today



What's Possible
Tomorrow



Rovers next to
minerals formed
by water?



Getting to Mars is a Challenge

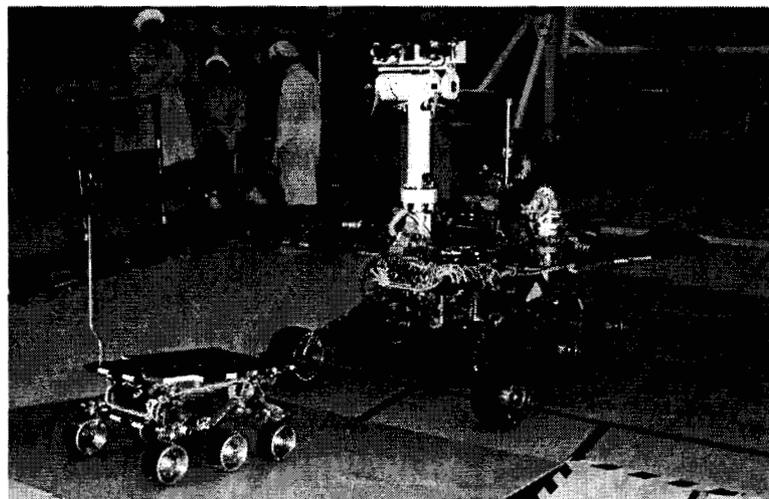
	USA	USSR/Russia*	Successful	Failure
Orbiters/Flyby	12	-	8	4 (2 LV)
	-	15	4	11 (5 LV)
Landers	6	-	3	3
	-	8	0**	8 (2 LV)
Totals	18	23	15	26
			37%	63%

* Japanese Nozomi mission is expected to arrive in Dec 2003

** Mars 3 in 1971 apparently transmitted for 20 sec after landing but no significant information was returned

Mars Exploration Rover Recipe

- Start with Mars Pathfinder design
- Add Athena Payload
- Make rover independent of lander (new design)
- Combine
- Repeat for second rover



Information Life Cycle and Design of Mars Exploration Rovers

- Mars Exploration Rover design was dependent on:
 - Reuse of Mars Pathfinder design and Athena Rover payload
 - On-line information system to capture, manage, and preserve new digital design files

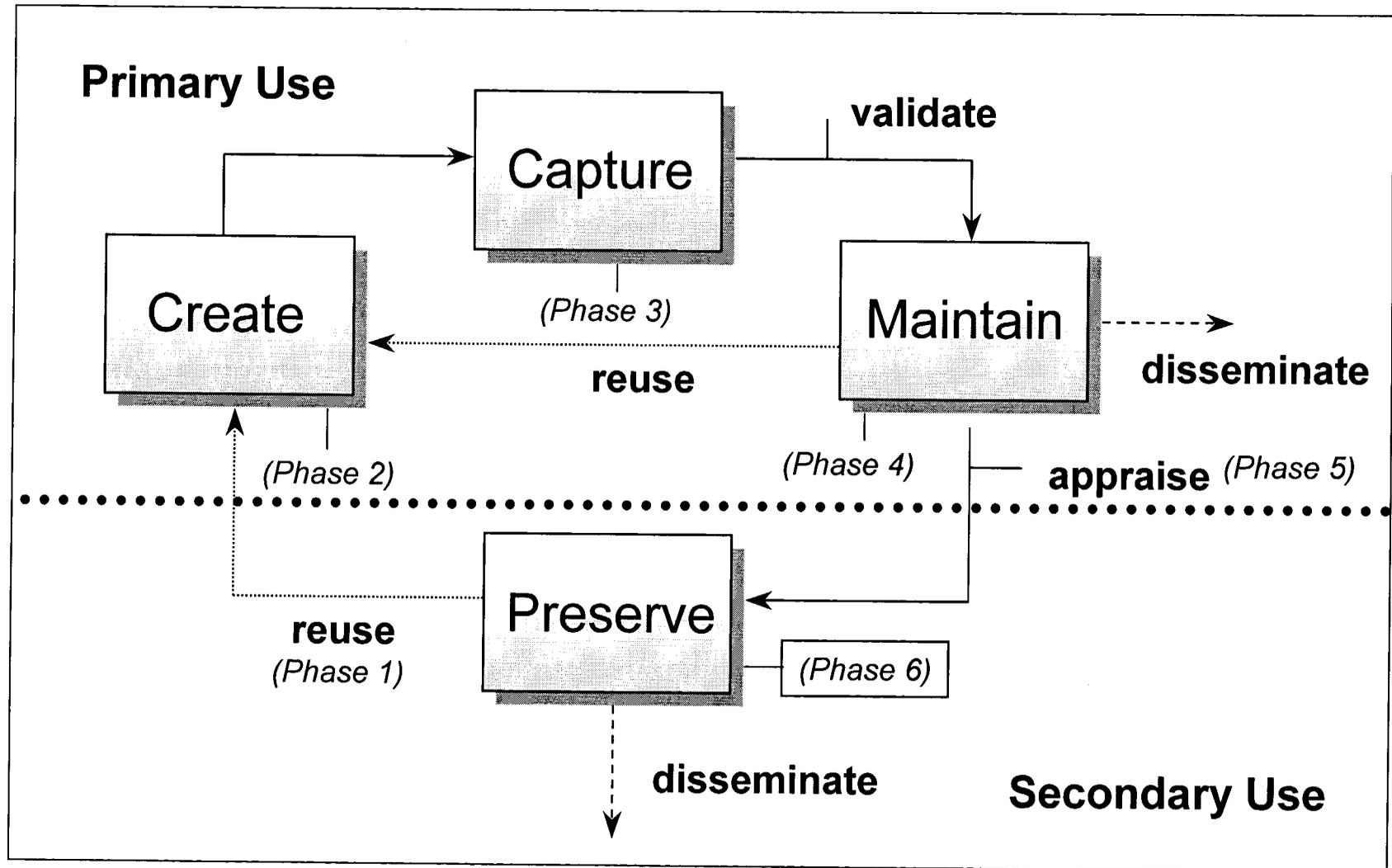
Information Life Cycle and Design of Mars Exploration Rovers, cont'd

Information Lifecycle Management

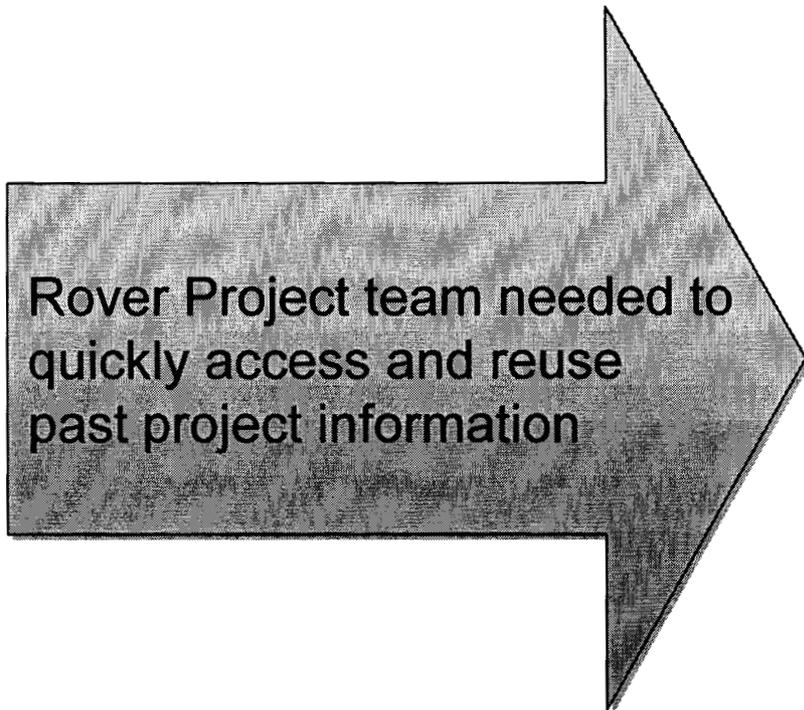
- Designed information life cycle workflow to emulate migration path of information from creation to preservation
- Developed on-line system to manage information beginning in project formulation through project completion

Integration of workflow and system design

Mars Exploration Rover Project Information Life Cycle



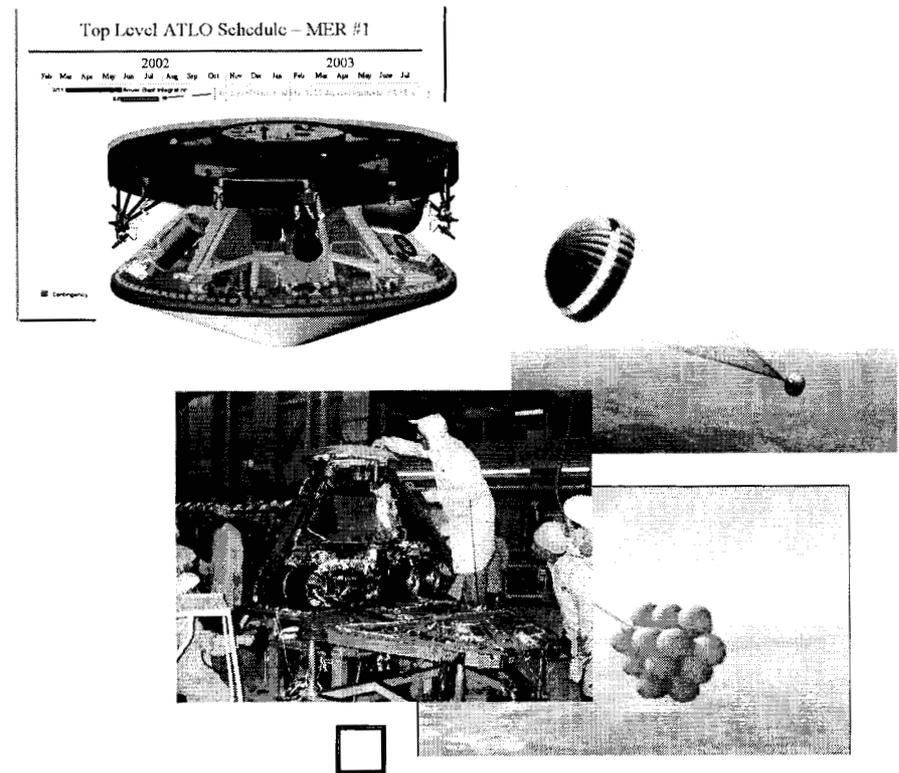
Information Life Cycle: Reuse (Phase 1)



- Reviewed mars project archival collections in hard copy and digital formats and identified pertinent materials
- Captured digital information in on-line, web-accessible system
 - Collected native files whenever possible
- Created physical repository for hard copy and a/v materials

Information Life Cycle: Create (Phase 2)

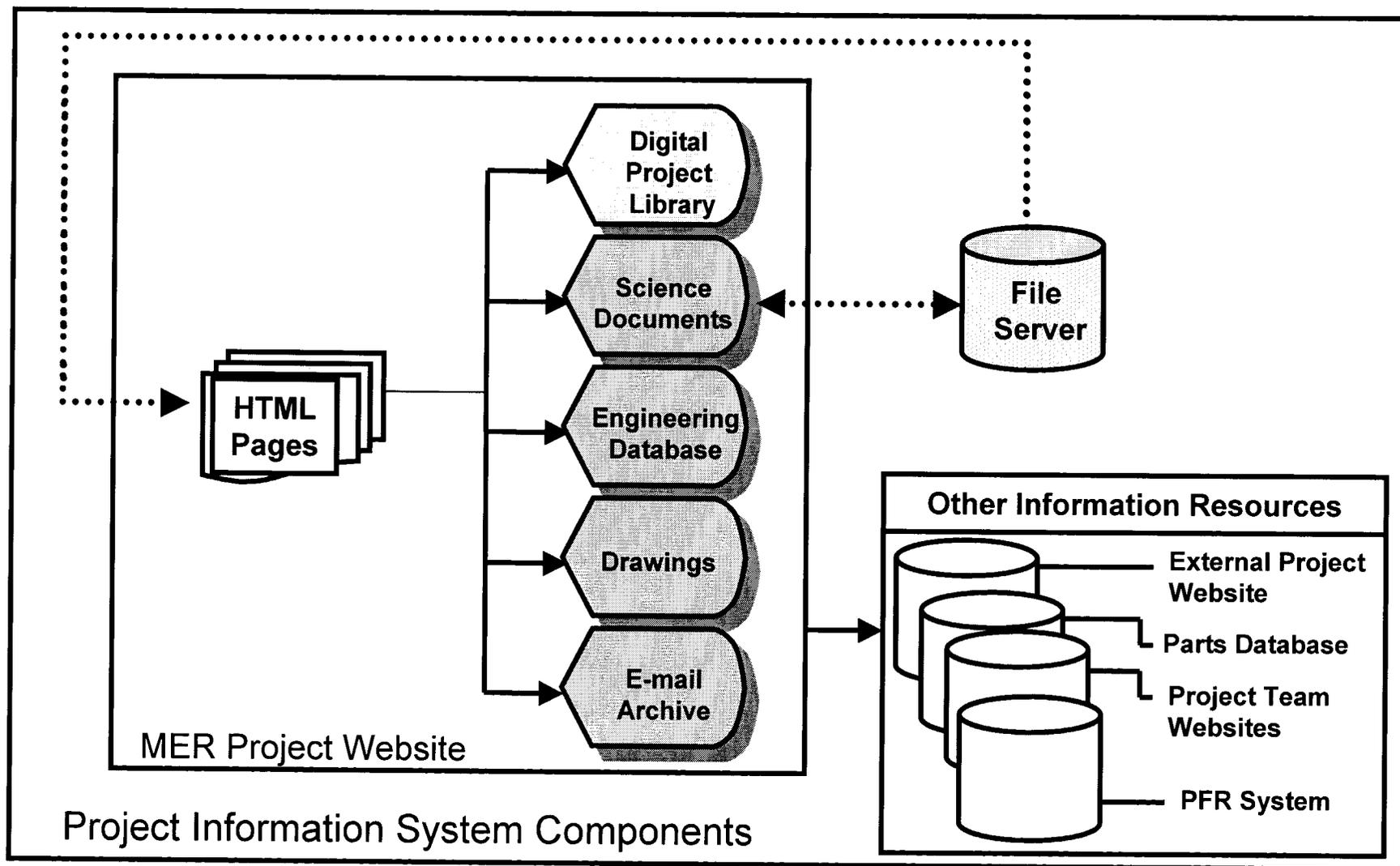
- More than 95% of Rover Project files in digital formats
- Files are in institutionally supported, standard native and web-viewable formats
 - MS Office files, PDF, HTML, CAD, JPEG, GIF, TIFF, MPG, AVI, RM, etc.



Information Life Cycle: Capture (Phase 2) cont'd

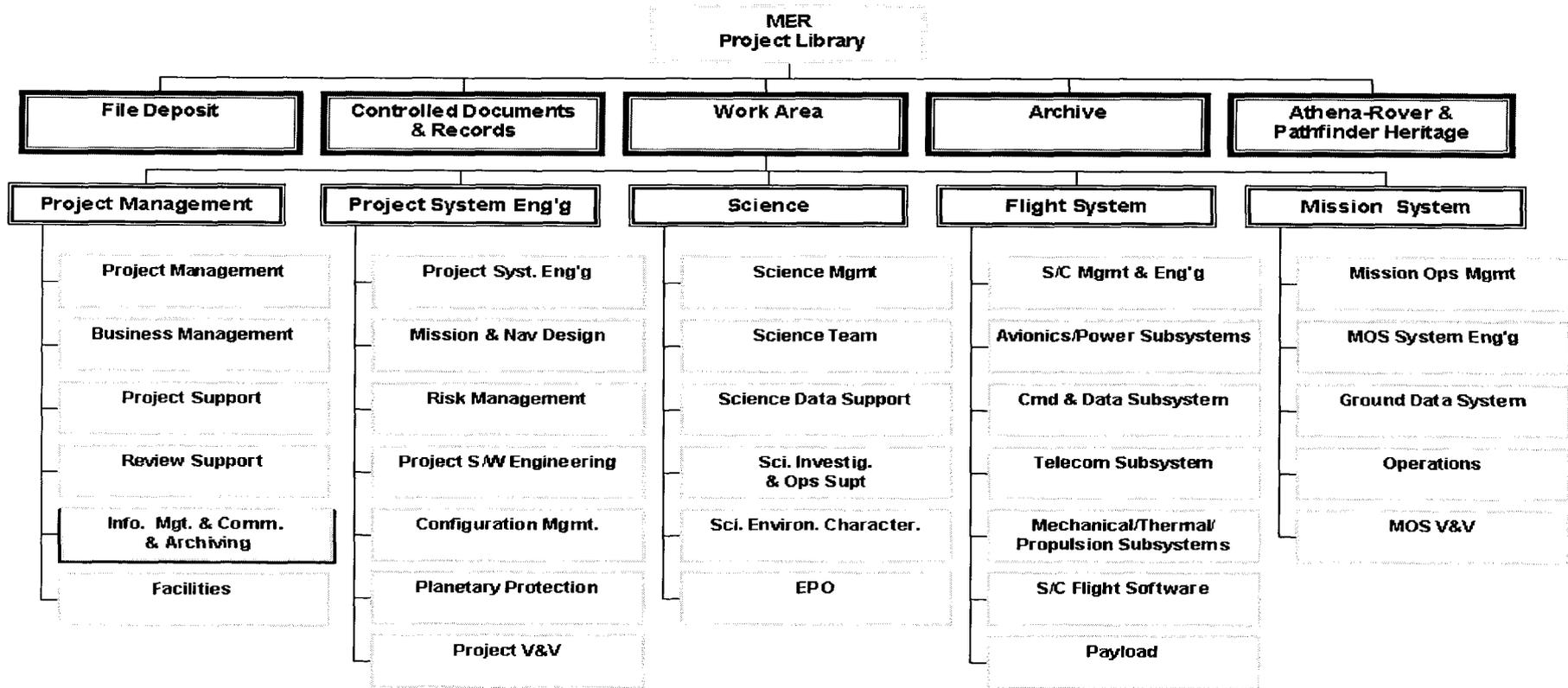
- Project information system environment built on standard institutional tools and components
 - Digital library tailored to include additional descriptive records management and archive metadata
- Project teams trained on how to use systems and what information needed to be captured

Information Life Cycle: System Architecture – Capture (Phase 3)

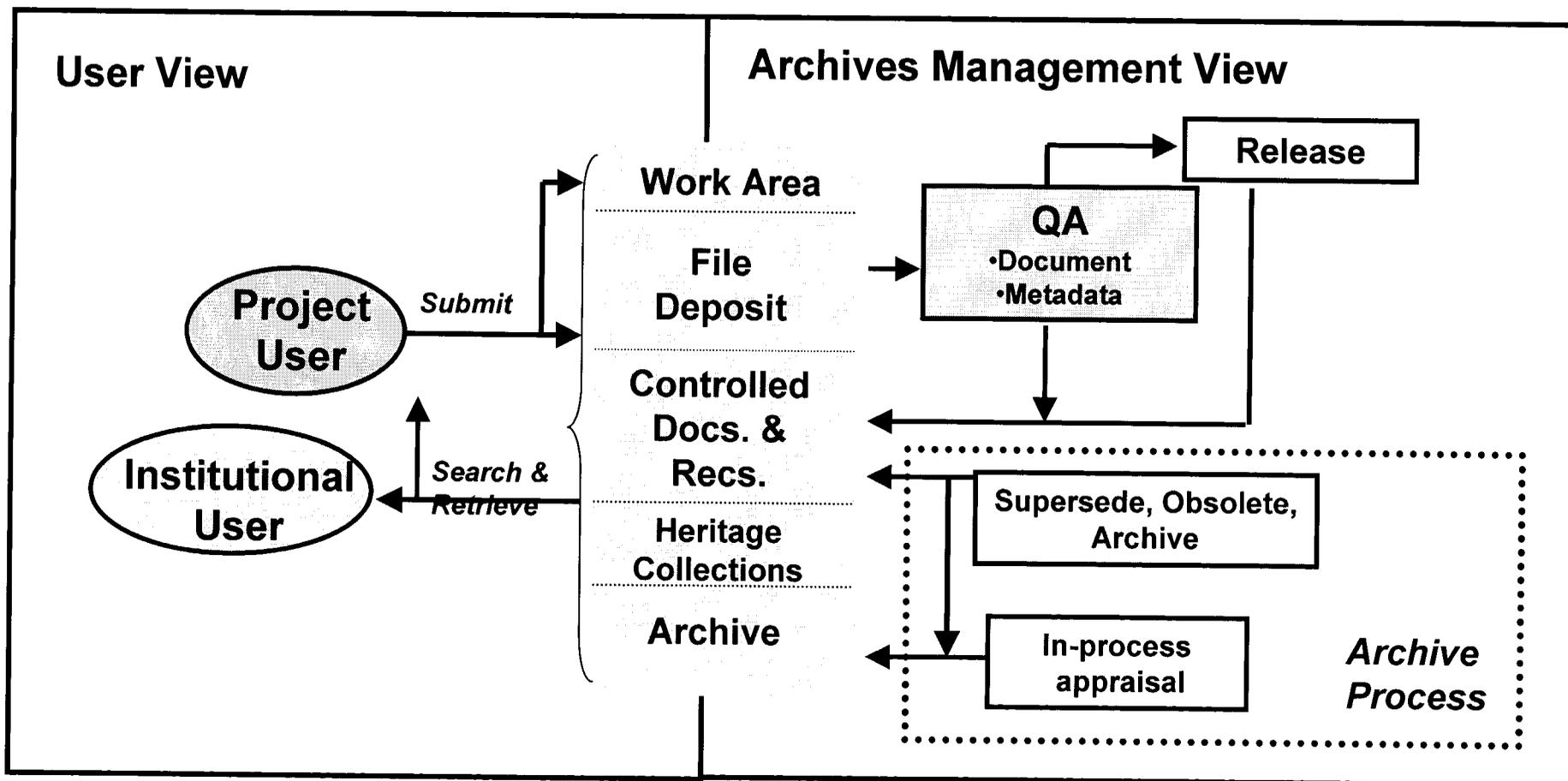


Information Life Cycle: Capture (Phase 3)

- Digital Project Library architecture
- Intuitive system design readily adopted by users



Information Life Cycle: Digital Library - Capture (Phase 3)



Information Life Cycle: Metadata - Capture (Phase 3)

Add File - Netscape
File Edit View Go Communicator Help

Add File

Required Fields

Title: (required) Mars Exploration Rover - Spacecraft Functional Requirements

Document: (required) C:\Documents and Settings\jrei Browse...

Max Versions: (required) 150

Author: (required) Richard Welch

Cover Date: (required) 03/15/2001

Apply

Optional Fields

Summary: Rover Functional Requirements Document (FRD)

Description: This document is part of a rover design series that includes requirements, design, specification, and test documentation.

File version history

Record series context

Information Life Cycle: – Metadata - Maintain (Phase 4)

Add File - Netscape
File Edit View Go Communicator Help

Restrict Write: Yes No

Keywords: rover design, requirements, avionics, mechanical, thermal

Program / Project / Division: Mars03

WBS / Subject Category: Not Specified

Document Type: Requirements/Specifications

Document Status: Official

Sensitivity: TAR/EAR

Project Document Number: MER 420-3-428

JPL Document Number: JPL D-10109
(required)

Document Revision: Rev. B
(required)

Configuration Management: Yes No

Custodian: Richard Welch

Historical Preservation: Yes

Preservation Notes: Retain for rover design archives

Record Retention Period: Through End of Project; then archived

Responsible for record: MER Project

Record Disposition: Retained by Project/Line Org

Authenticity

Access control

Preservation metadata

Information Life Cycle: Why Archive Project Information?

- To support project activities throughout its life cycle and to enable reuse of information by future projects
- Institutional and Project Archive Requirements:
 - NASA/Caltech/JPL archive requirements
 - Provide material needed to construct a Project history
 - Assist with analysis of in-flight anomalies
 - Enable the generation of lessons learned
 - Support proposal work, studies, project start-up by providing reusable information and examples
 - Save the institution time and resources through information reuse

Information Life Cycle: In-Process Appraisal (Phase 5)

- In-process archival appraisal involves:
 - Reviewing Project information stored in the Project's information systems to determine what should be preserved. Appraisal process occurs throughout the Project's life cycle, especially at phase transitions (e.g., concept study > formulation > design > build > launch > operate).
 - Filling-in gaps where information is missing
 - Tagging archival information to facilitate exporting

Information Life Cycle: In-Process Appraisal (Phase 5) cont'd

- Questions to ask during in-process archival appraisal:
 - Is the information the outcome of planning, designing, managing, and monitoring by the Project?
 - Is the information critical in supporting administrative, technical, and scientific processes throughout the Project's life cycle?
 - Does the information have technical, administrative, or legal reuse value?
 - Is the information in a useable format?

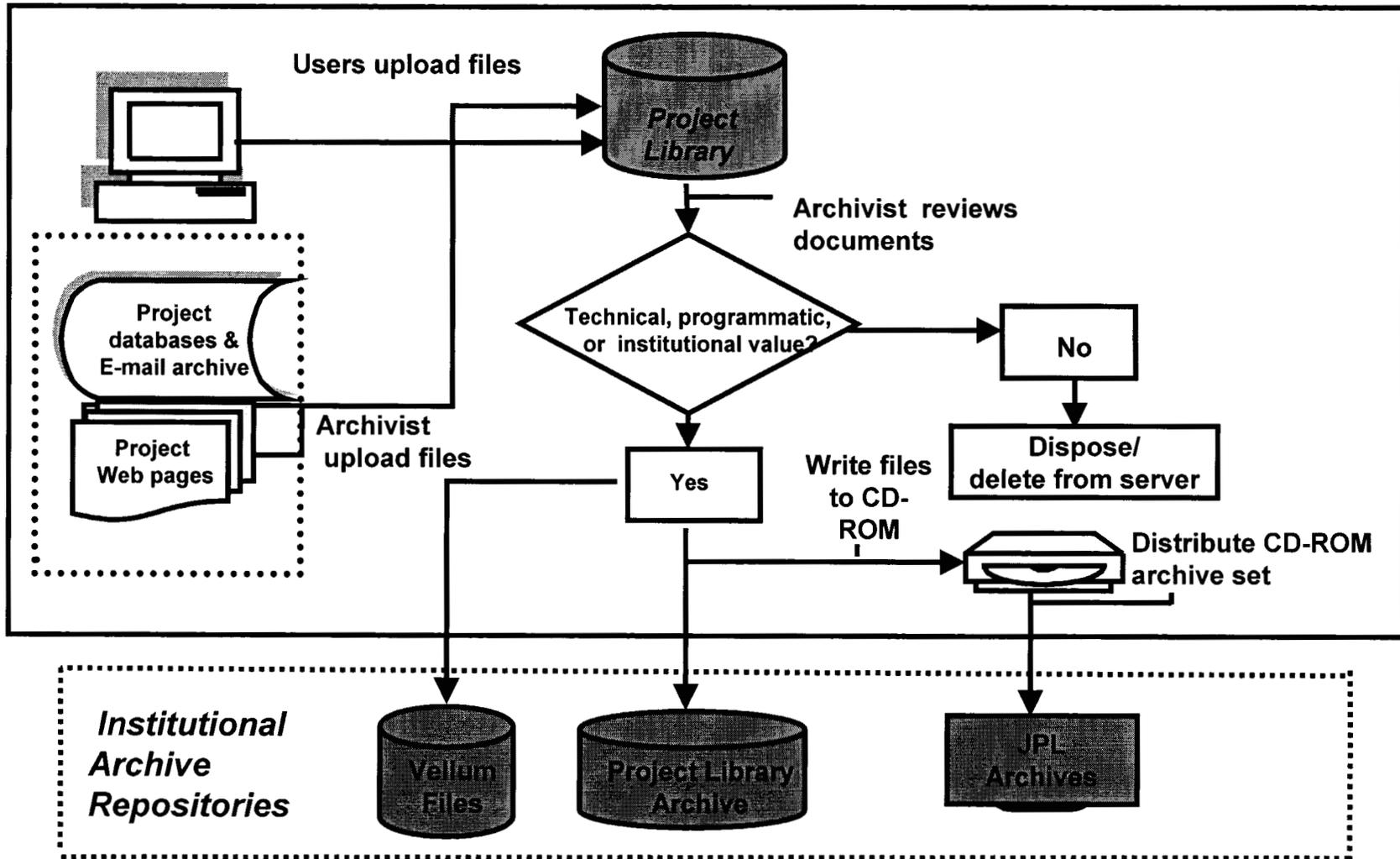
Information Life Cycle: Archival Information Types

- Information needed to construct a Project history
 - Documentation that captures decision rationale, trade-offs, studies, risk assessment, descoping, replanning, and significant milestones, including
 - Action items
 - E-mail
 - Monthly/quarterly management reports and reviews
 - Design reviews
 - Plans
 - Outreach materials

Information Life Cycle: Archival Information Types

- Information that is useful to analyze in-flight anomalies/failures:
 - Requirements
 - Problem/Failure reports
 - Reliability analyses
 - Hardware drawings and specifications
 - As-built lists
 - Engineering change requests
 - Design description documents
 - Test and integration data, notes, scripts
 - Vendor design data packages

Information Life Cycle: Preserve (Phase 6)



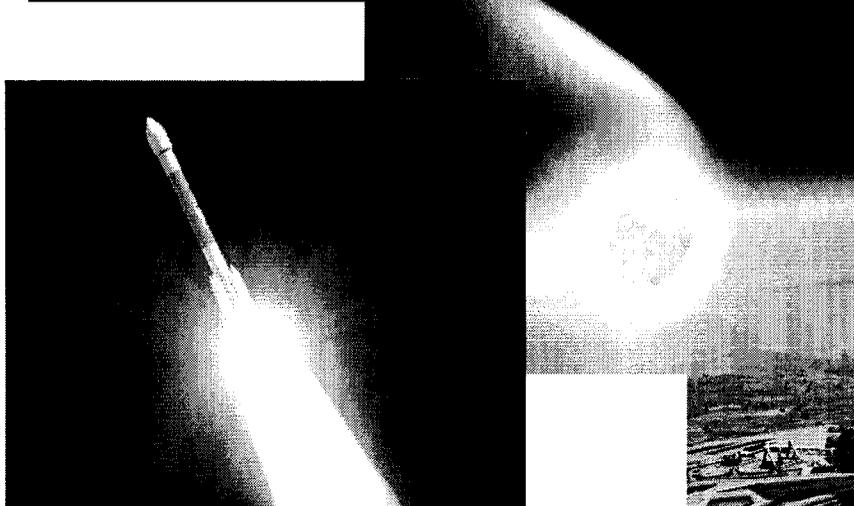
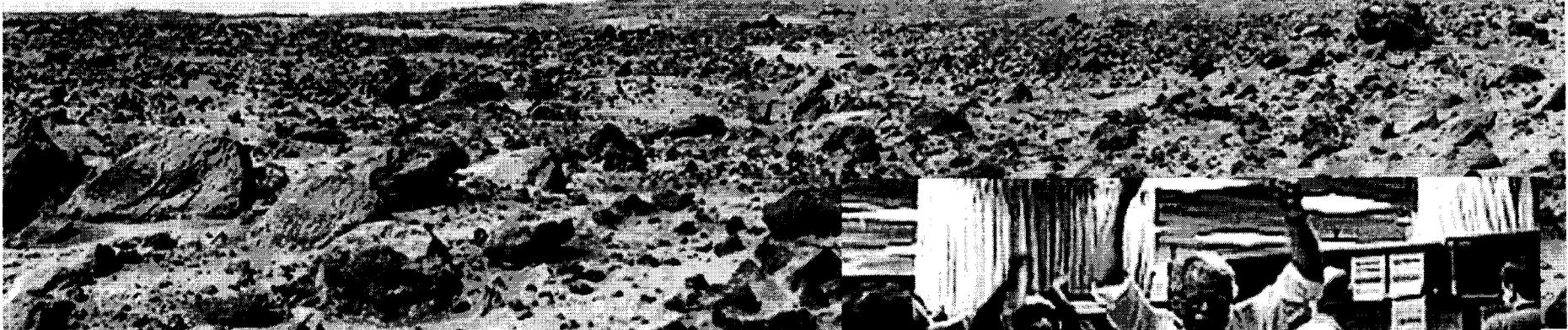
Information Life Cycle: Preserve (Phase 6) cont'd

- Project Archivist responsible for developing Archive Plan and agreements with institutional systems providers for transfer of MER archival information
- Files are transferred to institution for long-term storage at end of project
 - Will be mapped to NASA file categories, migrated to other formats/media, and eventually transferred to NARA

Conclusion

- Life cycle management of MER Project information was an essential key to the successful launch of the MER Project rovers
- Incorporating digital information archive requirements early in the project life cycle resulted in:
 - Design of information system that included archive metadata
 - Reduced the risk of information loss through in-process appraisal
 - Easier transfer of project information to institutional on-line archive
 - Project appreciation for preserving information for re-use by future projects

The rewards...



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<http://mars.jpl.nasa.gov/>