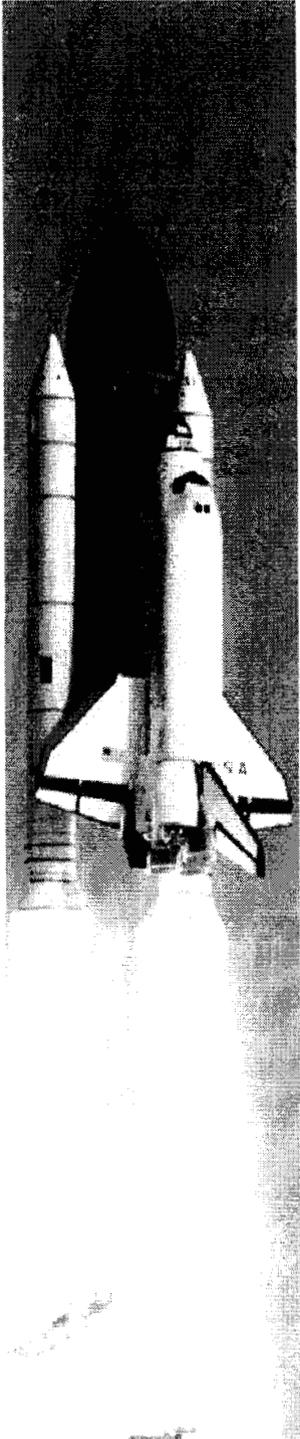


# Knowledge Management at NASA

Jeanne Holm  
Jet Propulsion Laboratory/Caltech  
NASA

KM Asia 2002  
July 16, 2002

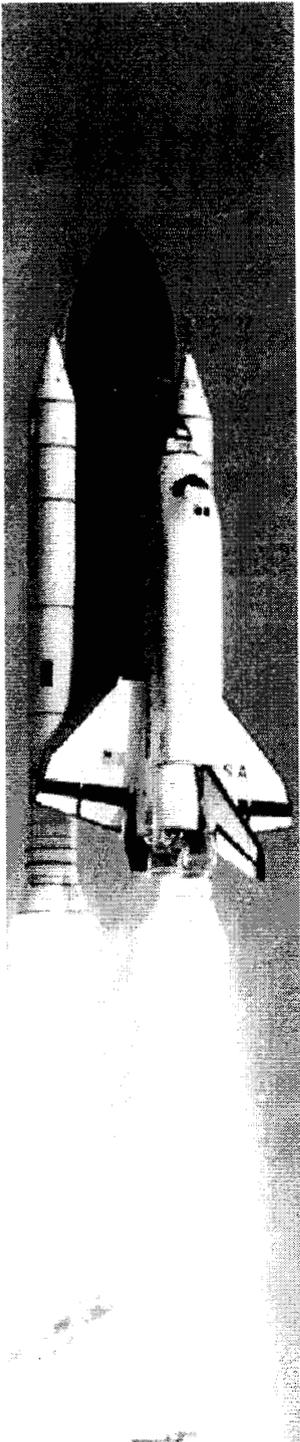


# Agenda

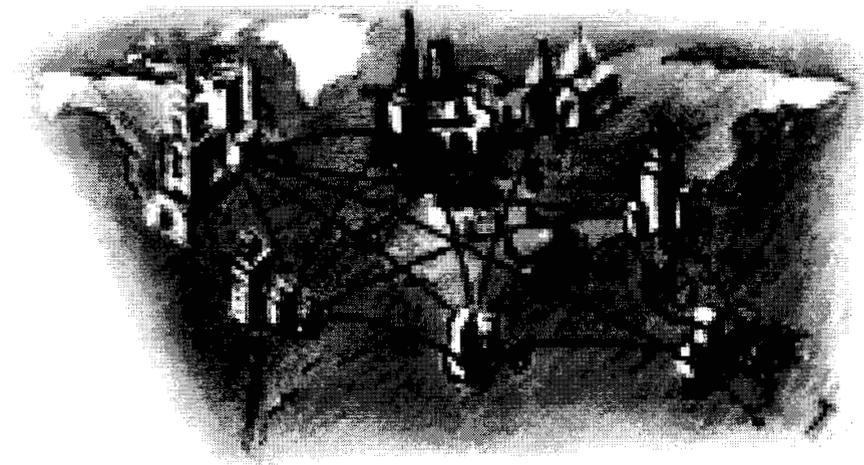
- ◆ What is the gap between how knowledge can be managed and used more effectively *AND* in helping to support measurable improvements for organizations and their partners?
- ◆ Principles of KM
- ◆ Detailed approaches and plans
- ◆ Blueprint for
  - Why is KM critical to organizations today?
  - What success factors were learned from benchmarking?
  - What are the architectural cornerstones of KM?
  - What constitutes a knowledge architecture with processes, services, and systems?
  - How was a KM architecture created for NASA?

# An Integrated View of KM

- ◆ Knowledge management is getting the right information to the right people at the right time, and helping people create knowledge and share and *act* upon information in ways that will measurably improve the performance of an organization and its partners



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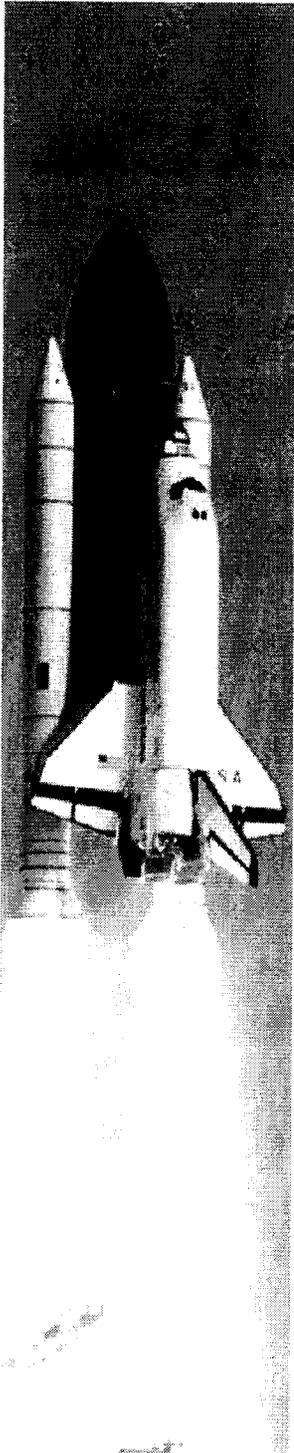


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# Why Is KM Critical to NASA?

- ◆ We are constantly challenged to document and integrate our lessons learned to effectively manage the risk involved in space exploration and human space flight
- ◆ By its nature, NASA employees have specialized, compartmentalized knowledge
- ◆ The workforce in the Agency is aging
- ◆ Our goal is to share knowledge with each other and with the public
- ◆ *The Administration will adopt information technology systems to capture some of the knowledge and skills of retiring employees. Knowledge management systems are just one part of an effective strategy that will help generate, capture, and disseminate knowledge and information that is relevant to the organization's mission.*

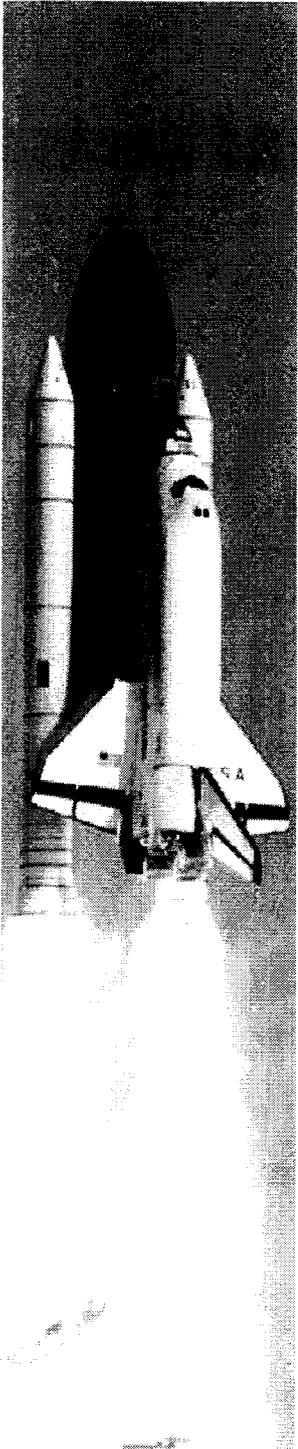
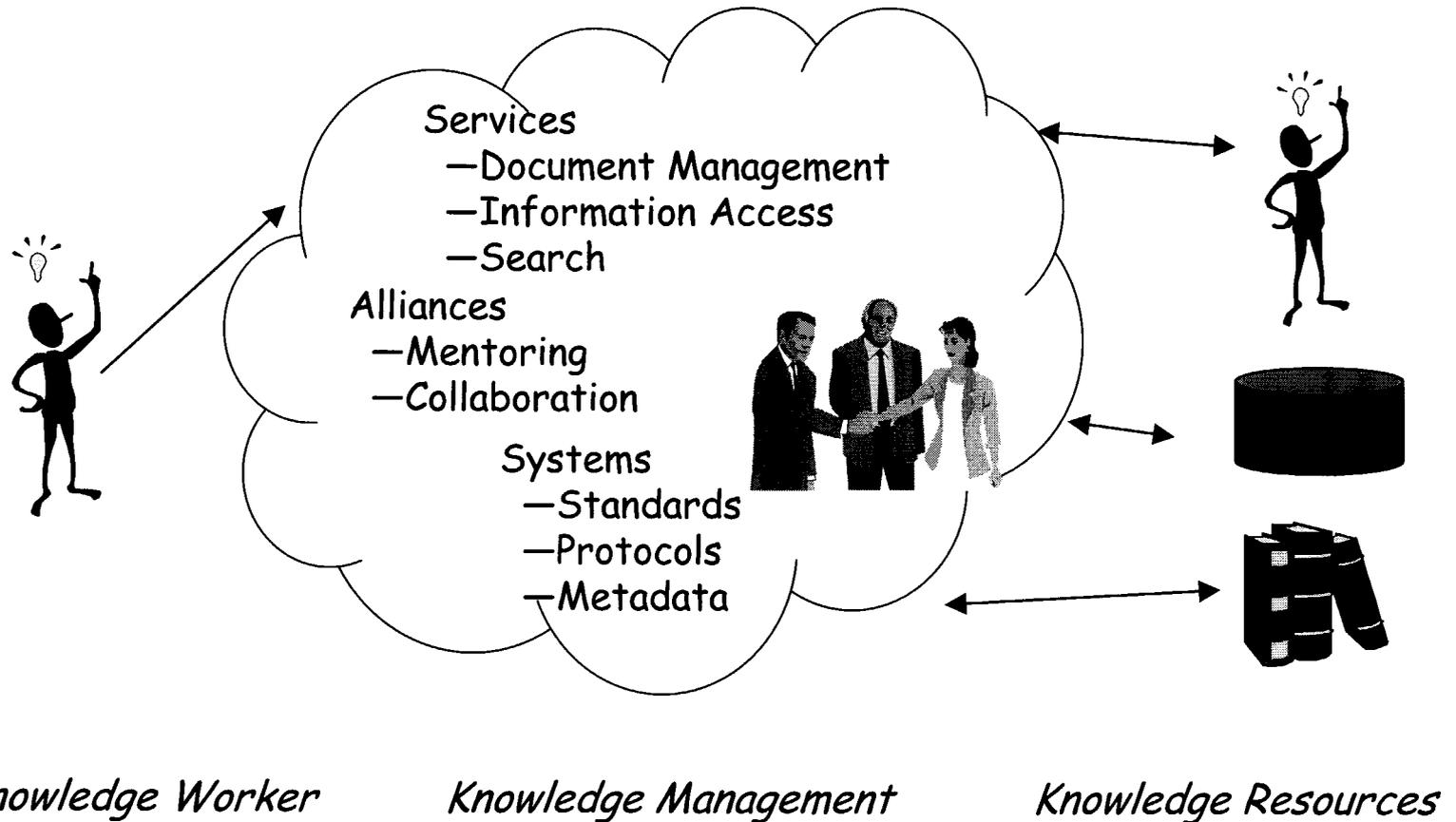
*President's Management Agenda*



# Tie KM to Business Drivers

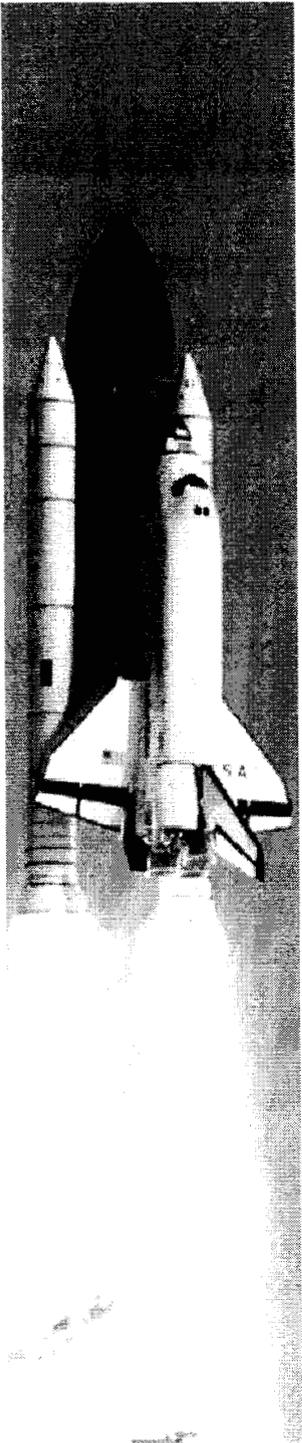
- ◆ When selecting a KM solution to implement, it needs to be tied to the core issues and business drivers for that company or field
- ◆ KM solutions are not “one-size-fits-all” and need to be tailored for each organization
- ◆ JPL was no exception, and our 25-year KM strategy is linked to those technologies and infrastructure services that will be needed by missions planned over the next decades

# KM Helps People Find Answers



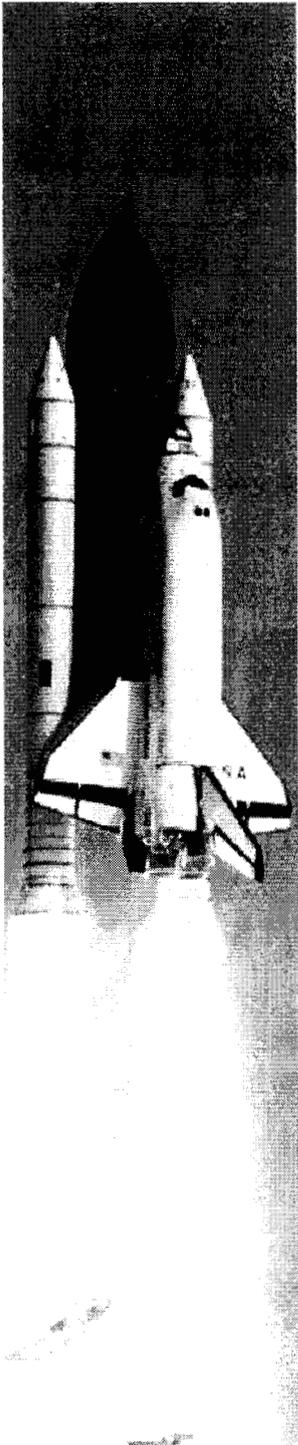
# Building a KM Team

- ◆ NASA's KM activities are led by the Chief Information Officer (Lee Holcomb) and guided by the NASA KM Team
- ◆ Our job is to find good solutions that already exist, and build a federation of resources to support NASA's missions and research communities
  - KM supports and enables other processes and initiatives, building infrastructure, applications, and “filling the gaps”
  - KM's goal is to help infuse new ideas or needed technology and to leave or turn over operations to the appropriate content area
- ◆ We actively share and benchmark with other Agencies, the National lab community, and academia



# Key Strategies for NASA KM

- ◆ To sustain NASA's knowledge across missions and generations
  - KM will identify and capture the information that exists across the Agency
- ◆ To help people find, organize, and share the knowledge we already have
  - KM will efficiently manage NASA's knowledge resources
- ◆ To increase collaboration and to facilitate knowledge creation and sharing
  - KM will develop techniques and tools to enable teams and communities to collaborate across the barriers of time and space



# Framework for KM at NASA

## Sharing and Using Knowledge

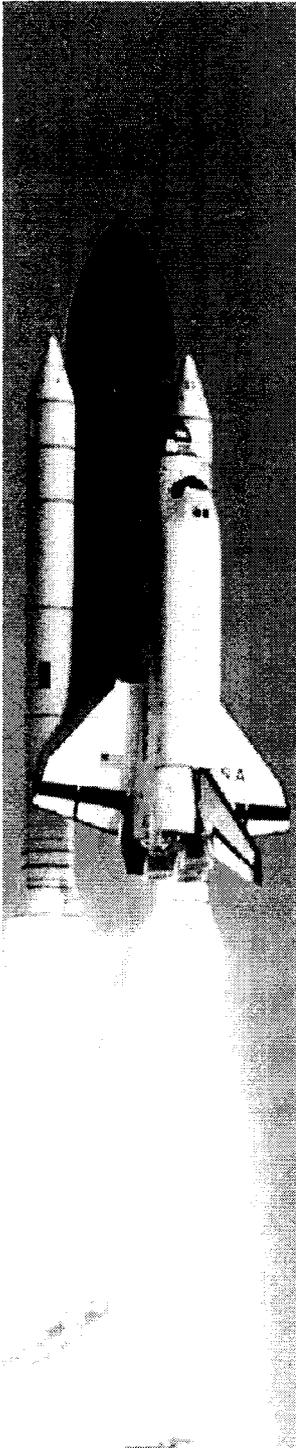
People	Process	Technology
<ul style="list-style-type: none"><li>• Enable remote collaboration</li><li>• Support communities of practice</li><li>• Reward and recognize knowledge sharing</li><li>• Encourage storytelling</li></ul>	<ul style="list-style-type: none"><li>• Enhance knowledge capture</li><li>• Manage information</li></ul>	<ul style="list-style-type: none"><li>• Enhance system integration and data mining</li><li>• Utilize intelligent agents</li><li>• Exploit expert systems</li></ul>

## Supporting Activities

Education and Training	IT Infrastructure	Human Resources	Security
------------------------	-------------------	-----------------	----------

# Current Work at NASA

- ◆ Providing training and mentoring
  - Academy of Program and Project Leadership (APPL) hosts classes, team-targeted training, just-in-time online learning, and a community of practice for project managers
  - <http://appl.nasa.gov>
- ◆ Encouraging storytelling
  - Knowledge Sharing Initiative (storytelling) provides forums for people to share stories and publishes the best of those
  - [http://appl.nasa.gov/knowledge/knowledge\\_home.htm](http://appl.nasa.gov/knowledge/knowledge_home.htm)
- ◆ Recognizing people for sharing knowledge
  - An HR-led Recognition Management Study is changing our incentives and rewards structures
- ◆ Providing access to our experts through integrated directories



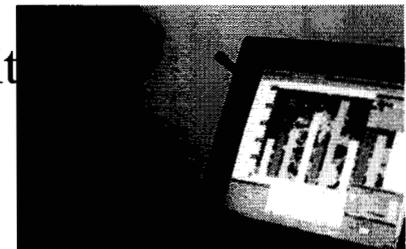
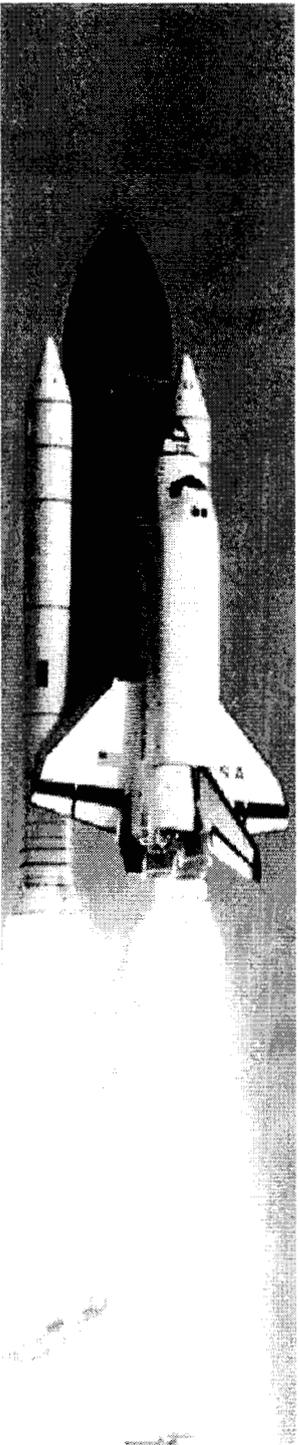
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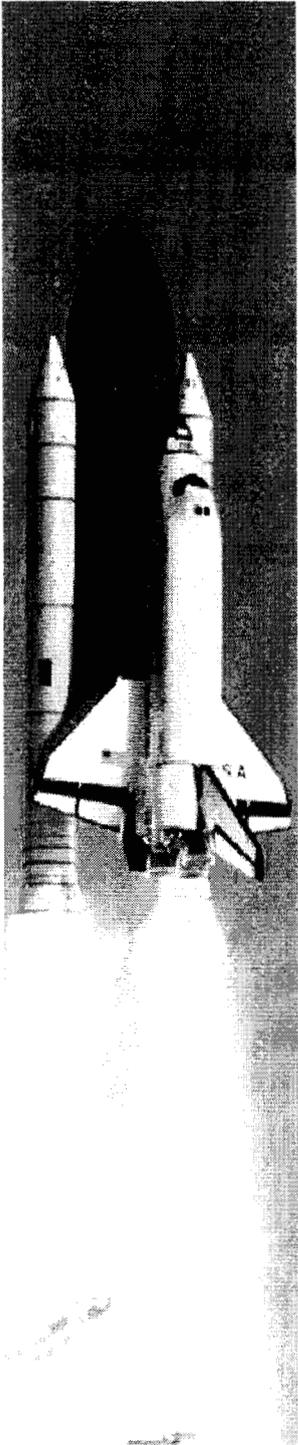
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# Current Work at NASA (continued)

- ◆ Easing access to information through deployment of cross-cutting information portals
  - <http://km.jpl.nasa.gov/portal/insidenasa>
- ◆ Enhancing our ability to capture knowledge
  - Process-Based Mission Assurance is collecting video nuggets and best practices for managing our risk
    - <http://pbma.hq.nasa.gov/pbmamaster.html>
  - Redesigning our Lessons Learned Information System to encourage sharing of successes and failures
    - <http://llis.nasa.gov>
- ◆ Rearchitecting our web environment from the ground up to better manage our messages and web production
  - Content management, web shops, enabling applications
  - <http://enasa.ksc.nasa.gov>
- ◆ Deploying collaborative environments to facilitate





# Sharing Information Electronically

- ◆ Deploying an **information portal** to gain access to explicit information
  - A portal is a home or entry page that can be customized to display your favorite and most-needed online resources
    - Agency news and events calendars
    - Directory of web space
    - Employee contact and directory information
    - Mission and project information
    - External news tailored to the user's needs
  - Employing an enterprise information portal to allow customized views into NASA internal and external resources
    - Stimulate development of interoperable standards, architectures, and knowledge transfer between Centers
    - Facilitate and broadcast communities of practice
    - Consolidate multiple publishing venues to create *One NASA*

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# InsideJPL

User Log In

Daily Planet

Most Commonly Accessed Business Links

Labwide Announcements

Engineering Links

Headline News

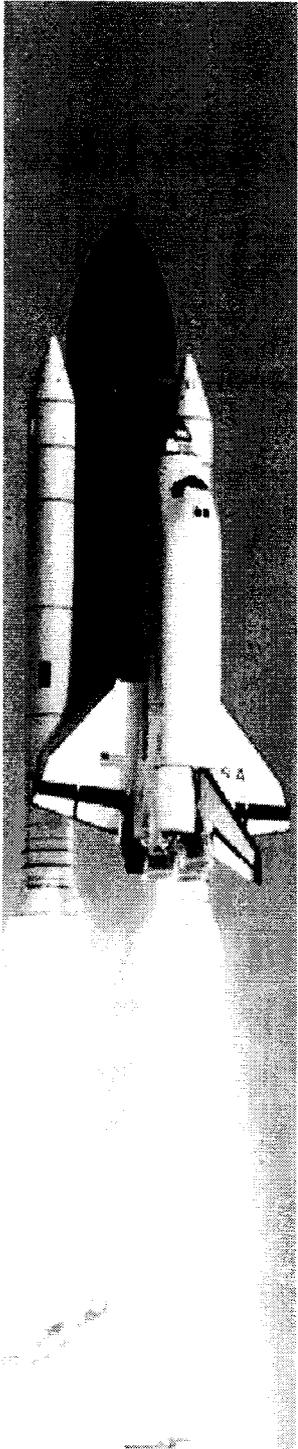
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Institutional Calendars

Institutional Search Engine

# Current KM Activities at JPL

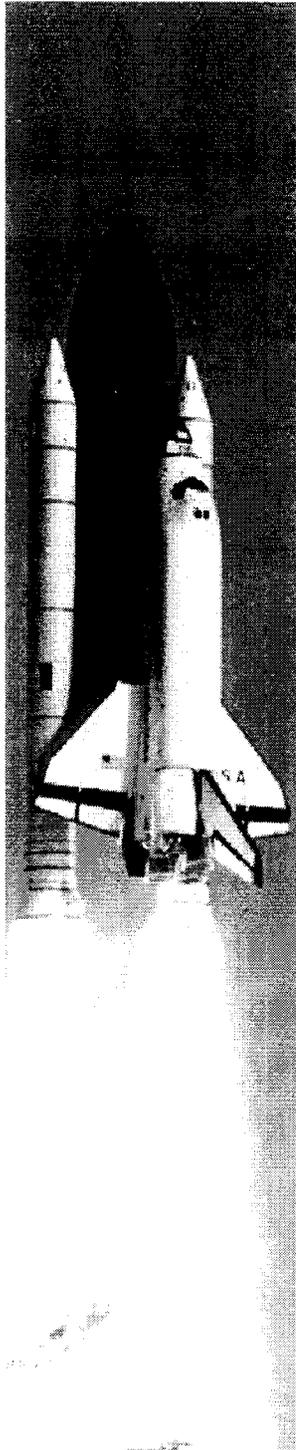
- ◆ Knowledge Capture Studies
  - Investigating how teams create, capture, and share knowledge
- ◆ Expert Connections
  - Helps to find people with the answers, includes profiles of ~1100 technical experts
- ◆ Document and Data Management
  - Goal is to support the entire lifecycle of project information
  - Currently provides Project Libraries (Xerox's DocuShare software) to 6500 users and 75 organizations
  - Moving to an electronic archive and integrated authoring environment
- ◆ Standards (<http://step.jpl.nasa.gov>)
  - Advocates and adopts standards for core metadata, name spaces, and engineering models (STEP)
- ◆ Knowledge Navigation
  - Using portals, taxonomies, and enhanced searching to help gather information for individuals and communities



# Knowledge Capture Task

- ◆ Combination of applied and academic research
  - Partnering with USC
- ◆ Investigating ways to capture and leverage JPL's corporate knowledge
  - Specifically focusing on the engineering and technology areas
  - Developing concepts and evolving those into services
  - Delivering personal knowledge organizers, legacy reviews, underground orientation, storytelling, lessons learned, and technical questions
- ◆ Thrusts
  - Codifying knowledge
  - Social networks and exchanges
  - Culture and learning

# Technical Questions Database



JPL

## TECHNICAL QUESTIONS DATABASE

ADMIN

HOW TO USE

FEEDBACK



### HOT QUESTIONS

The **Technical Questions Database** provides key technical questions that could be asked during the design process or at a review, with the purpose of identifying and preventing problems from occurring on flight projects. The database is intended to act as a "mind tickler" of items that designers, PEMs, Technical Group Supervisors, and review board personnel should be thinking about.



### BROWSE



### SEARCH

The **Technical Questions Database** consists of sets of concise questions (plus background information) organized by technical discipline areas (TDAs). The database can be searched or browsed using features embedded in the site. Questions of interest can be exported as text or Microsoft Word files.



### INPUT

Recommendations for how to use the database provide helpful hints to make the most of this resource.

- **Detailed Description**

*Format, contents, and organization of the questions and technical discipline areas*

- **How to Use**

*- Description of key features of the site and how to use them*

*- Recommendations for how to use the site based on your role (e.g., Cog E)*

- **Creating Questions and TDAs**

*How the existing questions and/ TDAs came to be and the process for updating them*

- **Related Resources**

*Links to related sites and additional resources*

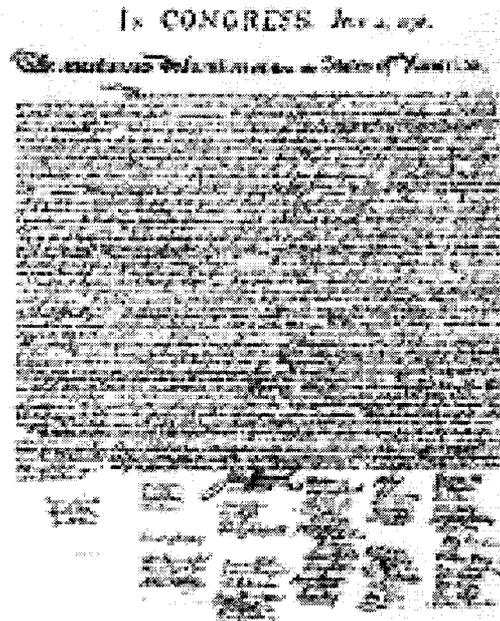
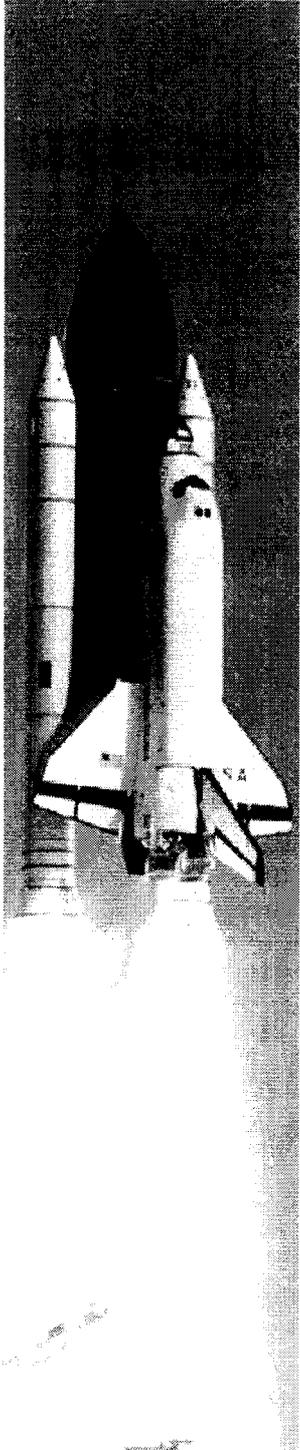
- **About this Site**

*Key participants, acknowledgements, and background of the **Technical Questions Database***

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# Adopting and Applying Standards

- ◆ Adopting standards for efficient implementation
- ◆ Core metadata, name spaces, and concurrent engineering (STEP)
- ◆ <http://step.jpl.nasa.gov>



```
@Dublin-Core-1 { ftp://ds.internic.net/internet-drafts/draft-
kunze-dc-00.txt
TITLE: The Declaration of Independence
CREATOR-1: Thomas Jefferson
PUBLISHER: The Second Continental Congress
CONTRIBUTOR-1: Benjamin Franklin
CONTRIBUTOR-2: John Adams
CONTRIBUTOR-3: Roger Sherman
CONTRIBUTOR-4: Robert R. Livingston
SUBJECT: freedom, political ties, inalienable rights, life,
liberty, pursuit of happiness
DESCRIPTION: A political treatise outlining grievances against
King of Great Britain [George III] and the the declared rights
of the American colonies and its citizens
DATE.COMPLETED 1776-07-04
DATE.SIGNED: 1776-08-02
TYPE: Political treatise
FORMAT: Hardcopy - parchment
SOURCE: National Archives, Washington, DC
LANGUAGE: en
RELATION:
COVERAGE: The United States of America
RIGHTS: Unlimited Distribution }
```

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# Expert Connections

- ◆ Finding people to get answers or work on a project, includes profiles of 1100 technical experts

## JPL KnowWho

[Home/Quick Search](#) [Advanced Search](#) [Add Profile](#) [Help](#)

JPL personnel possess expertise in a broad spectrum of Scientific, Engineering and other technical and non-technical areas. The Expert Connection will help you locate people with the expertise you need.

Related Sites: [Caltech Experts Guide](#) [Community of Science Expertise](#) [Publications](#)

Click a category below or enter a name, subject area or other descriptor of the information you seek in the search field at the right.

Exact Match? Yes  No  [Advanced Search](#)

### Technical

- [Astrodynamics & Navigation](#)
- [Chemical Systems & Processes](#)
- [Computer Science](#)
- [Control Systems](#)
- [Detectors & Detector Systems](#)
- [Energy/Power](#)
- [Environmental Compatibility](#)
- [Integration & Test](#)
- [Materials](#)
- [Mechanical & Thermal](#)
- [Metrology](#)
- [Microdevices](#)
- [Mission Design](#)
- [Operations](#)
- [Optics](#)
- [Propulsion](#)
- [Reliability Engineering](#)
- [Robotics](#)
- [Science](#)
- [Systems Engineering](#)
- [Telecommunications](#)

### Non-Technical

- [Finance](#)
- [Health and Safety](#)
- [Human Resources](#)
- [Industrial Relations](#)
- [Institutional Computing](#)
- [Legal and Regulatory](#)
- [Logistics and Facilities](#)
- [Planning](#)
- [Public Affairs](#)
- [Quality and Reliability](#)
- [Technical Information](#)

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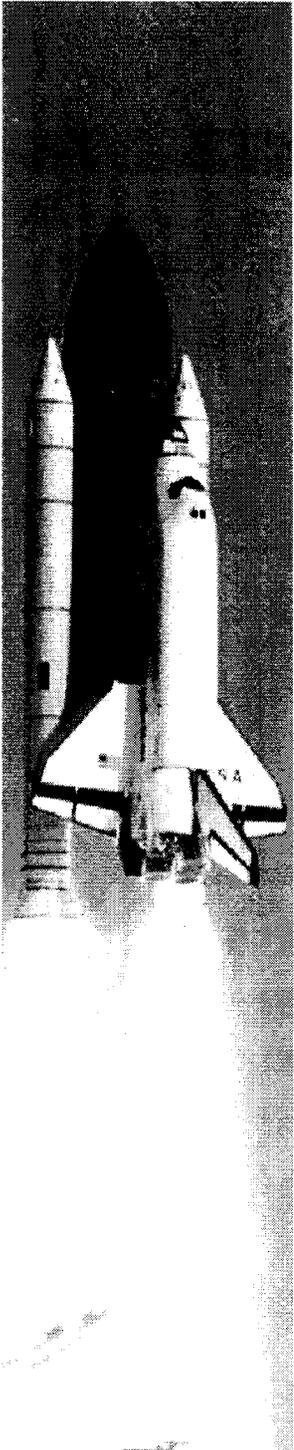
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# Moving Ahead: Communities

## *Supporting Communities of Practice*

- ◆ Enabling remote collaboration to support virtual teams and communities of practice
  - We are asking projects, teams, and research groups:
    - What services and infrastructure do virtual teams need to efficiently do their work?
    - How can we capture the “mobile” knowledge of a virtual team?
- ◆ Sample solution: Team collaboration kits
  - A welcome kit of collaborative tools and techniques, integrating new and pre-existing services
    - Integrated and engineered suite of collaborative tools
    - Integration with operational service bases
    - Proactive approach to infusing the solutions into projects
    - Shared access to specific tools, such as risk management and action item tracking



## My Lessons Learned

- Mars '03 LL 
- ISS LL
- NASA LLIS
- Thermal engineering
- Calibration

## Experts at NASA

- Search:
- Browse
- Partners on contract

## Team Training

- Mars '07 Required
- Recommended
- Management courses
- NASA APPL
- Team course reviews

## Best of the Rest

- STI Manager's ViTS
- NGST Implementation Plan
- MER Preliminary Design Review

## Help

- How do I start a team?
- How do I get help for an existing team?
- Help me now! <chat>
- 1-800-358-TEAM

Search:

# Collaboration Central



## My Teams

- Mars '03     
- ISS     
- eNASA     

## My Colleagues

- SEs   
- Cog Es    
- Research Team    
- Brian    
- Julie    

## My Project

- Risk 
- Budget 
- Schedule 
- 7120 status
- Implementation Plan
- Next Review (CDR: September 10, 2001)

## Task Support



### Services

- Risk management services
- Scheduling services
- Resource tracking services
- Team training services

### Tools



- Microsoft Project
- CA SuperProject (GRC)
- Welcom OpenPlan
- Primavera
- iTeamwork
- Doors
- RequisitePro (JPL)
- DekkerTracker (Stennis)
- Artemis
- Milestones
- FastTrak

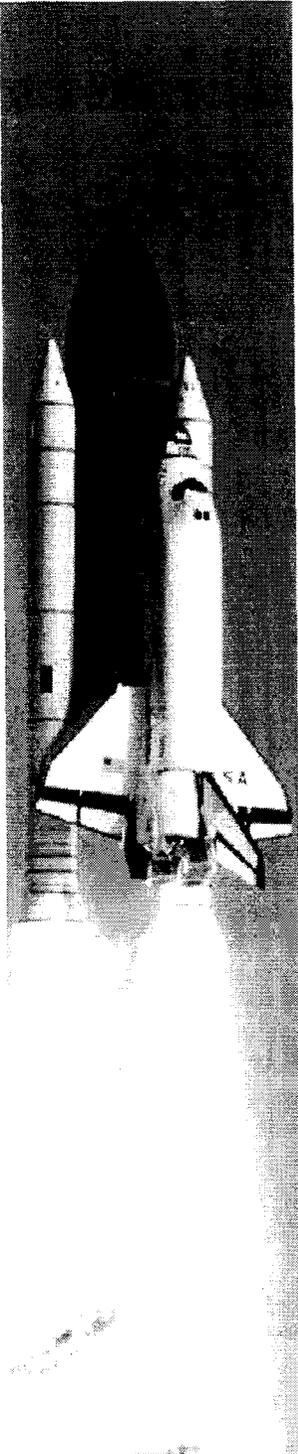
## Management Community

- PPM Newsgroup
- Hot topics and solutions
- Events and workshops

## Set Up and Tools



- New Team kit
- Teleconference
- Dataconference
- Videoconference
- Chat
- Documentation systems
- Training



# JPL Knowledge Management Roadmap



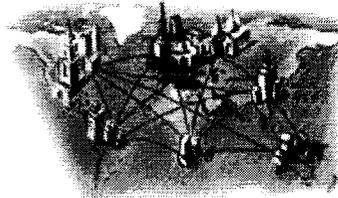
## Sharing Knowledge

- Adaptive knowledge infrastructure is in place
- Knowledge resources identified and shared appropriately
- Timely knowledge gets to the right person to make decisions
- Intelligent tools for authoring through archiving
- Cohesive knowledge development between JPL, its partners, and customers

*Enables sharing of essential knowledge to complete Agency tasks*



- MarsNet
- Europa Orbiter
- SIM



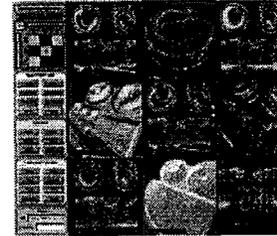
## Integrating Distributed Knowledge

- Instrument design is semi-automatic based on knowledge repositories
- Mission software auto-instantiates based on unique mission parameters
- KM principals are part of Lab culture and supported by layered COTS products
- Remote data management allows spacecraft to self-command

*Enables seamless integration of systems throughout the world and with robotic spacecraft*



- Europa Lander/Submersible
- Titan Organics: Lander/Aerobot
- Neptune Orbiter/Triton Observer



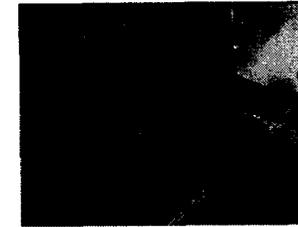
## Capturing Knowledge

- Knowledge gathered anyplace from hand-held devices using standard formats on interplanetary Internet
- Expert systems on spacecraft analyze and upload data
- Autonomous agents operate across existing sensor and telemetry products
- Industry and academia supply spacecraft parts based on collaborative designs derived from JPL's knowledge system

*Enables capture of knowledge at the point of origin, human or robotic, without invasive technology*



- Mars robotic outposts
- Comet Nucleus Sample Return
- Saturn Ring Observer
- TPF



## Modeling Expert Knowledge

- Systems model experts' patterns and behaviors to gather knowledge implicitly
- Seamless knowledge exchange with robotic explorers
- Planetary explorers contribute to their successor's design from experience and synthesis
- Knowledge systems collaborate with experts for new research

*Enables real-time capture of tacit knowledge from experts on Earth and in permanent outposts*



- Interstellar missions
- Permanent colonies

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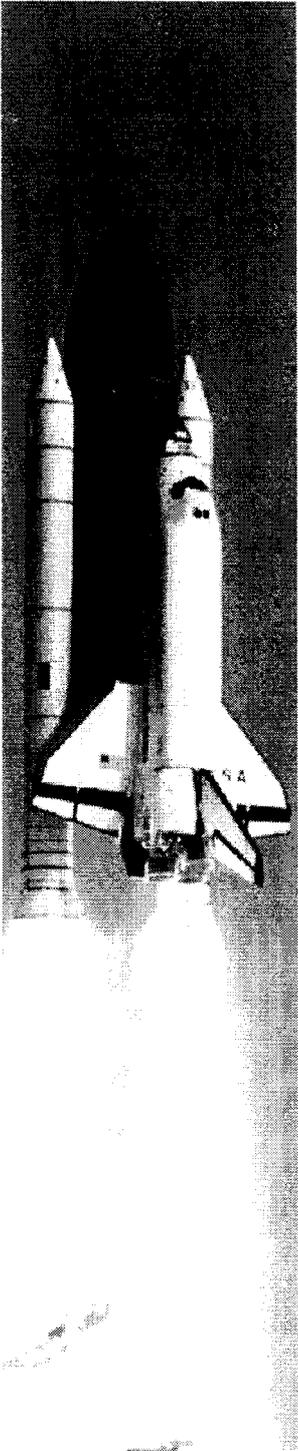
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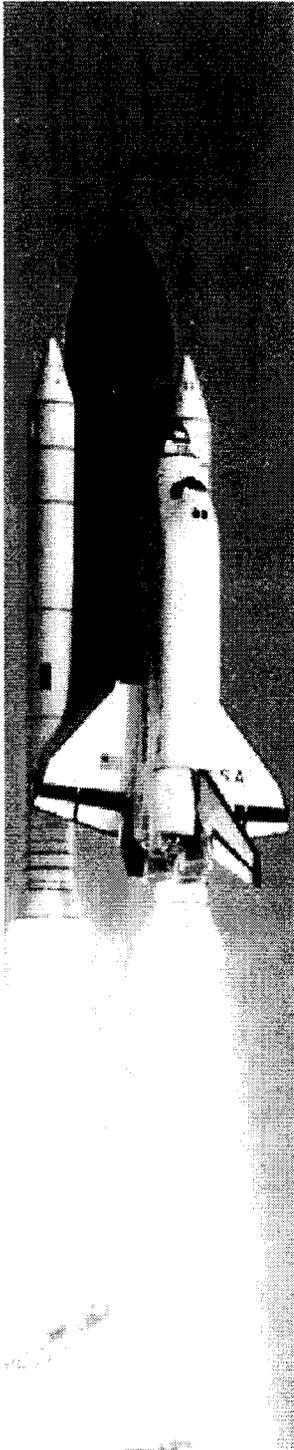
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# Lessons Learned

- ◆ Enlist, encourage, empower (baptize the evangelists)
- ◆ Develop solutions, services, and rewards
  - Deliver specific solutions to specific customers
  - Build KM into the way people already do their jobs
  - Understand that cultural acceptance is key
  - Make services operational (including funding and metrics)
  - Reward knowledge sharers through promotions, recognition, and time to learn and share
  - Recognize and celebrate contributions of the KM team and others
- ◆ Keep the alliances strong
- ◆ Balance long-term desires (capturing knowledge) with local requirements (specific solutions to a problem)
- ◆ Don't try to solve the whole problem—just start somewhere and solve part of the problem





# Thanks!

- ◆ Many thanks to my JPL and NASA colleagues and our academic partners who contributed to these ideas and to the excellent work they are doing in implementing knowledge management solutions at JPL and NASA
- ◆ If you have any additional questions about KM or the work of JPL or NASA, please contact me:

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<http://km.nasa.gov>