

Developing JPL's Knowledge Management Program

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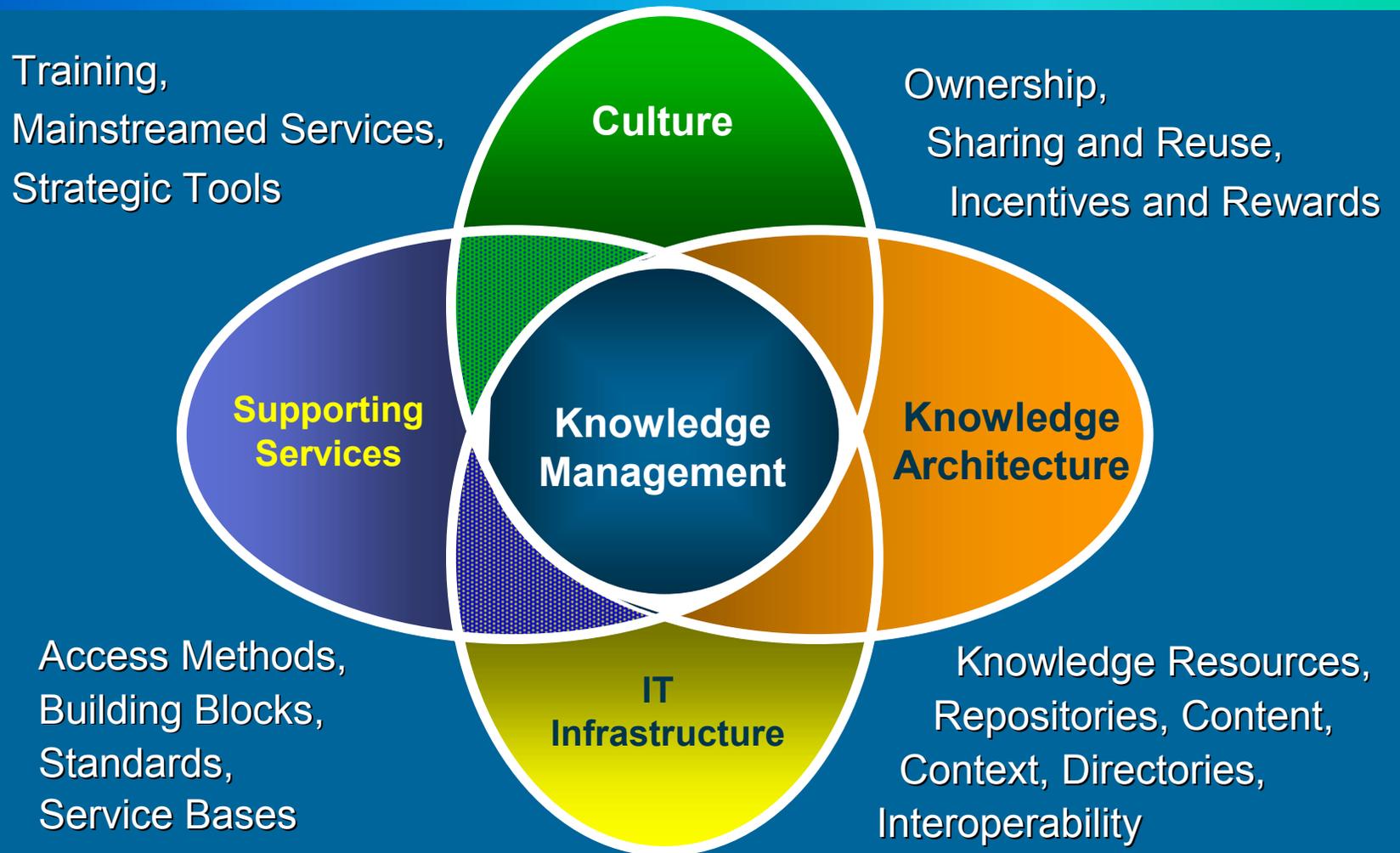
NASA KM Team
October 16, 2001



Formation

- In 1997, JPL realized there were issues related to the way in which we managed our knowledge
- We held a series of several all-day workshops to understand what was going on and chartered a system engineering team to develop an approach to KM
 - *A Knowledge Management Architecture for JPL*
- In April 1998, JPL formed a KM program under the CIO and we began to pull together good existing solutions and develop new solutions
- Built as a federation of processes, systems, and services, the KM project supports the JPL population and our outside partners

KM Critical Success Factors Learned from Benchmarking



Recognizing the Importance of Culture

- The most critical factor in the success of a KM implementation is cultural acceptance
 - Recognizing issues of data ownership
 - Individual vs. organization
 - Individual vs. team
 - Acknowledging the appropriateness and acceptance of knowledge sharing and reuse
 - Knowledge reuse is not always perceived by the individual to be “good” (innovation or creation is “better”)
 - Rewarding individuals and teams for promoting KM when they
 - Capture team discussions and decisions
 - Create a supportive environment for mentoring
 - Document and share lessons learned
 - Make tacit knowledge explicit

KM's Goal is to Unite Knowledge Seekers with Knowledge Resources



Creating a Knowledge Architecture

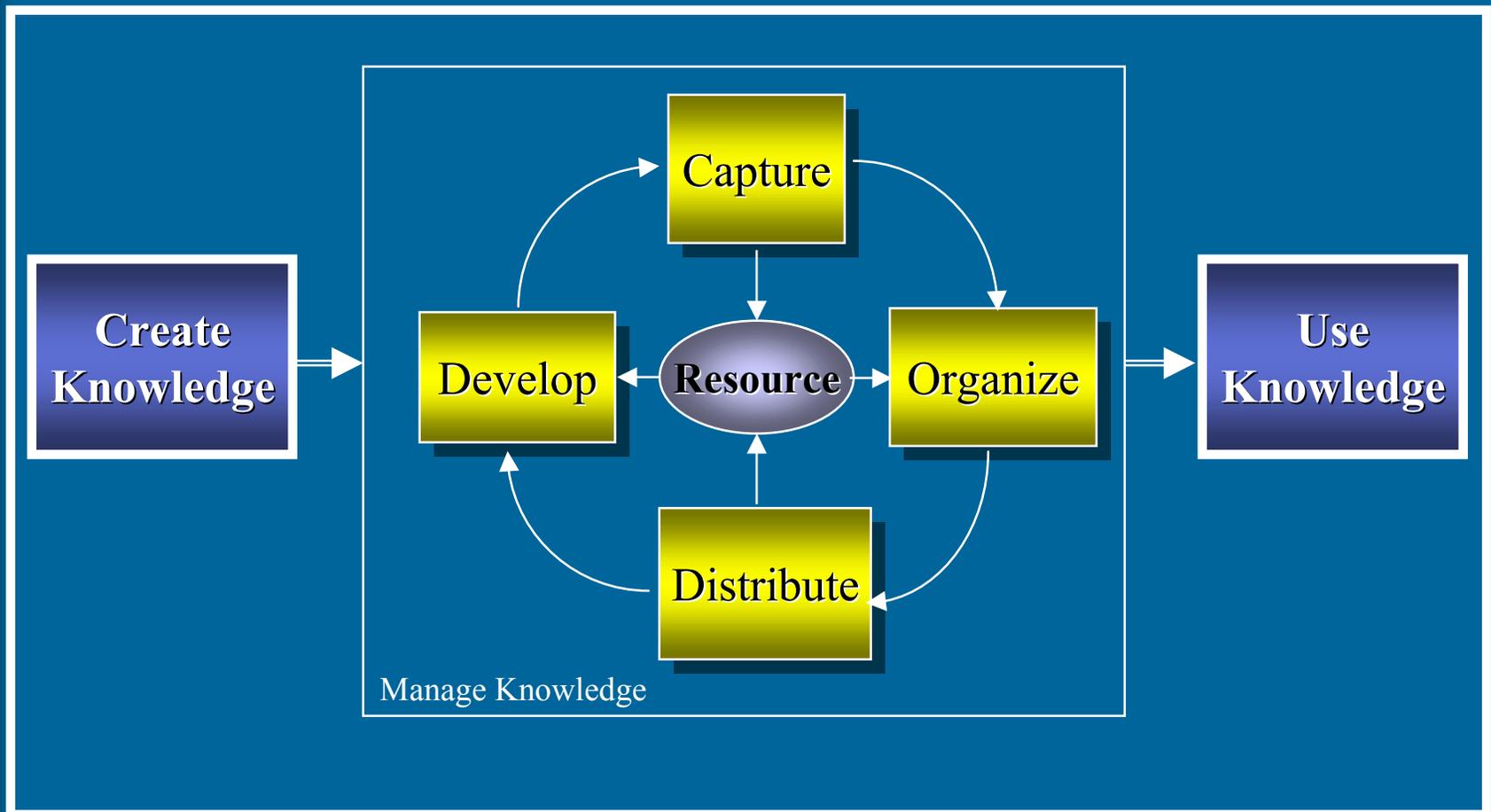
- There are three ways to look at architecting a KM program
 - **Process:** Oriented on the way in which people do their day-to-day work in the organization (the *how* and *why*)
 - **Services:** Focused on who will help people share their knowledge and who will maintain tools and processes (the *who*)
 - **Systems:** Are the IT infrastructure and tools necessary to deliver the processes and services efficiently and effectively to the end users (the *what* and *where*)



Services Processes Systems

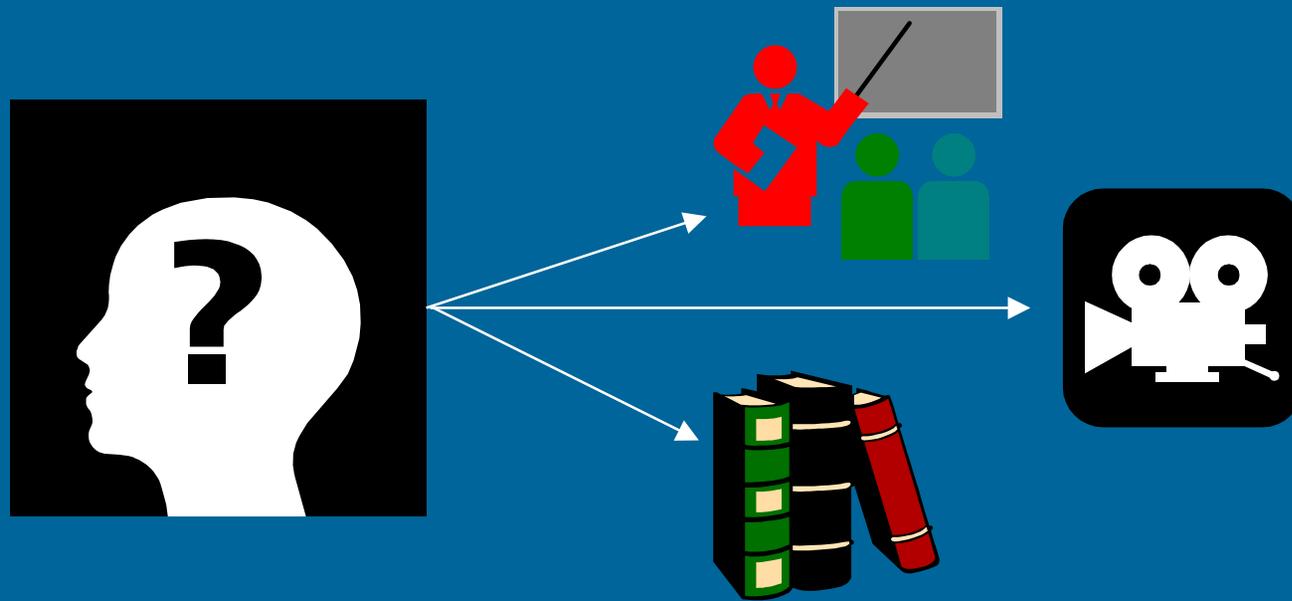
Step 1. Creating KM Processes

(a.k.a. "Doing Work") (Adapted From Ernst and Young)



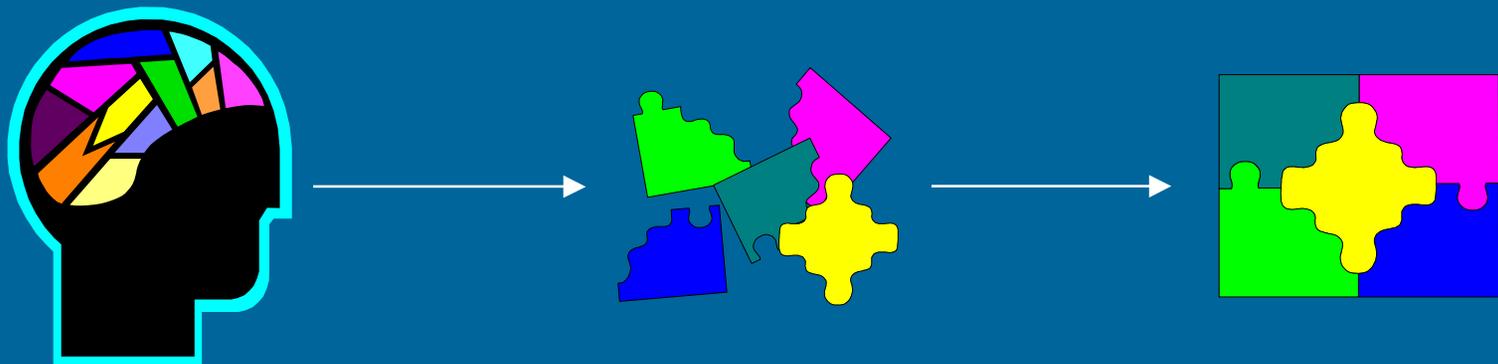
Capture Knowledge

- Helping people articulate knowledge that can be easily shared and reused
- Supporting people in moving tacit knowledge to explicit knowledge



Organize Knowledge

- Organize information so that people can easily share it, find it, and use it once it's found
- Structure information in standardized ways for use by others



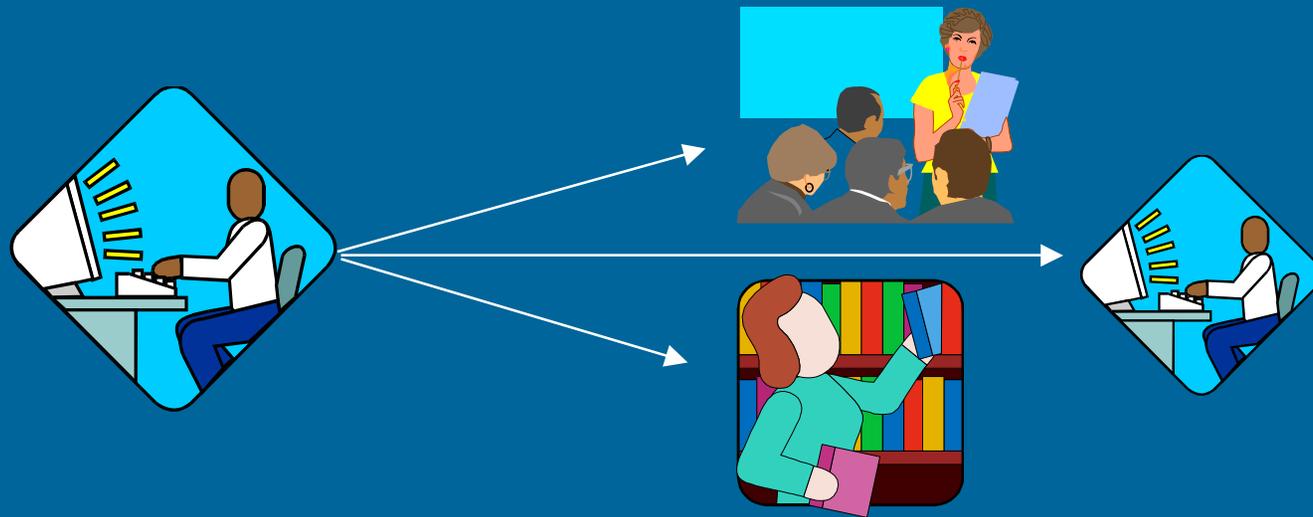
Develop Knowledge

- Refining knowledge so that it can be easily reused by others (such as others on your team, future teams, or in your discipline)
- Selecting which knowledge will be most useful based on the question asked or the need defined



Distribute Knowledge

- Helping people get access to knowledge
- Encouraging people to use and reuse knowledge
- Training people in how to use the knowledge management tools



Step 2. Establishing KM Services

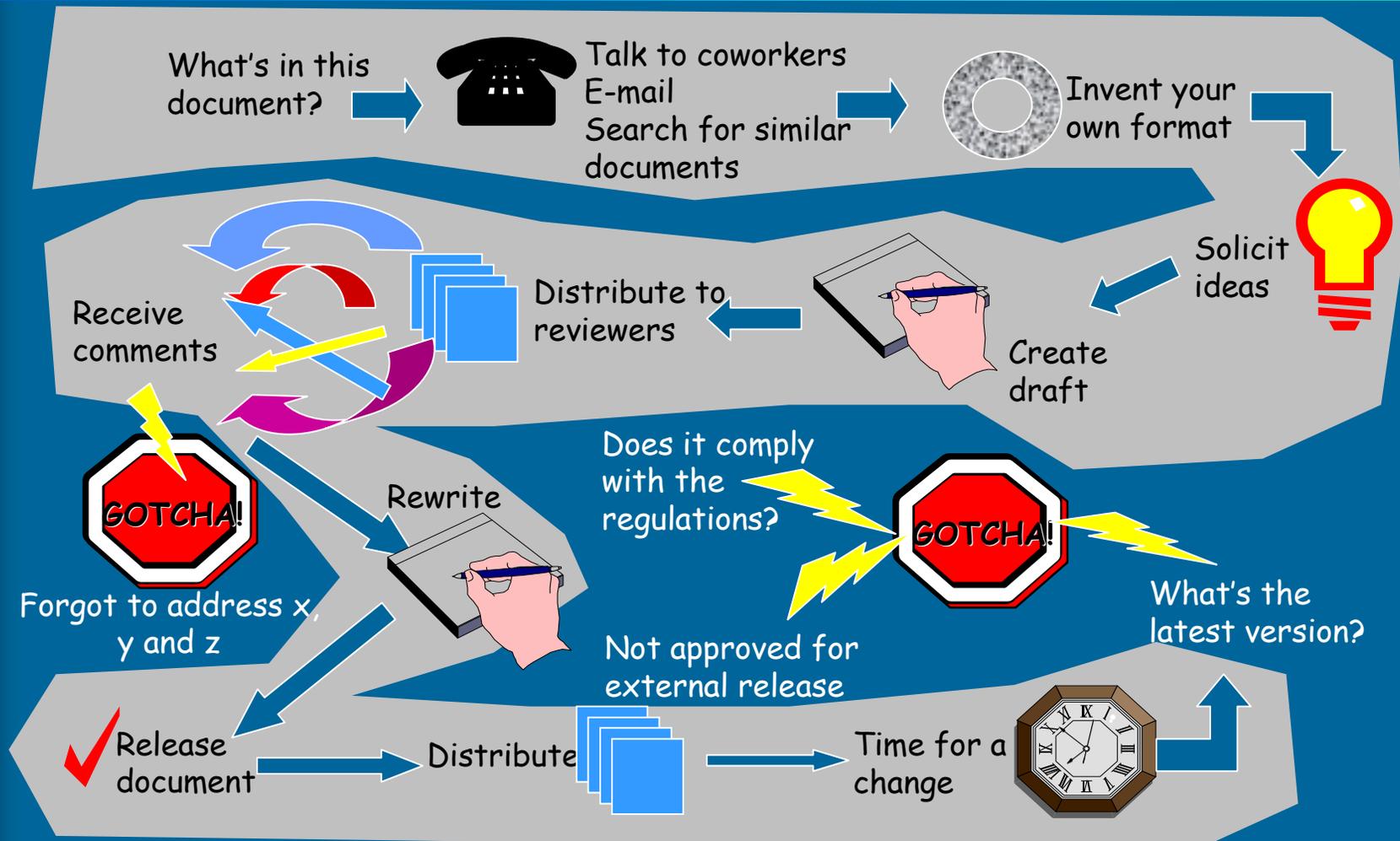
- The way in which people in an organization interact with knowledge management activities is through a service
- Services integrate processes, people, and systems into a cohesive support structure for how people actually do their work
- The “build it and they will come” mentality doesn’t work in the deployment of content-rich, enterprise-wide systems
 - Users need to be an active part in order to keep content refreshed, accurate, and relevant

A Sample Service: Document Management

- Document management is about much more than a shared, accessible repository enabled by workflow. It addresses the
 - Authoring environment (templates that include content guidelines and samples of good material)
 - Information lifecycle (how do objects move from stage to stage and how are they reused?)
 - Service base (where and who do you go to for support today, tomorrow, and in two years?)

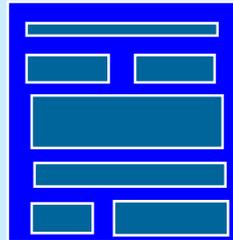


Writing a Document Before KM Services...

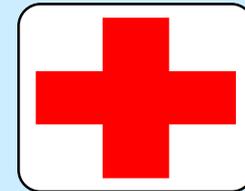


Writing a Document in a KM-Enabled World...

 What's in this document?



Template with all required areas



Subject matter experts



Good examples

 Review and release



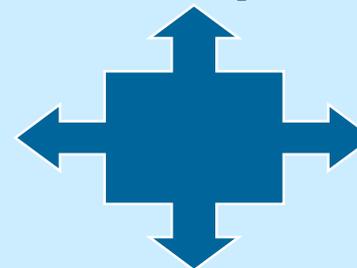
Collaboration tools



Regulatory compliance



Rules and regulations



Routing and distribution

Step 3. Develop a KM System Architecture

- A layered approach, building upon already existing infrastructure and services, KM provides
 - **User interface**
 - Enterprise portal or web sites with data channels for roles, interests, and disciplines
 - **KM functions**
 - Virtual team environments (sharing and collaborating)
 - Taxonomies for browsing
 - Robust search capability
 - **Application infrastructure services**
 - Document management
 - Content management
 - Standards



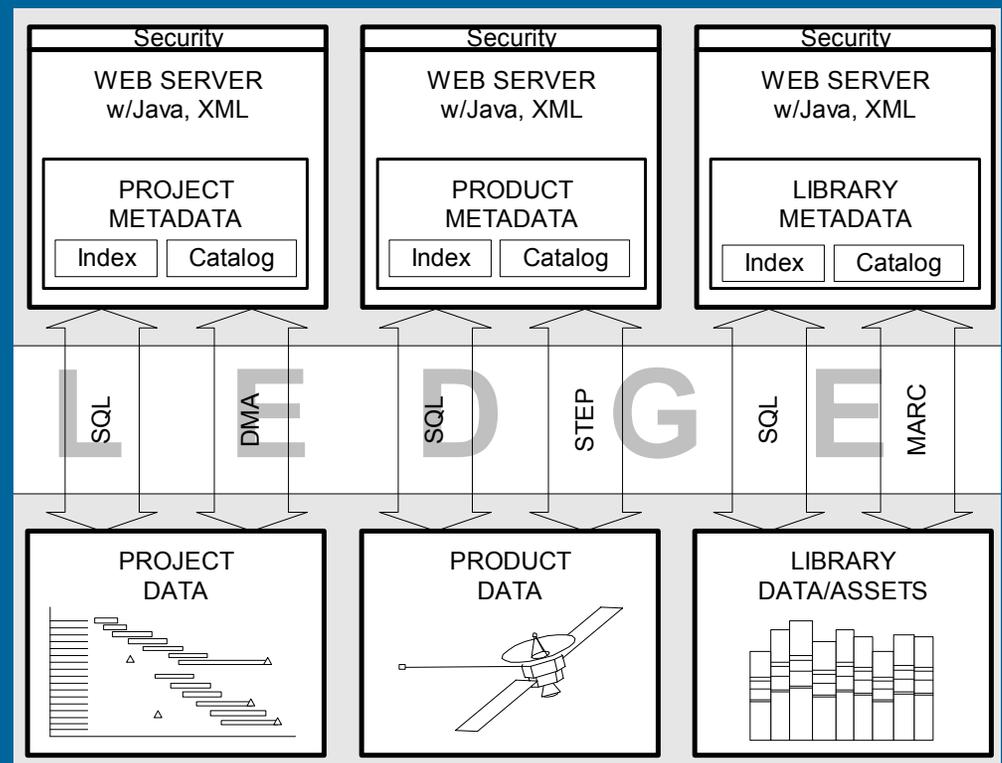
Step 3. KM System Architecture (continued)

– Knowledge resources

- Existing resources
- Experts database

– Infrastructure services

- Network
- Messaging
- File
- Desktop support
- Data access
- Security



Guiding Rule: Tie KM Solutions 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

Current KM Activities at JPL

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

- **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**
 - The 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 engineering and technology areas
 - Developing concepts and evolving those into services
 - Current tasks include personal knowledge organizers, legacy reviews, underground orientation, storytelling, lessons learned, and technical questions database for project reviews
- Thrusts
 - Codifying knowledge
 - Social networks and exchanges
 - Culture and learning

Technical Questions Database



The screenshot shows the JPL Technical Questions Database website. At the top left is the JPL logo. The main header is a purple banner with the text "TECHNICAL QUESTIONS DATABASE" and a small graphic of a globe. Below the header are three navigation links: "ADMIN", "HOW TO USE", and "FEEDBACK". The main content area is divided into four sections, each with a small image icon and a title:

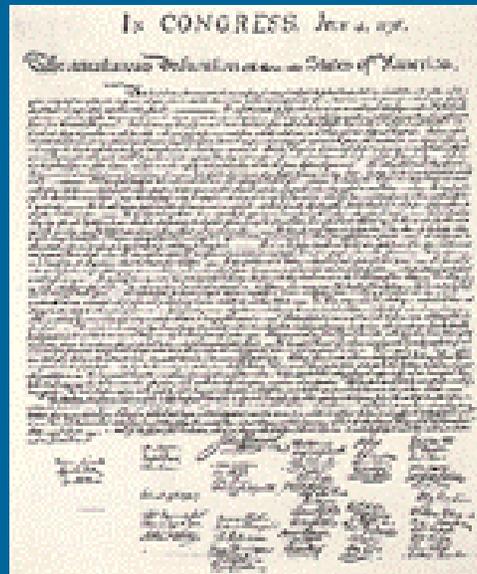
- HOT QUESTIONS**: The **Technical Questions Database** provides key technical questions that could be asked during the design process or at a review, with the purpose of identifying and preventing problems from occurring on flight projects. The database is intended to act as a "mind tickler" of items 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. Recommendations for how to use the database provide helpful hints to make the most of this resource.
- INPUT**

Below these sections is a list of links and descriptions:

- [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***

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 }
```

Expert Connections

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

The screenshot shows the JPL KnowWho website. At the top, the JPL logo is on the left and the 'KnowWho' logo is in the center. Below the logo is a navigation bar with links for 'Home/Quick Search', 'Advanced Search', 'Add Profile', and 'Help'. A paragraph of text explains that JPL personnel possess expertise in various scientific, engineering, and technical areas, and that the Expert Connection tool helps locate these experts. Below this is a 'Related Sites' section with links to 'Caltech Experts Guide', 'Community of Science Expertise', and 'Publications'. A search section follows, with a text input field, a 'Search' button, and a radio button option for 'Exact Match? Yes' (unchecked) and 'No' (checked), with a link to 'Advanced Search'. The main content area is divided into two columns: 'Technical' and 'Non-Technical'. Each column contains a list of expert categories, each preceded by a bullet point and a link. The 'Technical' categories include Astrodynamics & Navigation, Computer Science, Detectors & Detector Systems, Environmental Compatibility, Materials, Metrology, Mission Design, Optics, Reliability Engineering, Science, and Telecommunications. The 'Non-Technical' categories include Finance, Health and Safety, Human Resources, Industrial Relations, Institutional Computing, Legal and Regulatory, Logistics and Facilities, Planning, Public Affairs, and Quality and Reliability.

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](#)
- [Computer Science](#)
- [Detectors & Detector Systems](#)
- [Environmental Compatibility](#)
- [Materials](#)
- [Metrology](#)
- [Mission Design](#)
- [Optics](#)
- [Reliability Engineering](#)
- [Science](#)
- [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](#)

Expert Connections: Detailed View

[[Current Work](#) | [Key Skill](#) | [Name](#) | [Nontechnical Category Name](#) | [Organization Number](#) | [Technical Category Name](#) | [Website Name](#) | [Web Server Name](#) | [X500 Name](#)]

JPL Know-Who

Moustafa T Chahine

If you are Moustafa T Chahine, you can [Update](#) this information.

Technical Category Name	Science: Atmospheres
Nontechnical Category Name	Administrative
Key Skills	Director's Research and Discretionary Fund (DRDF)
Websites	http://ood.jpl.nasa.gov/bios/chahine.html

Finding and Sharing Information Electronically

- **Knowledge Navigation:** Getting people access to the explicit information we have
 - Using portals, taxonomies, and enhanced searching through individually customizable gateways that push and pull information to individuals and communities
 - Employing an enterprise information portal to allow customized views into internal and external resources
 - Stimulate development of interoperable standards, architectures, and knowledge transfer processes between Centers
 - Facilitate and broadcast communities of practice
 - Consolidate current, multiple publishing venues to take JPL into the next generation of web usage
 - Integrating products for the user interface from Sun, iPlanet

Portal in Development

NASA Mockup:
<http://km.jpl.nasa.gov/portal/insidenasa>

JPL Prototype:
<http://insidejpl.jpl.nasa.gov>

inside JPL
a portal to the JPL intranet
prototype release

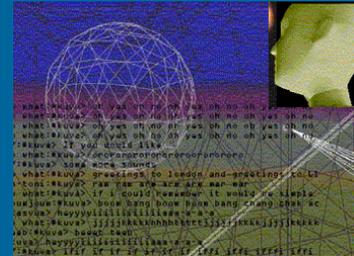
Monday, July 16, 2001 Contact the Webmaster Report A Problem | Home | Content | Layout | Help | Log Out

User Information [?] [Edit]	Labwide Announcements [?] [Edit]	This Week [?] [Edit]
My Project Libraries [?] [Edit]	Labwide Announcements <ul style="list-style-type: none">• CONFIDENTIAL DEPRESSION AND ALCOHOL SCREENING (Jul 12, 2001)• Mailhub server upgrade: Monday, July 16, 2001, 6:00 P.M. until 12:00 A.M. (Jul 10, 2001)• Submission of Time (Jun 27, 2001)• Rolling blackouts and JPL's off-site facilities (Jun 21, 2001)• Meeting Maker Upgrade June 22-25, 2001 (Jun 12, 2001) How to Post Labwide Announcements	My Calendars [?] [Edit]
Knowledge Management KIS Strategic Planning TMOD Technology (TMOT) Library CSMISS	Institutional News [?] [Edit]	JPL Speakers Calendar JPL Events Calendar NASA Launches
Quick Links [?] [Edit]	Today@JPL <ul style="list-style-type: none">• Lectures will Explore Viking Legacy, Future Missions to Mars (Jul 11, 2001)• Genesis Set to Catch a Piece of the Sun (Jul 11, 2001)• Hubble Spies Hot, Young Star Cluster in Neighbor Galaxy (Jul 10, 2001)• Dust Storm Swallows Half of Mars (Jul 9, 2001)• How Fast Does the World Turn? New Quantum Gyro May Tell Us (Jul 5, 2001)	Science Links [?] [Edit]
Phone Book Yellow Pages JPL Maps Blue Pages New to JPL Cafeteria Menu Timecard Log In	Today@NASA <ul style="list-style-type: none">• Tests Ready Airlock for Astronauts' Use (Jul 13, 2001)• Water Clouds Found Outside our Solar System (Jul 11, 2001)• Genesis Set to Catch a Piece of the Sun (Jul 11, 2001)• Native American Educators Go Back to School at NASA (Jul 10, 2001)• A Front Door for the Space Station (Jul 9, 2001)	Elsevier Chicago Press Journals American Astronomical Society
Search JPL [?] [Edit]	Aviation Week [?] [Edit]	Aviation Week [?] [Edit]
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Advanced Search	Headline News - New York Times [?] [Edit]	Weather & Traffic [?] [Edit]
Find a Person [?] [Edit]	Directory to JPL Web Space [?] [Edit]	
Last Name <input type="text"/> First Name <input type="text"/> <input type="button" value="Search"/> <input type="button" value="Clear Form"/>	Directory to JPL Web Space Employee Resources Institutional News and Events	
Go to Phonebook Front Page NASA X-500 Directory		
Google Internet Search [?] [Edit]		

Moving Ahead: Supporting Communities of Practice

- Enabling remote collaboration to support virtual teams and communities of practice
 - Integrating solutions that already exist or in development with a focus on distributed work teams
 - Collaboration infrastructure being deployed at the Center in partnership with Network Services
 - Integrated voice and data conferencing via Latitude's MeetingPlace
 - Upgrades to conference rooms and facilities
 - Webcasting services available

JPL Knowledge Management Roadmap



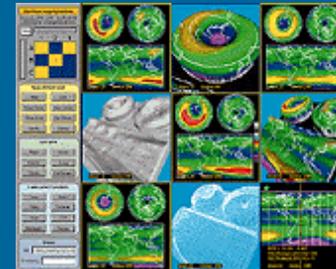
Modeling Expert Knowledge

- 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



Capturing Knowledge

- Knowledge gathered anywhere 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



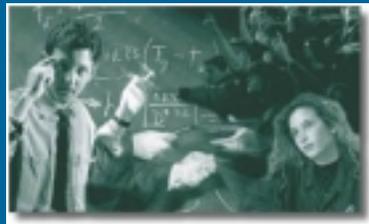
Integrating Distributed Knowledge

- 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



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

2003

2007

2010

2025

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
 - 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