STI 15-146

REAL Knowledge at NASA: A Knowledge Services Model for the Modern Project Environment

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NASA Chief Knowledge Office

I. Knowledge at NASA

- Generational Knowledge
- The Changing Landscape
- Products, Projects, Entrepreneurship
- Complexity
- Stakeholder Messages

Knowledge Spans Generations

X-15 → Space Shuttle

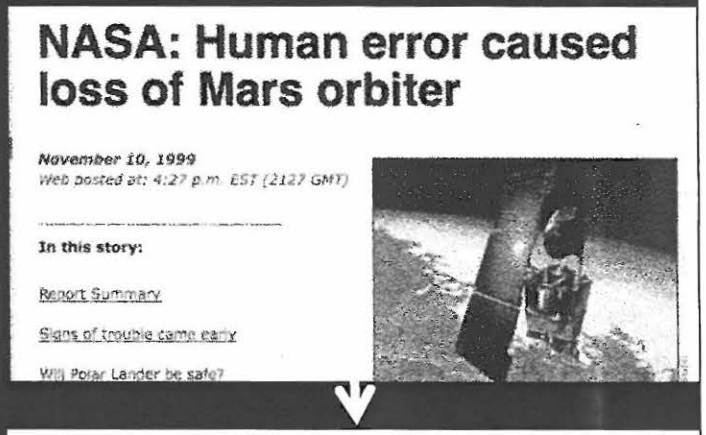
Introduced: 1958

Retired: 2010

One of the X-15's many knowledge legacies that it passed to the Shuttle was unpowered landing — both reentered the atmosphere as gliders.

The Changing Knowledge Landscape

- Managing knowledge is nothing new at NASA.
- Many early efforts were in response to specific needs.
- In recent years, agency stakeholders have identified opportunities for greater coordination and collaboration across NASA.



NASA: Human error caused loss of Mars orbiter

November 10, 1999
Web posted at: 4:27 p.m. EST (2127 GMT)

In this story:

Report Summary

Signs of trouble came early

Will Polar Lander be safe?

United States General Accounting Office

GAO

Report to the Subcommittee on Space and Aeronautics, Committee on Science, House of Representatives

January 2002

NASA

Better Mechanisms Needed for Sharing Lessons Learned

Products, Projects, Entrepreneurship

	Complex Project-Based Organization	*Mass-Production Organization*
Product	One-and-only	Scalable manufacture
Problems	Novel	Routine
Technology	New/invented	Improved/more efficient
Cost	Life cycle	Unit
Schedule	Project completion	Productivity rate
Customer	Involved at inception	Involved at point of sale
Knowledge Need	Innovation	Continuous improvement

Complexity at NASA

Complexity works against mission success:

- Confusing, vague, and poorly defined priorities, strategies, lines of authority, governance, policies, roles, responsibilities & support.
- A proliferation of customers, stakeholders, & strategic partner interfaces at multiple levels of interest, involvement & responsibility.
- Technical complexity & system integration issues within & across multiple disciplines and multiple systems.
- Increased data & information amount & availability for process input, throughput, & output.
- Multiple overlapping, conflicting, outdated processes and procedures that involve multiple points of contact distributed across multiple organizational levels & across multiple oversight & advisory entities.

Message from Stakeholders, 2002-2012

GAO 2002: "…fundamental weaknesses in the collection and sharing of lessons learned agency-wide."

ASAP 2011: "…recommends NASA establish a single focal point (a Chief Knowledge Officer) within the Agency to develop the policy and requirements necessary to integrate knowledge capture…"

OIG 2012: "…inconsistent policy direction and implementation for the Agency's overall lessons learned program."

II. Areas of Progress

- Policy and Governance
- NASA Imperatives
- Knowledge Community and Networks
- Knowledge Services Strategy
- CKO Roles and Responsibilities
  - Knowledge Transfer (Chris Scolese)
- The 4 As
  - Speaking up (Bryan O'Connor)
- Knowledge Map and km.nasa.gov

Policy and Governance

NASA collaboratively developed and adopted a new knowledge policy in November 2013. Key features:

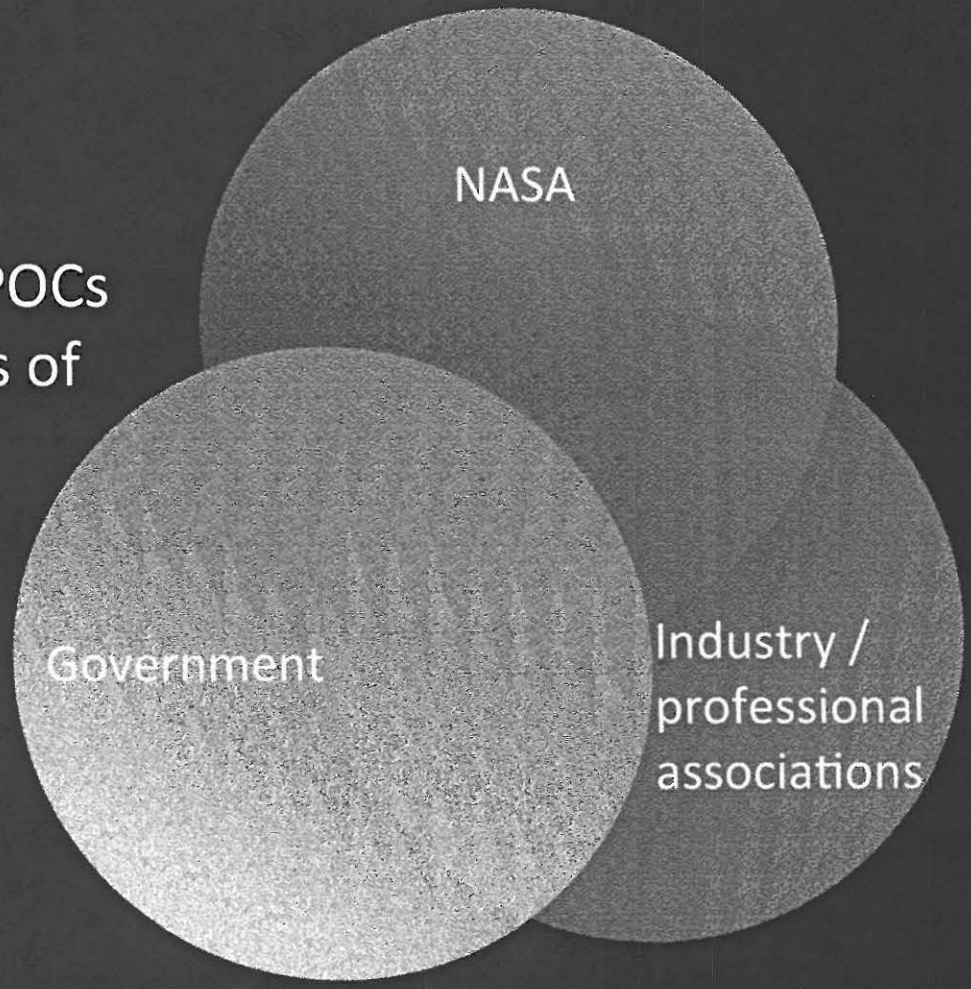
- Federated approach to governance.
- CKOs appointed at Centers, Mission Directorates, Functional Offices, with Roles and Responsibilities.
- Tools such as the first NASA Knowledge Map based on 6 activity categories that form a common vocabulary and km.nasa.gov to focus communications and distribution.

NASA Imperatives

- Supports and extends Knowledge Services gains for the NASA Technical Workforce towards improved accessibility, searchability, findability, and visualization.
- No additional cost.
- Least administrative burden.
- Formal, rigorous, iterative, and Senior Leader supported.
- Integrated, reinforcing, and actionable.
- Measurable and objective.

NASA Knowledge Community and Networks

- Agency CKO
- Local CKOs/POCs
- Communities of practice



- Federal KM Working Group

- APQC
- PMI
- IPMC
- IKTC

Knowledge Services Strategy

The goal: *Where does the NASA Technical Workforce go to find and use the critical knowledge required now and in the future to achieve mission success in a highly complex and unforgiving environment?"*

Enable accessibility, findability, searchability, and visualization of data, information and systems.	Facilitate opportunities through better communications and processes for sharing and networking.	Establish best practices for capturing & retaining, sharing & applying, discovering & creating knowledge.	Establish maturity model for knowledge effectiveness to measure and validate.

Respect local customs & enhance organizational norms (The Federated Approach).

CKO Role and Responsibilities (1)

Given the complex nature of knowledge at NASA, the agency has adopted a *Federated model* for coordination of knowledge activities.

The NASA CKO functions as a *facilitator* and *champion* for knowledge.

CKO Roles and Responsibilities (2)

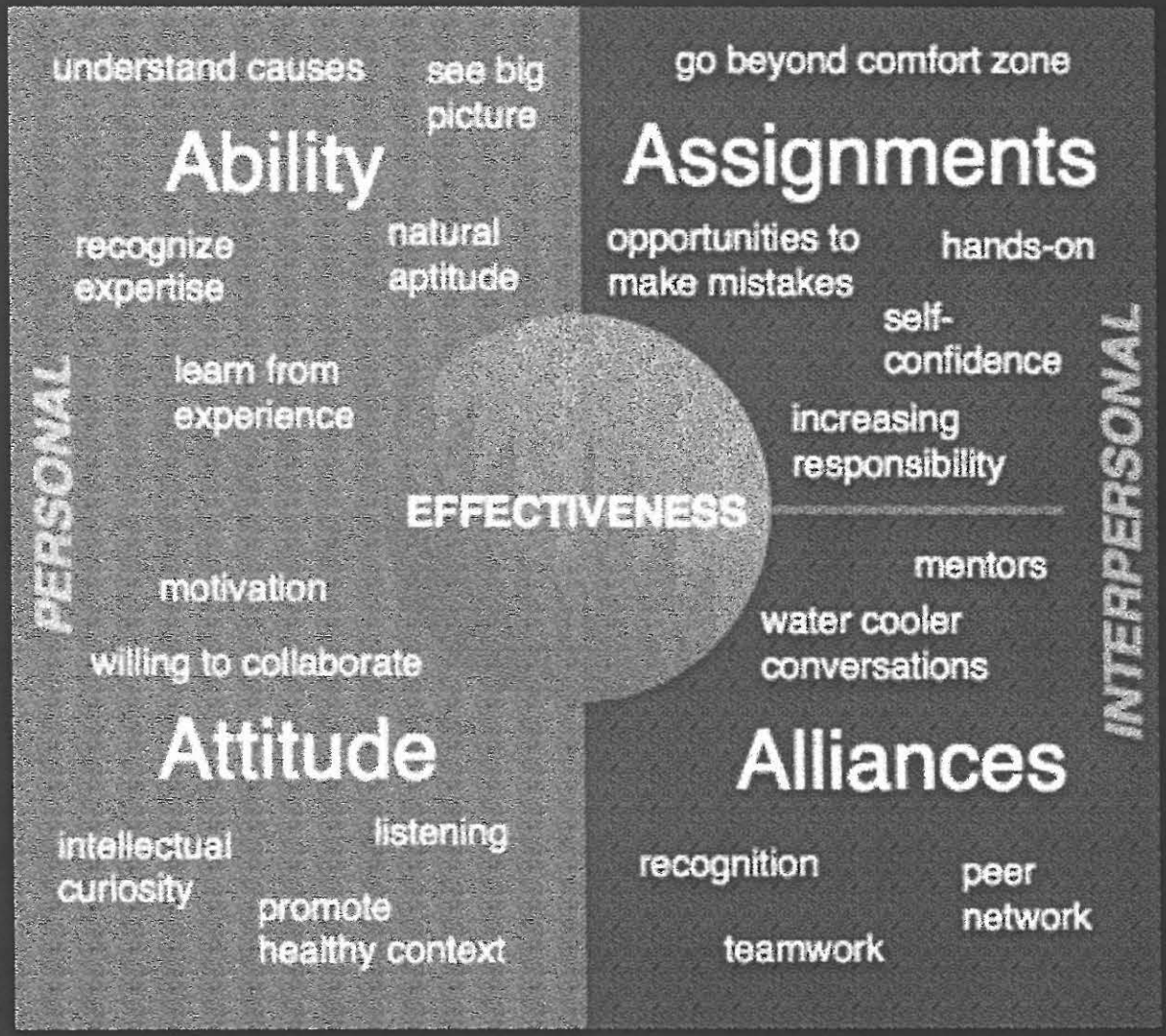
The Federated Model

Autonomy + Responsibility

Each Center and Mission Directorate determines the approach that best meets its needs.

Knowledge applicable to all NASA missions and Centers will be shared to the extent possible across the entire Agency.

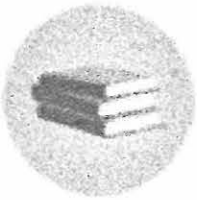
Individual Responsibility: 4 A's



Knowledge Map (1)

- Online resource at km.nasa.gov
- Information hyperlinked and sortable by:
  - Organizations
  - CKOs/points of contact
  - Knowledge categories (see next slide)

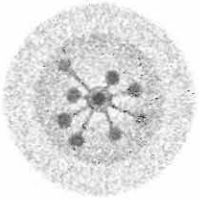
Knowledge Map (2)



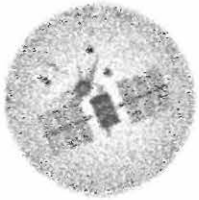
Case Studies / Publications

Face-to-Face Knowledge Services

Online Tools



Knowledge Networks

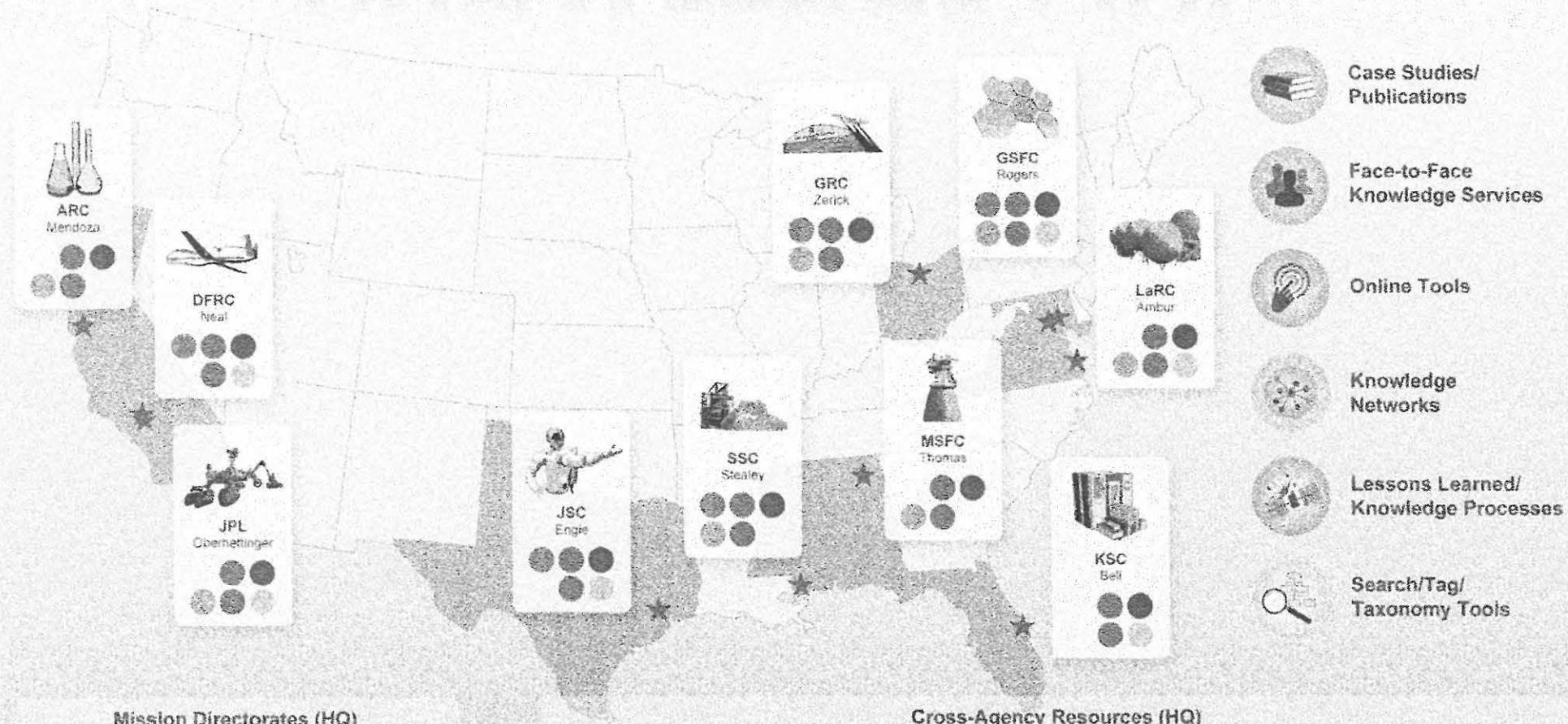


Lessons Learned / Knowledge Processes

Search / Tag / Taxonomy Tools

National Aeronautics and Space Administration's

KNOWLEDGE MAP

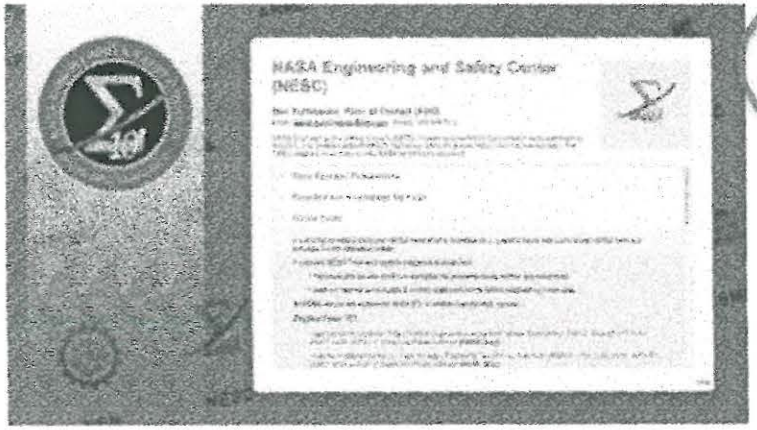


km.nasa.gov

BLOG & STORIES | KNOWLEDGE NETWORK | KNOWLEDGE MAP | EVENTS | KNOWLEDGE SHARING

Links, resources, and updates

WHAT'S NEW »



NESC Academy Announces the Release of New Online Lessons

February 12, 2014 // No Comment

The NESC Academy recently announced the release of new online lessons in the Electrical Power TDT, Loads and Dynamics TDT and Materials TDT areas.

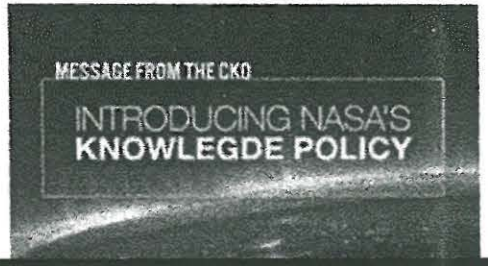
Full story

SEARCH

CKO Search

CKO communications

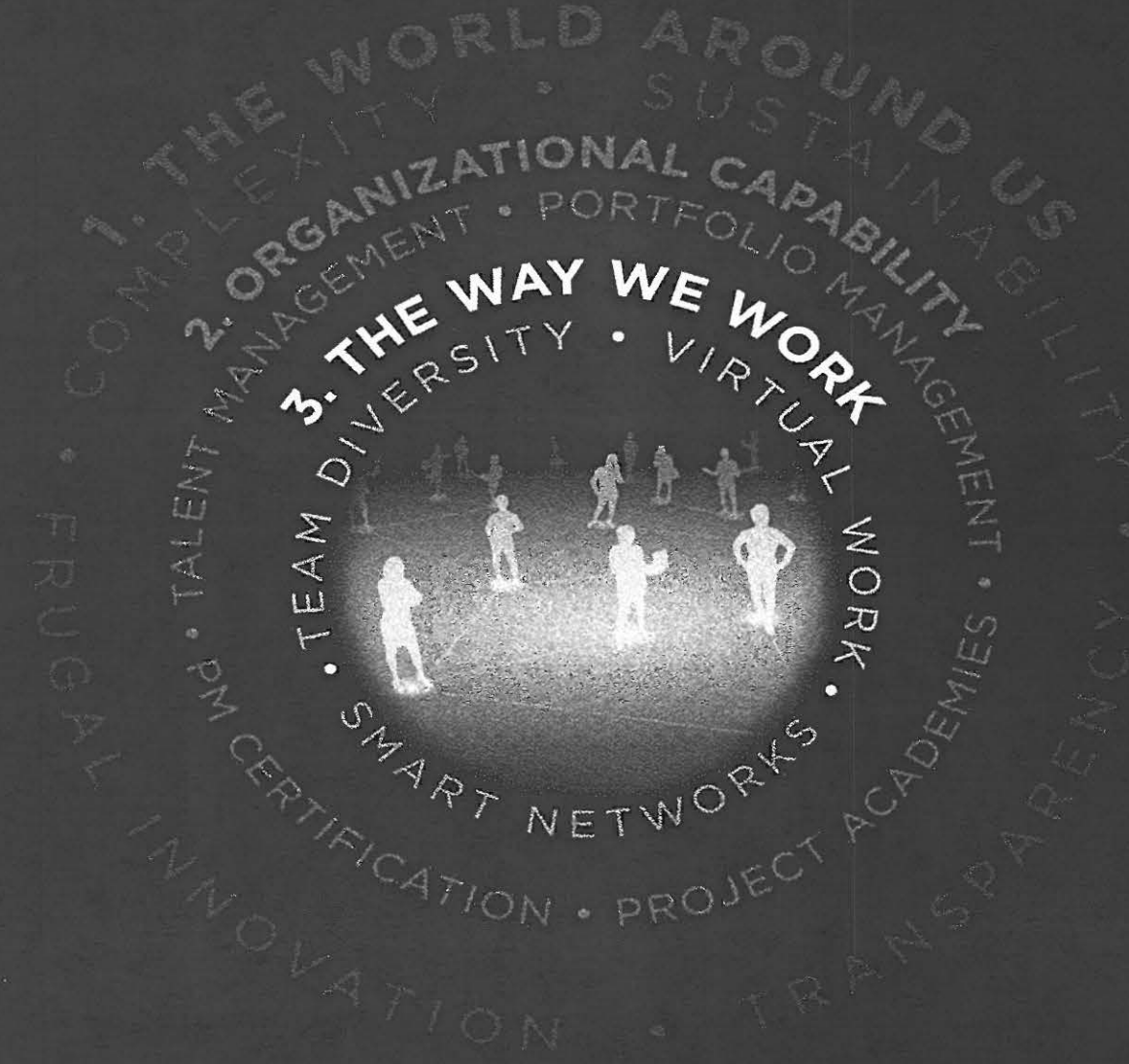
CKO BLOGSPOT



III. The Road Ahead

- Strategic Knowledge Imperatives
- Reflective Leadership
- REAL Knowledge KS Model
- Process Gaps
- Big Challenges
- Critical Knowledge and Referee Process
- Digital Tools
- Questions

Strategic Knowledge Imperatives (1)

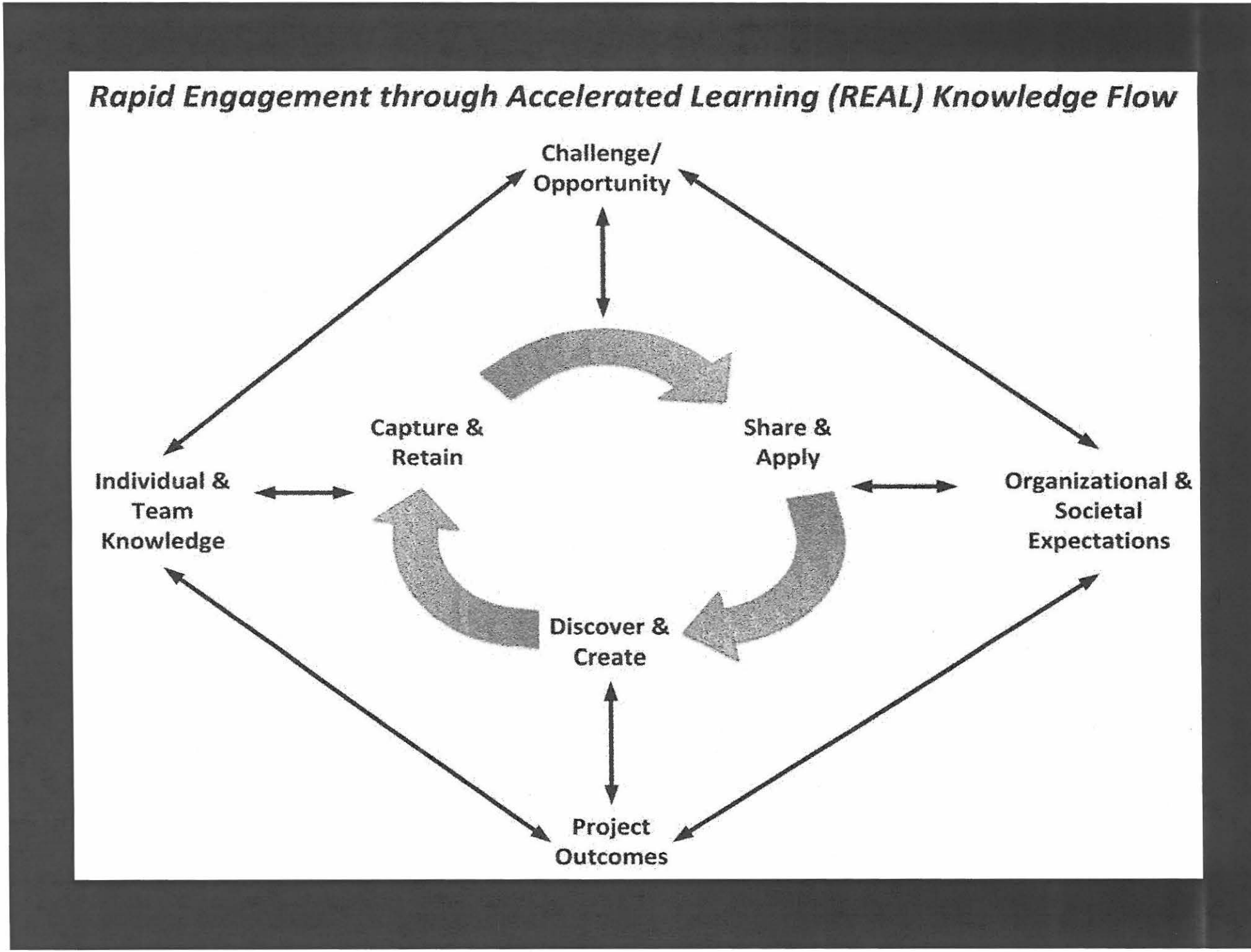


Strategic Knowledge Imperatives (2)

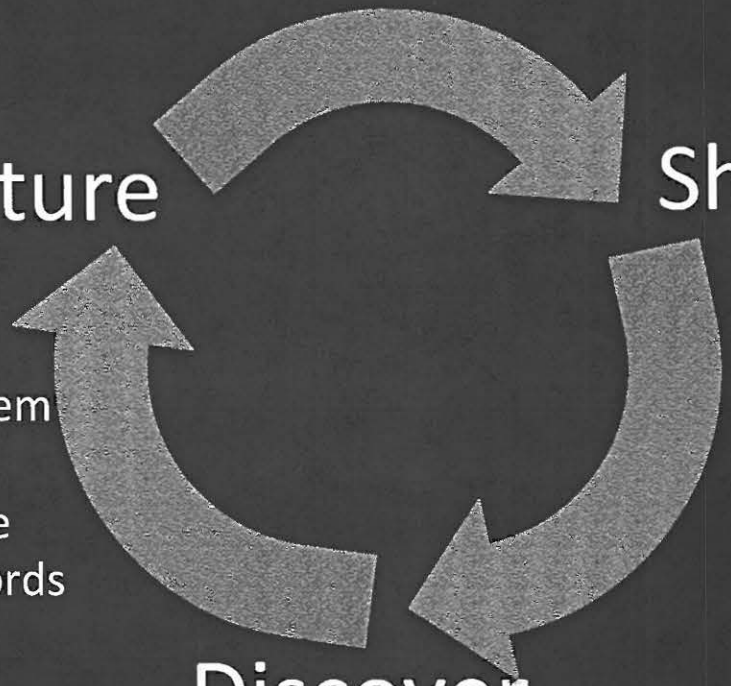
- *Leadership:* Without leadership, KS results are at best serendipitous, at worst fail.
- It is a *Project World*: An adaptable discipline that maximizes use of learning to promote efficiency and effectiveness.
- *Knowledge*: Organized set of content, skills, and capabilities gained through experience and formal and informal learning that is applied to make sense of new and existing data and information.
- *Talent Management*: Specification, identification, nurturing, transfer, maintenance, and expansion of the competitive advantage of practitioner expertise and competence.
- *Portfolio Management*: Integrates projects with strategy and creates an organizing framework and focus driving organizational purpose and activities.
- *Certification:* Objective, validated standards and functions to benchmark achievement in defined categories of practitioner performance and capability.

Strategic Knowledge Imperatives (3)

- *Transparency*: Nothing hidden for long, especially errors.
- *Frugal Innovation*: Viewing constraints as opportunities in an era of restricted and diminished resources.
- *Accelerated Learning*: Broadest view of learning using digital technologies, knowledge-sharing, learning strategies, social media, cross-discipline content.
- *Problem-centric Approach:* Non-partisan, non-biased, non-judgmental, pragmatic orientation to problems and solutions, focusing on achievement, improvement, and innovation.
- *Governance, Business Management and Operations:* Pragmatic alignment, oversight, approvals, and implementation of project operations that are not administratively burdensome.
- *Digital Technology*: Can result in open, social network-centric, non-proprietary, adaptable, and flexible frameworks to accelerate learning.


Rapid Engagement through Accelerated Learning (REAL) Knowledge Flow
Challenge/ Opportunity
Capture & Retain
Share & Apply
Individual & Team Knowledge
Organizational & Societal Expectations
Discover & Create
Project Outcomes

NASA's Gaps in Core Knowledge Processes



Capture

Mature capability:
Case studies
Lessons Learned Info. System
Videos
Shuttle Knowledge Console
Knowledge-based risk records

Share

Mature capability:
Online tools and portals
Face-to-face events
Communities of practice

Discover

Inadequate capability:
Search – enhanced ability to discover
Culture – expectation to discover
"Nudges" – reminders to discover

Big Challenges

- Findability, Searchability, Adaptability
- Prioritization of Agency Critical Knowledge
- What are the metrics and measures that capture effectiveness and efficiency in the core knowledge processes?
- What is the relationship between Knowledge Services, accelerated learning, and reducing complexity?
- Can an understanding of biases and heuristics that drive organizational and societal expectations help organizations make better decisions and design better knowledge services?

Example: Agency Critical Knowledge & Knowledge Referee Activity (1)

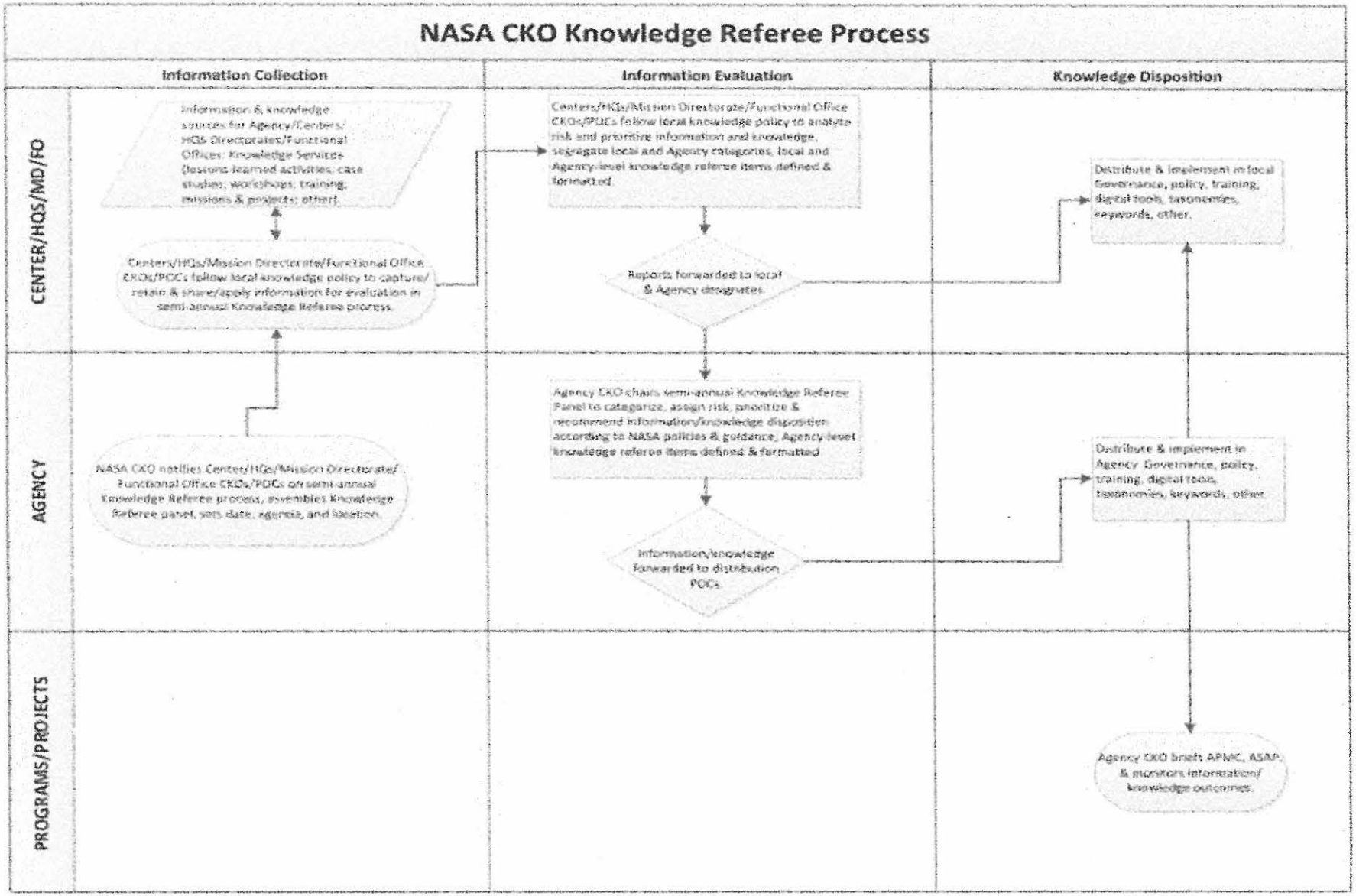
ASAP RECOMMENDATION (Status Yellow) 2014-05-19

- Knowledge Capture and Lessons Learned: The ASAP strongly recommends a *continuous and formal* effort in knowledge capture and lessons learned that will make them *highly visible and easily accessible*. *Modern tools exist* to facilitate this and NASA should avail itself of them. NASA's Knowledge Management system should include *risk-informed prioritization of lessons and a process to determine which lessons have generic (vs. local or project unique) potential*. Further, it should be supplemented by *formal incorporation into appropriate policies and technical standards of those lessons that are most important to safety and mission success*. *Rigor* in this area is particularly critical as the experience in specific skills dissipates over time and as engineering talent is stretched across programs.

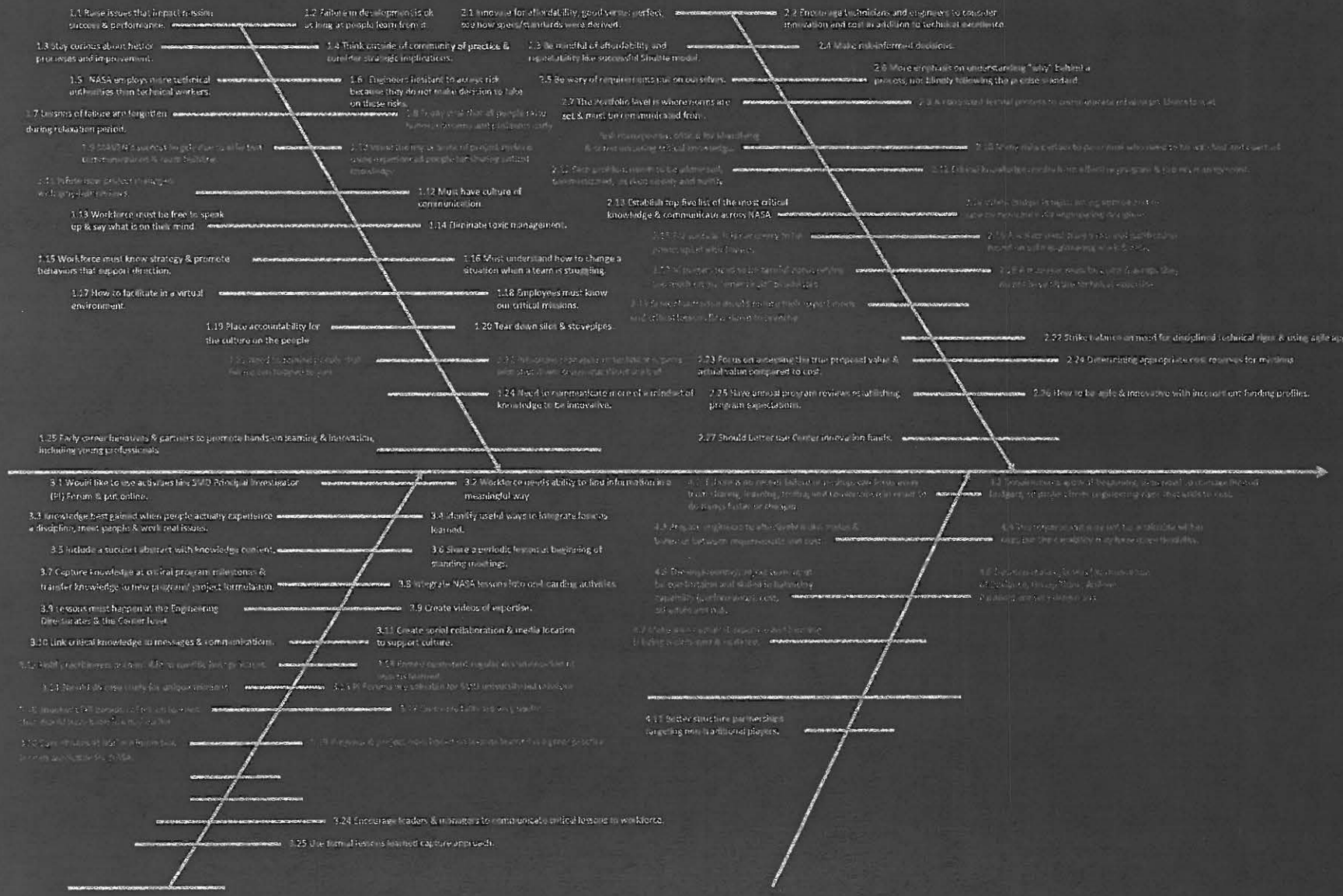
Example: Agency Critical Knowledge & Knowledge Referee Activity (2)

- NASA initiated the *Critical Knowledge* & *Knowledge Referee* process to address the open ASAP Recommendation:
  - CKO initiates semi-annual *risk-informed critical knowledge review* for safety & mission success. Sources include, but not limited to: program & project reviews; NESC Technical Reports; Mishap Findings; Lessons-Learned Information System (LLIS) submissions; ASAP meetings; & other technical findings as appropriate.
  - Knowledge Referees (OHCM for People, OSMA for Process, NESC for Discipline Technical, Agency CKO for Knowledge Services) determine which lessons possess *broad applicability* across the Agency involving top 5% of updateable knowledge *most important for programmatic & engineering missions* to learn; involves knowledge that *keeps evolving* towards new applications and missions, and lends itself to a *formal process* as candidates for formal *incorporation into appropriate policies and technical standards as well as to technical workforce development products and activities to prevent skills dissipating over time*.
  - Responses are formatted into lessons learned *tables*; a *Fishbone* diagram; km.nasa.gov; and are distributed directly to the NASA *Knowledge Community* to inform key efforts in Agency digital tools.
  - CKO monitors and advises NASA Senior Management and ASAP on information/knowledge outcomes.

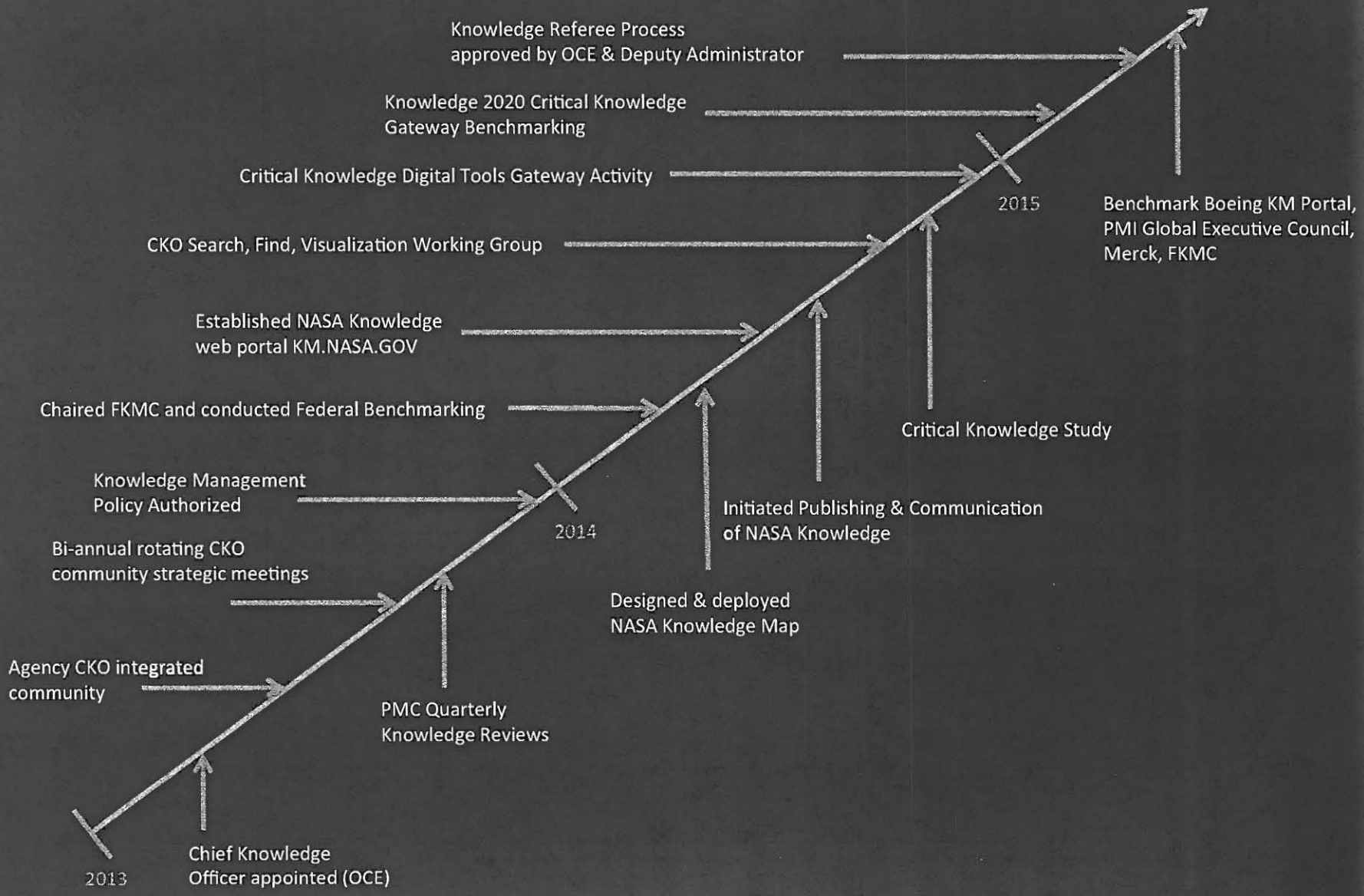
Example: Agency Critical Knowledge & Knowledge Referee Activity (2)



Example: Agency Critical Knowledge & Knowledge Referee Activity (3)



Example: Agency Critical Knowledge & Knowledge Referee Activity (4)



Digital Tools for Critical Knowledge at NASA (1)

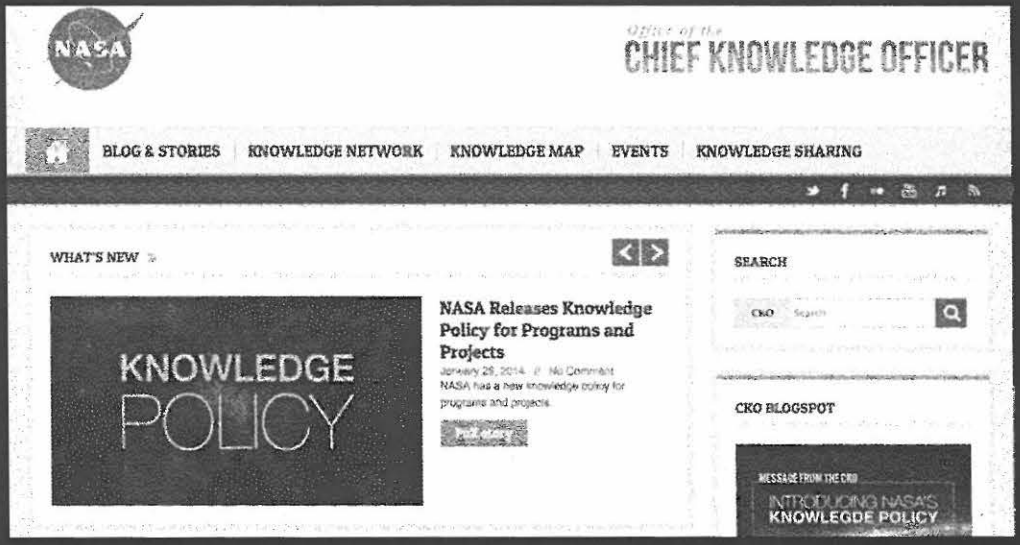
- km.nasa.gov serves as integrating mechanism and critical knowledge gateway.
- Data and information visibility, searchability, findability, and visualization are key factors driving Agency improvement efforts for Data Management, Knowledge Services, and Analytics.
- Critical Knowledge from Knowledge Referee Process drives priorities and administrative actions.

Digital Tools for Critical Knowledge at NASA (2)

- Additional actions on modern digital tools are moving rapidly by leveraging KM federated infrastructure. Examples:
  - Creation of *JPLTube* video with spoken keyword search capabilities.
  - Capture & sharing lessons at GSFC of over 50 *Case Studies* & direct support of JPL, GRC & MSFC case development & digital distribution.
  - LaRC Oral *Lessons Learned* documentation & digital distribution.
  - KSC analysis & update of Agency *Lessons Learned Information System* (LLIS) Database.
  - Active analysis at JSC of cutting-edge *Searchability* & *Findability.* Capabilities & *Shuttle Console* development that captures thousands of documents & lessons related to the program.
  - NASA CKO Office *Agency Knowledge Map* update with new content & interactivity including a new *HEOMD Knowledge-Based Risk Dashboard*.
  - New *Masters with Masters* video series on Lessons Learned and Critical Knowledge & digital distribution.
  - *Young Professionals* assisting NASA in citing best digital tools.
  - Benchmarking best-in-class Knowledge Services (Boeing and others)

Questions

web: km.nasa.gov



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