

# Connecting People Through Semantics

Series Conclusion:  
Ontologies and Knowledge  
Management for Decision Making

Jeanne Holm and Andrew Schain

# Series Context

- Desire to connect two active communities with an agency to understand the application of ontologies and knowledge management for decision support
- Key questions to be answered
  - How can we explore the intersection of Ontology and Knowledge Management and Decision Support to define promising collaborations among them?
  - How do we help people working with our organizations to discover useful knowledge?
  - How can we structure information for decision support (both known and serendipitous inquiry)? Conversely, how can we structure decision making processes to take maximum advantage of knowledge?
  - What are the ontologies to prioritize for scientific exchange?
  - How does the use of semantic technologies draw these fields closer and support better knowledge discovery and better decision and policy making
  - How could "simulation-scripting" exercises in virtual worlds accelerate the development and sustained use of ontologies in the real world?
  - How might these "simulation-scaffold" ontologies, in turn, improve the pace and complexity of learning associated with large-scale "modeling event" scenarios and mission-rehearsals that are anticipated in virtual world settings?

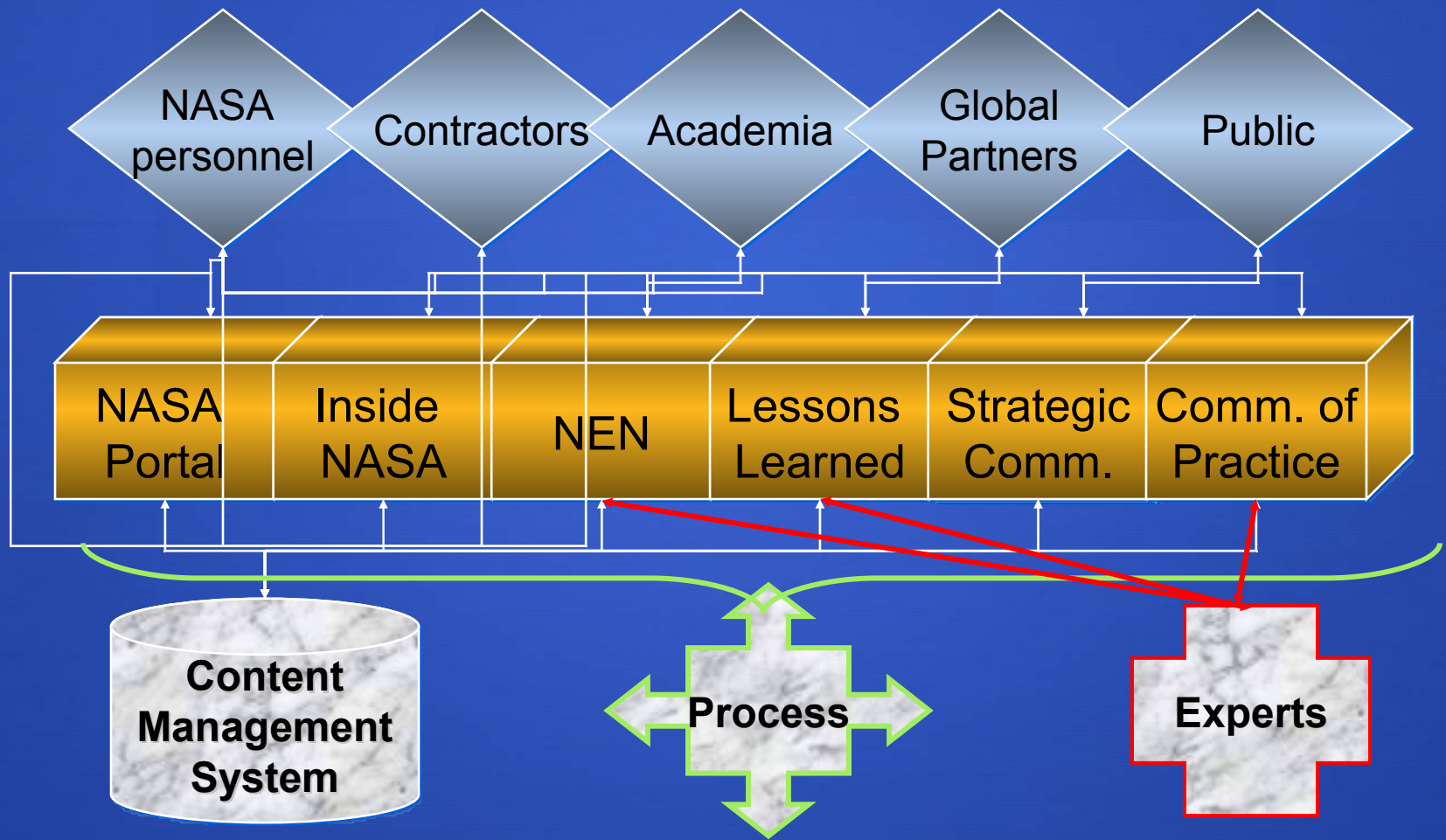
# Series Talks

- **October 25, 2007: Virtual world orientation, Charles White and Jeanne Holm**
- **November 8, 2007: Ontology in Knowledge Management and Decision Support Launch; Peter Yim and Jeanne Holm**
- **December 13, 2007: Making Better Strategic Decisions by Asking If It Going To Get Better or Worse; Ted Gordon, Peter Yim, Adam Cheyer, Denise Bedford, Pat Cassidy, Ken Baclawski, Duane Nickull and Jerry Glenn**
- **January 17, 2008: Creating Informational and Virtual Space for Knowledge Sharing; Tom Soderstrom, Jeanne Holm, and Marcela Oliva**
- **February 21, 2008: How KM Supports Decision Making in the US Federal Government; Giora Hadar, Michael Kull**
- **March 20, 2008: Organizing Science Knowledge for Discovery at NASA; Rich Keller, Rob Raskin, and Ralph Hodgson**
- **April 17, 2008: Knowledge Mapping for Sensemaking; Jeff Conklin, Simon Buckingham Shum, Eric Yeh, and Jack Park**
- **May 8, 2008: Cooperation, Human Systems Design, and Peer Production; Yochai Benkler**

# NASA Key Learnings

- Understanding how people view and navigate through information spaces
- Informing the work in taxonomies, ontologies, and information architecture underlying our KM systems
- Moving from theory to practice
- Greater understanding of using virtual worlds and Second Life for business

# Knowledge Management Environment



# InsideNASA

- For employees and partners
- Customizable
- Access to e-mail
- Secure instant messaging
- Collaborative tools
- Application integration
- Wikis and blogs (e.g. Shana Dale)

The screenshot shows the InsideNASA website with a navigation menu on the left and several content sections on the right. The navigation menu includes links for Administration @ HQ, Centers, Communities & Teams, Education, Employee Resources, Financial Resources, Information Resources, Missions & Projects, NASA Engineering Network, NASA Lessons Learned, Science, and What's New. The main content area features a 'Home' section with a 'NASA Image of the Day', 'NASA-Wide Announcements' (listing events like STS-118 and Endeavour's launch), 'NASA News from Public Affairs', 'NASA Breaking News', 'Messages from InsideNASA', 'Current Weather', and 'The TSP Ticker'. On the right, there are sections for 'Administrator's Corner' (featuring Michael Griffin), 'NASA Administrator's Q & A', 'Deputy's Corner' (featuring Shana Dale), and 'NASA Management Calendars' (showing a calendar for July 2007).

**NASA-Wide Announcements**

- STS-118 Countdown Rehearsal Set to Begin 13-Jul-2007
- NASA Announces Aeronautics Research Opportunities 12-Jul-2007
- Endeavour Arrives at Launch Pad 39A 11-Jul-2007
- Scolese to Succeed Geveden as NASA Associate Administrator 11-Jul-2007
- Mars Lander Readied for August Launch to Icy Site 10-Jul-2007

**NASA Breaking News**

- Scott Horowitz Announces Departure From NASA
- NASA Announces Aeronautics Research Opportunities
- Space Shuttle Endeavour Moves to Launch Pad
- Scolese to Succeed Geveden as NASA Associate Administrator
- Canadian Astronaut to Dismiss Role on Next Shuttle Flight
- NASA Sets Briefing and TV Coverage for Station Spacewalk
- NASA Awards Mississippi Space Center Facilities Contract
- NASA Readies Mars Lander for August Launch to Icy Site
- Dawn Rescheduled for September Launch
- Endeavour To Move To Pad, Crew Ready For Test

**The TSP Ticker**

FUND	G	F	C	S	I
Jul 13, 2007 close	\$12.02	\$11.24	\$17.34	\$21.21	\$25.43
Daily Change:	\$0.01	\$0.01	\$0.05	\$0.06	(\$0.05)
This Month (%)	0.25	-0.18	3.34	3.16	3.12

**Local Forecast**

City, State or ZIP:  Go

**NASA Management Calendars**

July 2007

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11 SMC	12 PMC	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

**2006 Calendar**

- 2007 Calendar
- Strategic Management Council (SMC)
- Operations Management Council (OMC)
- Program Management Council (PMC)

# Communities for Collaboration

The screenshot displays the NASA Engineering Network (NEN) website interface. At the top, it includes navigation links for 'NASA TV | NASA Employment', 'Customer Support | Site Help', and 'NASA Engineering Network' with sub-links for 'Employee Locator' and 'Google'. A search bar is present with the text 'Search for'. Below the header, the user is logged in as 'Jeanne Holm'. The main content area is titled 'Program/Project Management' and features a 'Main Page | PPMB | 7120.5D' section. A 'Program/Project Management Announcements' section includes a 'PM Challenge 2008 Call for Speakers' announcement dated June 8, 2007. A 'FAQs on NPR 7120.5 (D)' section lists various forum topics such as 'Decision Authority', 'Governing Documents', and 'New Definitions in 7120.5 (D)'. A 'Learn Project Management with NASA APPEL' section lists resources like 'APPEL website', 'Case Studies', and '100 Lessons Learned for Project Managers'. A 'NASA Project Management' section lists requirements for space flight programs and lessons learned. On the right side, there is a 'Project/Program Management Community' section with a welcome message from Michael Blythe, a 'POLARIS' section for the 'Program/Project Online Library And Resource Information System', and a 'Design Suggestions & Recommendations' form. The footer includes the NASA logo, 'National Aeronautics and Space Administration', contact information, and the text 'NEN v 2.0'.

Integration to document management

Saved searches and subscriptions

Find information

Discussions and Q&A

Key lessons are integrated into the community

# Discovering Knowledge in New Ways

- **Semantic SEEK**
  - Searching engineering expertise and knowledge (MIT, Sir Tim Berners-Lee)
    - Semantic query to dynamically integrate distributed content and context
    - Focusing on lunar mission data from international partners
- **Explorer Island--Second Life immersive avatar-driven environment for collaboration and engineering**
  - Mission support (modeling and simulation, collaboration, proposal development, and more); outreach; education; and training





# What is POPS?

- **An expertise location service that harvest and reuses information from existing disparate NASA data sources and enables customer driven polyarchical queries.**
- **Really an exemplar to illustrate you can reuse existing systems and get out of the build-an-adhoc-query-report business.**
  - X.500 at MSFC/LDAP (people, locations, and organizational structures).
  - CMS at KSC/.Net (Competency Management System our formal skills database).
  - WIMS/Oracle at LaRC (Workforce Information Management System what we bill to).
  - NTRS/HTML (NASA Technical Reports Server many of our engineering publications).
- **Originally sponsored by the NASA Office of the Chief Engineer's NASA Engineering Network (NEN) Program and the HQ Information Technology Division.**

# Project Objectives

- **Meet the customer requirements, make it available to everyone at NASA, and prove a point.**
  - We can begin to look at existing information systems as sources for both logic and data.
  - We can migrate away of trying to anticipate in advance what queries customers will need.
    - Information management needs to focus on areas that facilitate candidate systems being promoted.
      - Standards in interface controls
      - Mechanisms for nomenclature alignment and metadata publication
      - Understanding of quality in data and concepts
- **This needs a Program, must be cross-cutting, long range, multimission, and because policy guidance, standards, and technology all need to play.**

# Problems are Wonderful!

- POPS currently includes NASA civil servant information only. Contractor information to build a Social Network is not included. This, for example, means that the majority of published JPL employees' papers will not be as easily discovered. **This is an issue that reflects how we keep similar information in multitudes of ways.**
- Some users may want to experiment with using the POPS client with other data sources. While the client provides the ability to change between data-sources and use different models to view the data, it is outside of the scope of the pilot and is considered an advanced feature. **This issue gave us a real sense of how hungry the community is for automagic discovery and polyarchical queries - it drove us to create new combinations of models and ways for models to self-register.**
- POPS is an people locator and the goal when browsing data using the POPS client is to establish a set of constraints that yield a person or list of persons. Since you are always driving toward the goal of finding people, the Person column is considered the goal column. The goal column is different from the other columns in the interface in that it cannot be closed, and it must always be the right-most column. You also cannot add columns to the left of the goal. **This issue shows us that the freer the form for queries the better and lead us to construct jSpace in a way where all columns are configurable.**

# POPS Demonstration

- **The basics**
  - **Interface layout**
  - **Navigation**
  - **Creating constraints for queries**
  - **Social network**

# POPS screenshots <sub>1</sub>

The screenshot displays the jSpace v.41 web application interface. The title bar indicates the user is logged in as 'Michael Grove' and is using the 'POPS on FatDuck Model'. The main interface is divided into several sections:

- Search Results:** Four panels show search results for different categories:
  - NASA Center (15):** Lists various NASA centers, with 'GSCFC' and 'LARC' highlighted.
  - Project (241):** Lists various projects, with 'Glory Mission' highlighted.
  - Competency (216):** Lists various competencies, with 'Advanced In-Space Propulsion' highlighted.
  - People (1):** Lists one person, 'Eric H.', who is highlighted.
- Information Panel:** A detailed view of the selected person, 'Eric H.', showing contact information and organizational details:
  - Eric H.**
  - fax:** 301.286.1718
  - hasEmployer:** NASA
  - phone:** 301.286.1718
  - firstName:** Eric
  - mbox:** eric.h. [redacted]@nasa.gov
  - ldapDN:** cn=Eric H. [redacted], ou=Goddard Space Flight Center
  - hasDepartment:** GSFC:597.0
  - roomNumber:** 8118
- Navigation:** Buttons for 'Details', 'Query', 'Alternate Paths', and 'Web View' are located at the bottom of the Information Panel.

# POPS screenshots 2

The screenshot displays the JSpace v0.28 RC1 interface. The title bar indicates the user is connected to 'POPS Sesame' and logged in as 'Default User'. The interface is divided into several sections:

- Filter Panes:** Five panes at the top allow for filtering results based on different criteria:
  - NASA Center (Source: LDAP):** Lists centers like ARC, DFRF, CRC, HQ, JSC, KSC, LARC, and SSC.
  - Project (Source: WIMS):** Lists projects such as 'Center G&A - B&TD - Available for New W', 'Corporate Labor', 'ESMD - HSR&T - Human Systems Integration', etc.
  - Competency Sub-Category (Source: CMS):** Lists various competency suites like 'Business Operations Competency Suite', 'Computer Sci & Info Technology Competency Suite', etc.
  - Competency Category (Source: CMS):** Lists categories like 'Business Knowledge Domain', 'Engineering & Technology Knowledge Domain', etc.
  - Person (Source: LDAP):** Shows the selected person: 'McManus, John W. (HQ-JA000)'. Below this, there are 'Multiple Selections' buttons for each pane.
- Information Panel:** A large panel at the bottom showing the instance view of the selected person. It includes tabs for 'Instance View', 'Alternate Paths', and 'Query'. The instance view shows a list of properties and their values:

uupic	747603962
hasEmployer	NASA
type	http://xmlns.com/foaf/0.1/Person
worksOnProject	Corporate Labor
surname	MC MANUS
uniqueid	HQ007816
hasDepartment	JA000
firstName	JOHN
hasCompetency	Engineering of Systems Competency Suite Management Competency Suite Business Operations Competency Suite Business Knowledge Domain Engineering & Technology Knowledge Domain Business IT Systems Work Performance Leadership Leadership & Management Knowledge Domain Professional Development Competency Suite Systems Engineering International Relations Systems Integration Engineering Executive Management Integration Engineering NASA Headquarters
workAddress	employeeNumber=747603962,ou=people,dc=nasa,dc=gov
ldapDN	jmcmanus@nasa.gov
mbox	McManus, John W. (HQ-JA000)
label	tel:202.358.1802
phone	HQ
worksAt	

# POPS screenshots <sub>3</sub>

JSpace v0.28 RC1 - Connected to 'POPS Sesame' - Using Model 'POPS JSpace Model' - Logged in as 'Default User'

File Options Bookmarks Advanced Help

NASA Center (Source: LDAP)

- ARC
- DFRF
- GRC
- HQ
- JSC
- KSC
- LARC
- SSC

Project (Source: WIM)

- Center G&A - B&TD - Available for New W
- Corporate Labor
- ESMD-HSR&T-Human Systems Integration
- Education HQ Labor
- Exploration Mission Directorate
- Function to Another Center
- ISS - ISS Launch and Mission Objectives

Competency Sub-Category (Source: OMS)

- Business Operations Competency Suite
- Computer Sci & Info Technology Compete...
- Financial Operations Competency Suite
- Mission Operations Competency Suite
- Professional Development Competency Su...
- Workforce Operations & Support Compete...

Competency Category (Source: OMS)

- Business Knowledge Domain
- Engineering & Technology Knowledge Dorr

Person (Source: LDAP)

- Schain, Andrew (HQ-LD070)

Multiple Selections: and

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Information Panel

Instance View | Alternate Paths | Query | Network

Select Column constraints to relax to find similar paths

	NASA Center	Project	Competency Sub-Category	Competency Category	Person
NASA Center					
Project	HQ	Center G&A - B&TD - Avail...	Business Operations Compe...	Engineering & Technology K...	Schain, Andrew (HQ-LD070)
Competency Sub-Category	HQ	Center G&A - B&TD - Avail...	Business Operations Compe...	Business Knowledge Domain	Schain, Andrew (HQ-LD070)
Competency Category	HQ	Available for New Work	Business Operations Compe...	Engineering & Technology K...	Schain, Andrew (HQ-LD070)
Person	HQ	Available for New Work	Business Operations Compe...	Business Knowledge Domain	Schain, Andrew (HQ-LD070)
	HQ	Corporate Labor	Business Operations Compe...	Engineering & Technology K...	Schain, Andrew (HQ-LD070)
	HQ	Corporate Labor	Business Operations Compe...	Business Knowledge Domain	Schain, Andrew (HQ-LD070)

Find Paths Show Path

# POPS screenshots 4

JSpace v0.2B RC1 - Connected to 'POPS Sesama' - Using Model 'POPS JSpace Model' - Logged in as 'Default User'

File Options Bookmarks Advanced Help

NASA Center (Source: LDAP) Project (Source: WIM) Competency (Source: CMS) Competency Category (Source: CMS) Person (Source: LDAP)

ARC  
DFRF  
CRC  
HQ  
JSC  
KSC  
LARC  
SSC

Center C&A - B&TD - Available for New W  
Corporate Labor  
ESMO-HSR&T-Human Systems Integration  
Education HQ Labor  
Exploration Mission Directorate  
Function to Another Center  
ISS - ISS Launch and Mission Objectives

Business Operations Competency Suite  
Computer Sci & Info Technology Competency Suite  
Engineering of Systems Competency Suite  
Financial Operations Competency Suite  
Institutional Operations & Support Competency Suite  
Management Competency Suite  
Mission Operations Competency Suite  
Professional Development Competency Suite  
Workforce Operations & Support Competency Suite

Business Knowledge Domain  
Engineering & Technology Knowledge Domain  
Leadership & Management Knowledge Domain

McManus, John W. (HQ-JA000)  
Schain, Andrew (HQ-LD070)

Multiple Selections: and

Information Panel

Instance View Alternate Paths Query Network

Maximum Relationship Strength Same Skill and Same Project

POPS

Same Facility  
Same Department  
Same Skill and Same Department  
Same Skill and Same Project  
Same Skill, Project, and Facility

Name: JOHN MCMANUS  
Email: jmcmanus@nasa.gov  
Phone: tel:202 358 1802  
Employer: NASA



# POPS screenshots 5

JSpace v0.23 - Connected to 'POPS Source Demo' - Using Model 'POPS Demo' - Logged in as 'andrew'

File Options Bookmarks Tools

NASA Center: ARC, DFRC, DFRF, GRC, GSFC, HQ, IVV, JSC, KSC

Project: CoF Facility Planning & Design, CoF Minor Revitalization, Communications, Computing, Elec..., Contingency Response Technologi..., Crew Exploration Vehicle Spiral 1, Design Tools & Operation for In-F..., Extravehicular Activity, G&A, HALE ROA, High Energy Space Systems

Competency Category: Business Knowledge Domain, Engineering & Technology Knowle...

Person: Claus, Russell W. (GRC-RTS0)

Information

Maximum Relationship Strength

POPS

Table

- Same Facility
- Same Department
- Same Skill and Same Department
- Same Skill and Same Project
- Same Skill, Project, and Facility
- How I am Connected

Same Facility  
Same Department  
Same Skill and Same Department  
Same Skill and Same Project  
Same Skill, Project, and Facility

# POPS screenshots 6

POPS v.28.3 – Connected to 'POPS on FatDuck' – Using Model 'POPS on FatDuck Model' – Logged in as 'Michael Grove'

File Options Bookmarks Advanced Help

NASA Center (15)

- ARC
- DFRC
- GRC
- GSFC**
- HQ
- IVV
- JPL
- JSC
- KSC
- LARC
- MAF
- MSFC

Source: x500

Project (176)

- Mars Global Surveyor
- Mars Odyssey 2001
- Mars R&A
- Mars Reconnaissance Orbiter 2005 (...)
- Messsenger
- Minor Revital
- Mission Operations
- Mission Science Guest Investigator
- Mission Success – Center Specific
- Multi-Mission Operations
- NMP Program Management and Futur...
- NPOFSS Preparatory Project (NPP)

Source: WIMS

Competency (21)

- Astrobiology
- Astronomy and Astrophysics
- Climate Change and Variability
- Earth Atmosphere
- Earth Science Applications Research
- Earth System Modeling
- Fluid Physics
- Fundamental Physics
- Geophysical/Geologic Science
- Geospatial Science and Technologies**
- Icing Physics
- Laser Technology

Source: CMS

People (1)

- Jeanne M

Source: ...

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Information Panel

View Different Social Network's Present in the Data

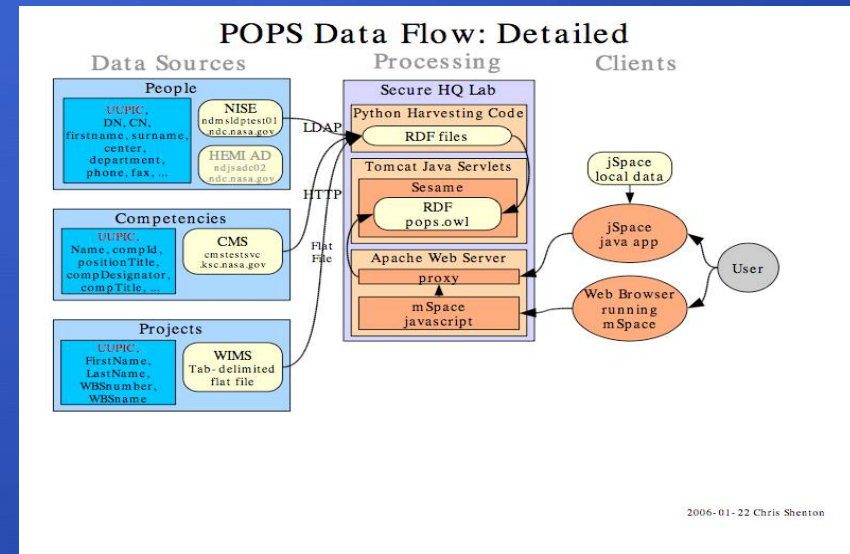
Name: Michael Grove  
 Email: michael.h.grove@nasa.gov  
 Phone: 301.523.7185  
 Employer: Clark and Parsia

1 of 1

Social Net

# POPS in Context

- Science, Engineering, and Mission all have SWT production or development efforts in place
- Now focus in on re-using the data systems we already have in place
- Agency wide-integration planning is underway for building a federation of models into an integrated information service across all disciplines
- One example is POPS (people, organizations, projects, and skills)
- Inspired by mash-ups and mSpace
- Dreamed and engineered by NASA and ClarkParsia LLC
- Provides polyarchical queries ad-hoc'ly
- Wicked *perspectival* viz shows relationships
- Easy to add sources
  - Local or sharable annotations of integrated info
  - Federates info into a reusable service



# Finding Experts?

- POPS isn't really an expertise locator
- It's:
  - infrastructure for information integration
  - generic services (convert, federate, query, browse) for other apps and services to use
  - a generic client of those services (jspace)
  - applicable to hundreds of information integration problems at NASA

# The Problem

- It is extremely difficult to find relevant information you *are* aware of and virtually impossible to discover critical information that you did not know existed.
- The problem exists within at least 5 dimensions; size, complexity, diversity, rate of growth and trust.
- Use-case scenarios and requirements change all the time.
- ***We cannot anticipate in advance what the next collection of information elements need to be or for what purpose!!***

# The Challenge

Integrate information from disjointed data sources, ad hoc'ly, to solve customer needs

- Without upsetting delicate info-ecologies (data owners, curators, extant policies and procedures)
- Without requiring major investment in time or \$\$

# The Inspiration

The screenshot shows a web browser window titled "Programmable Web: The Web As Platform" with the URL "http://www.programmableweb.com/". The browser's address bar and tabs are visible. The website's header features the "programmableweb" logo and the tagline "Web 2.0 APIs Because the world is your programmable oyster". A navigation menu includes links for Home, Blog, The APIs, Mashups, Reference, Share, and About. The main content area is divided into two columns. The left column contains a "Mashup Index" with links to "All Mashups", "/popular Mashups", "Mashup Matrix", "Mashup Cloud", "Random Mashup", and "How-to Guide". The right column, titled "The count is now: 161 APIs + 456 mashups", features a "What's Here?" section with four items: "Web 2.0 API Reference" (a database of APIs), "Mashup Database" (hundreds of mashups), "Mashup Matrix" (an experimental view of mashups), and "Blog" (focused on API and mashup news). Each item includes a small thumbnail image and a brief description.

# Formalizing Info-models

- Use Ontologies to formalize the problem domain(s)
- Why?
- Correctness, create shared understanding
  - Regulatory compliance (DRM)
- To prepare for the eventual semantic upshift



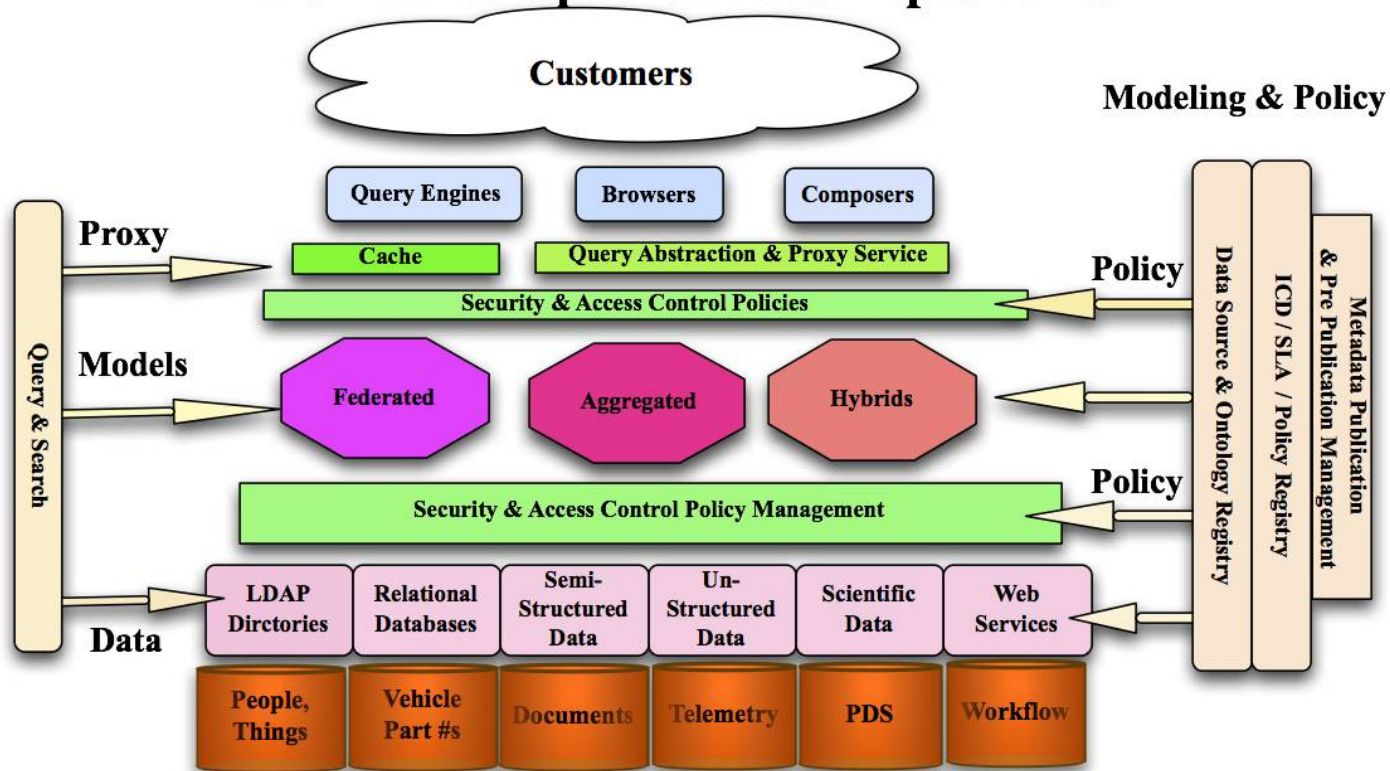
**Knowing how to write  
ontologies is the smallest  
part of what is needed**

# Information Infrastructure

- Model libraries
- Data access agreements
- Data assurance
- Model assurance
- Good “go to” application models
- Nomenclature Management
- Metadata pre and post publication
- Ad hoc reuse of logic at atomic levels
- ESB integration
- Application Interface Agreements

# Information Infrastructure

## How to Get Information That's Locked up in Various Repositories



Andrew Schain  
NASA HQ  
IDM Arch Rev. 2.5  
November 2007

# Series Overview

- **Key statements from Leadership team**
  - **Susan Turnbull**
  - **Ken Baclawski**
  - **Peter Yim**
  - **Denise Bedford**
  - **Ontolog successes**
  - **KMWG successes**
  - **NASA successes**

# Thank You

- Thanks to all who have participated in these discussions
- Special thanks to the organizing committee
  - Andrew Schain (NASA/HQ)
  - Denise Bedford (WorldBank)
  - Jeanne Holm (NASA/JPL, KMWG)
  - Ken Baclawski (NEU)
  - Kurt Conrad (Ontolog, Sagebrush)
  - Leo Obrst (Ontolog, MITRE)
  - Nancy Faget (GPO, KMWG)
  - Peter Yim (Ontolog, CIM3)
  - Steve Ray (NIST)
  - Susan Turnbull (GSA)