



45th Space Wing

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Building a Virtual Enterprise: Sharing and Integrating Data Among Multiple Organizations



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Purpose and Overview

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- **PURPOSE**

- Present an overview of the “virtual enterprise” represented by the many organizations involved in space launch and range operations at the Eastern Range
- Describe the technical and organizational challenges created by the virtual enterprise for integrating and sharing data
- Describe a strategy and practical approach for meeting these challenges and how organizational issues impact the technology solutions

- **OVERVIEW**

- Background and Challenges
- Vision: Building a Single Integrated Range Picture
- Approach: Knowledge Management Initiative
 - Forming a Community of Interest
 - Building a Knowledge Management Framework
 - Creating Specific Applications

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45th Space Wing and the Eastern Range

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- The 45th Space Wing (45 SW), headquartered at Patrick AFB, FL, provides space launch and range support for:
 - Air Force, Department of Defense (DoD), civil, and commercial space launch missions
 - DoD submarine launch ballistic missile Test and Evaluation missions



- 45 SW operates and maintains the Eastern Range
 - Launch head at Cape Canaveral Air Force Station
 - Remote stations as far away as Ascension Air Station off the coast of Africa--15 million sq miles
 - Includes launch complexes, processing facilities, tracking radar, optical systems, telemetry, command destruct systems, and communications systems
 - Work performed primarily through major service contracts
 - Work with many customers and contractors
—a virtual enterprise of stakeholders

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Virtual Enterprise Defined

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- **Virtual (Webster's Dictionary)**
 - Existing in effect though not in actual fact, form or name
- **Enterprise (Webster's Dictionary)**
 - An undertaking of great scope and complexity
- **Virtual Enterprise**
 - An organization of great scope and complexity that exists, in effect, though not in actual fact, form or name
- **The Eastern Range organizations that participate in space launch and range operations in effect form a virtual enterprise**

Virtual



Enterprise

Cape Canaveral Air Force Station—Eastern Range launch head

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Many Organizations Involved

45SW ** LOSC ** RTSC ** JBOSC ** NASA ** SMC ** Boeing ** Lockheed Martin



Delta II ** Delta IV ** Pegasus ** Shuttle ** Atlas V ** Titan IV ** Spacecraft ** Navy

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Many Activities to Coordinate

Launch Vehicle Processing ** Spacecraft Processing ** Facilities Management

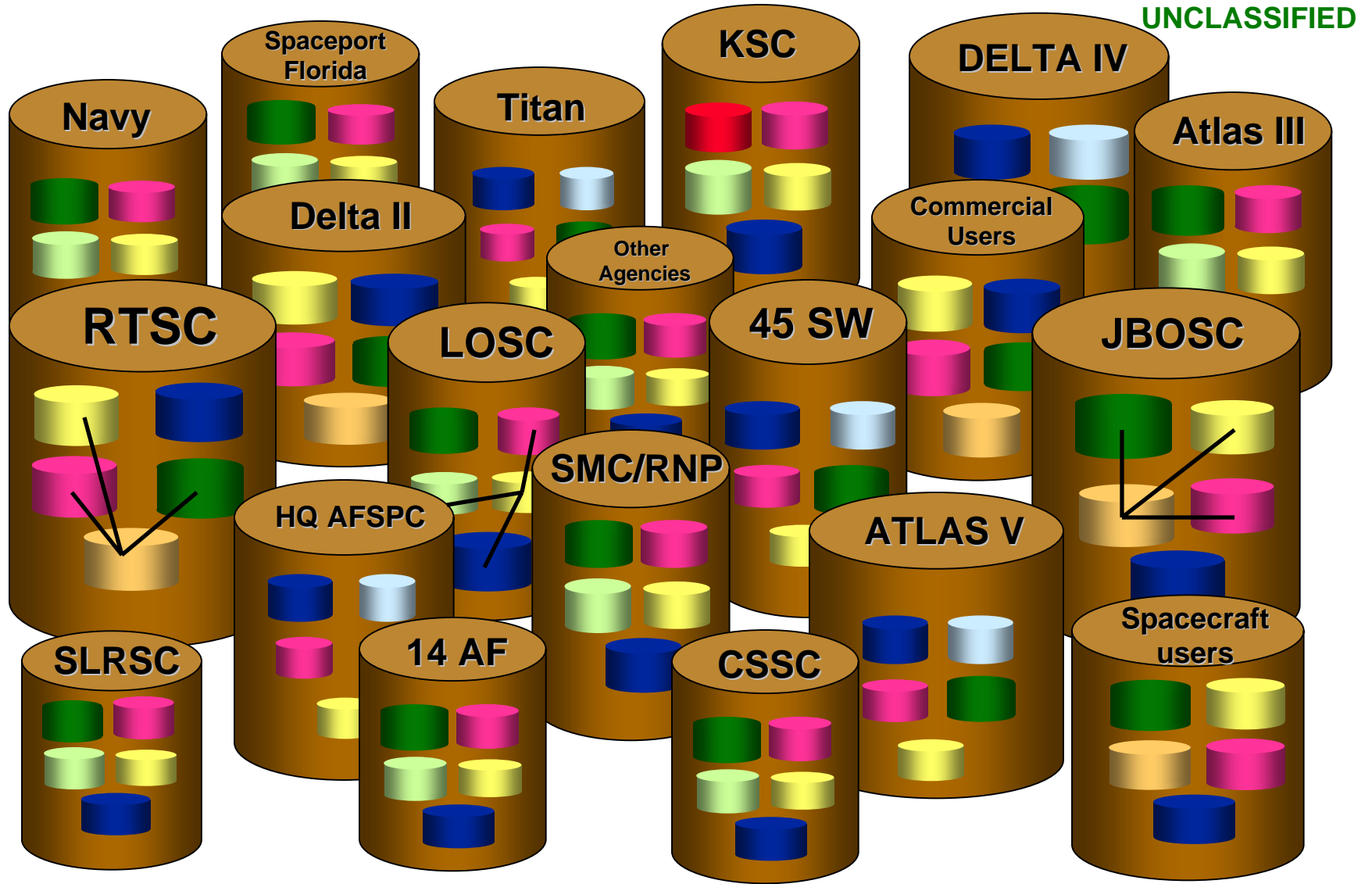


Telemetry Support ** Communications Support ** Safety ** Security ** Logistics

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Many Information Sources



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The Virtual Enterprise at the Eastern Range

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- The virtual enterprise at the Eastern Range is complex with many organizations interacting to differing degrees through many activities
- There is no one central organization that controls everything, but many independent/related organizations that collaborate
- It exists, in effect, to support a common purpose: the space launch and range operations mission

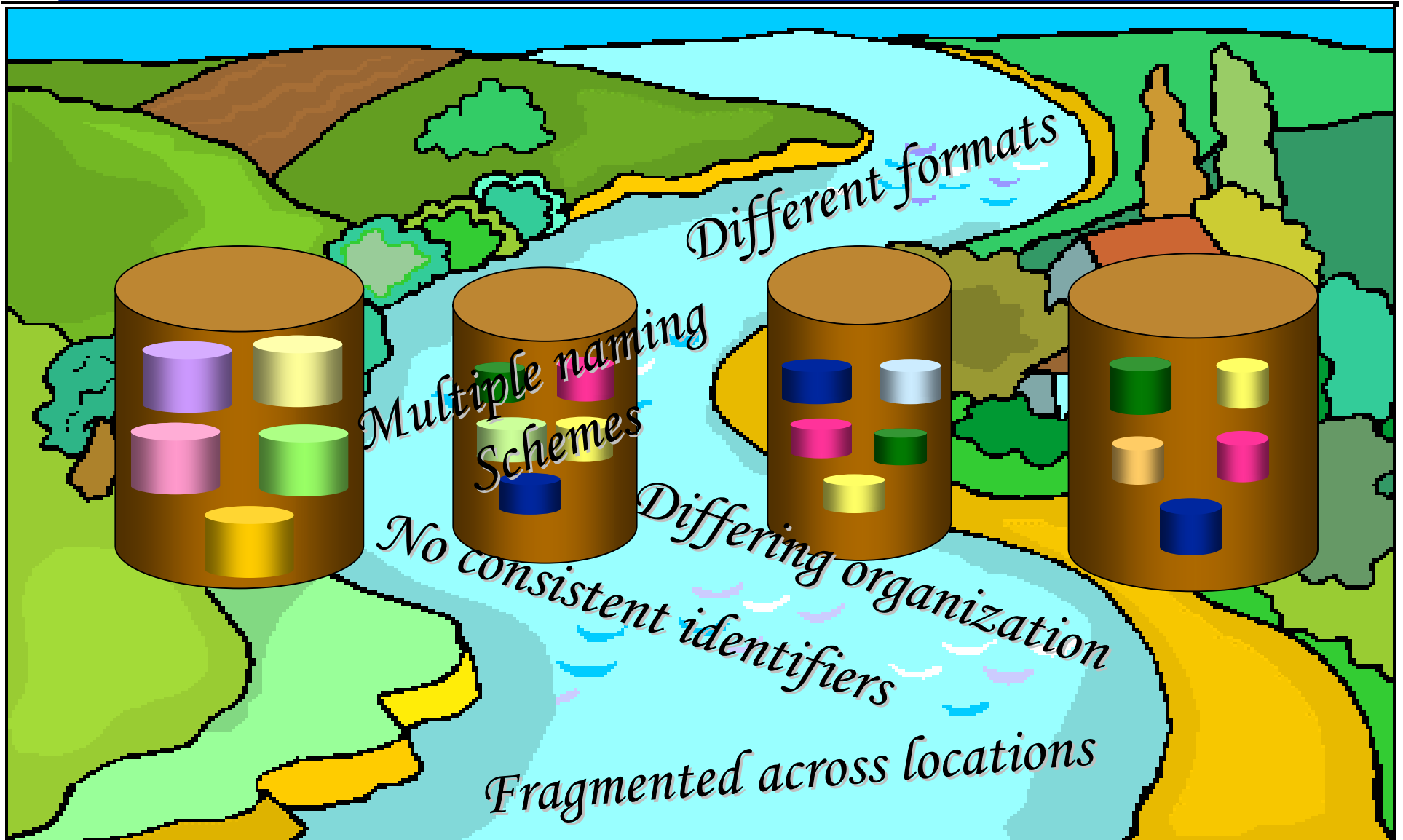
The Information Sharing Problem:

The enterprise produces non-integrated information located in many different, distributed data sources owned by various organizations

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Many Barriers to Information Access





Result: Fragmented Range Picture

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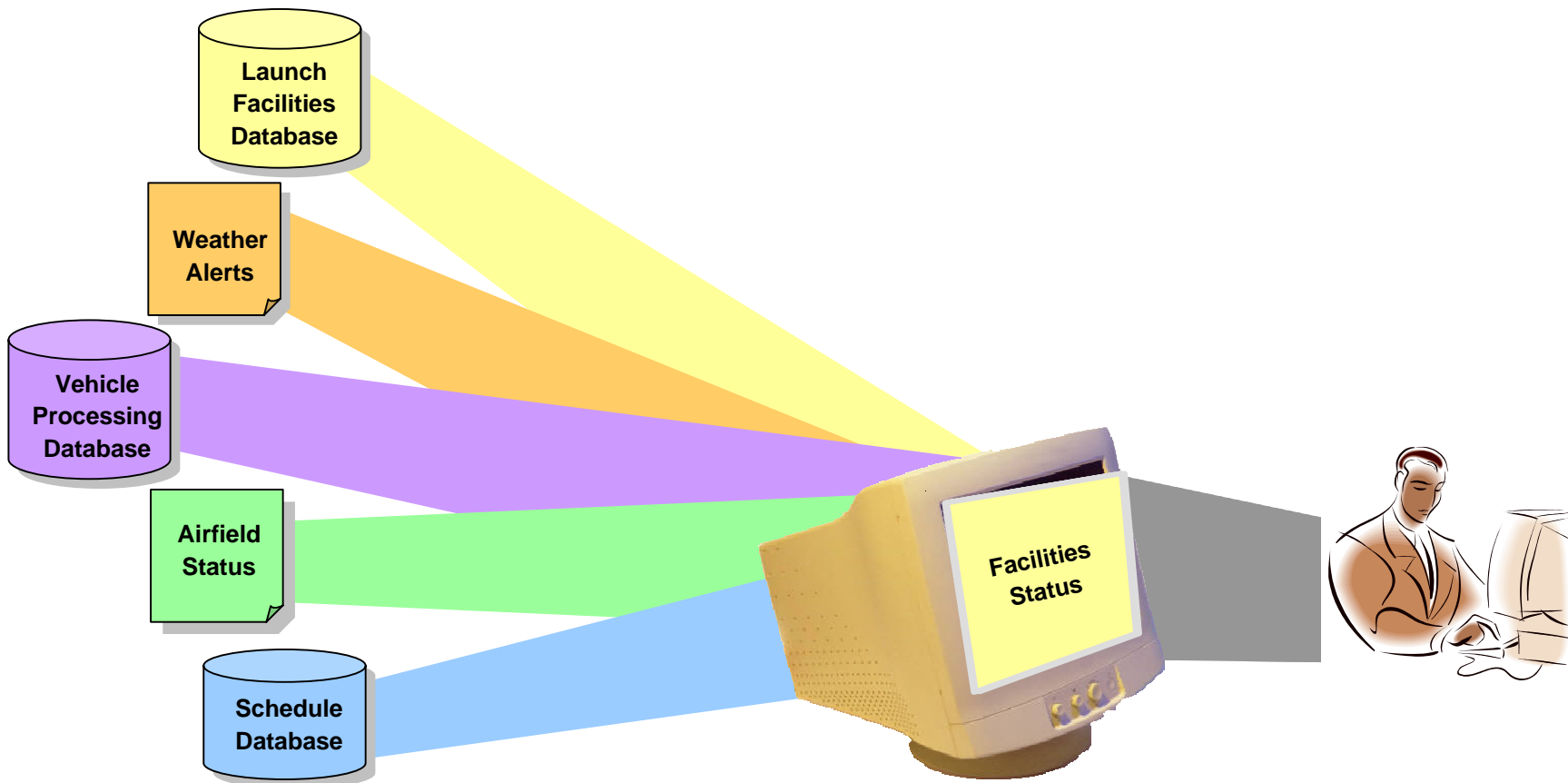


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Fragmented Applications

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Many applications currently provide non-integrated information

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Vision

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Knowledge Management Initiative

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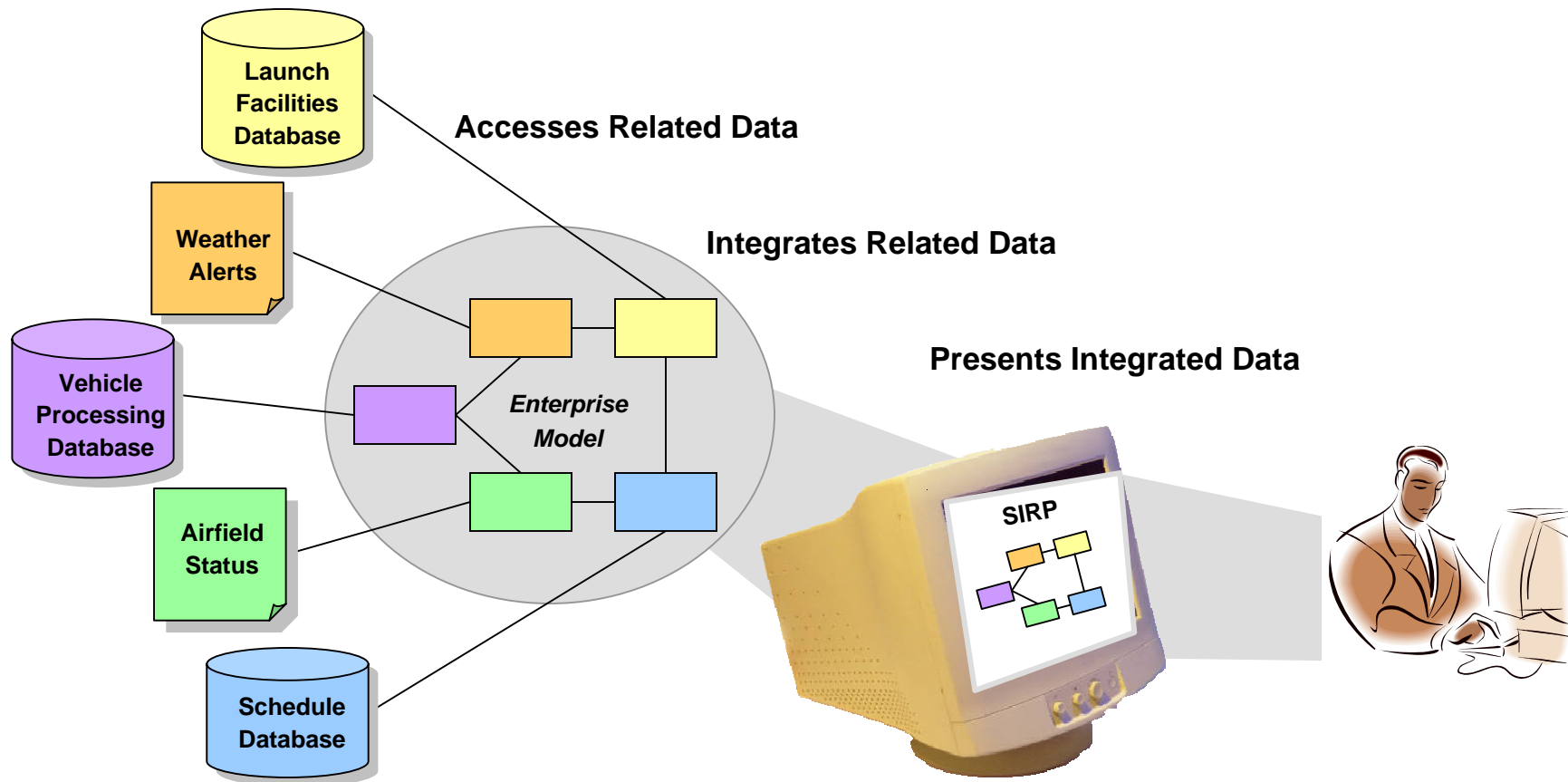
- **The Knowledge Management Initiative is the 45 SW's strategy for implementing a Single Integrated Range Picture vision**
 - **Understand the information integration challenges**
 - **Work as a team to share information**
 - **Build a vision and strategy for addressing challenges**
 - **Develop technical framework for data integration and sharing**
- **The Knowledge Management Framework (KMF) is the 45 SW's technical approach to integrating/sharing disparate information**
 - **Access data on demand without impact to operational systems**
 - **Deliver it where and when needed in the right formats**
 - **Integrate distributed information via an Enterprise Model (ontology) of Eastern Range concepts and relationships**
 - **Provide single, integrated views to new or commonly used applications**

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KM Framework Concept

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KMF provides a Single Integrated Range Picture

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The Challenges

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Organizational Challenges

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- **Different organizations with different agendas**
 - Corporate cultures/attitudes toward information sharing
 - Conflicting motivations: government vs. commercial
 - Competition issues for commercial companies
- **Concerns about sharing data**
 - Ownership of data--concern over loss of control
 - Data used out of context
 - Exposing “dirty” data
 - Impact on internal processes
- **Security**
 - Protection of commercial proprietary data and intellectual property
 - Government concern for sensitive data and operational security
- **Focus on immediate information need vs. long term vision**
 - No single organization owns “information sharing” mission
 - Everyone has a piece of the puzzle and no one has responsibility for the single integrated picture
 - Focus is on “urgent” vs. “important”

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Technical Challenges

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- **Connectivity and security**
 - Access control across multiple organizations
 - Access control for specific data
 - Firewalls between organizations
 - Data aggregation concern
- **Heterogeneous data**
 - Data not designed to be shared outside of its native application/database
 - Every database has different schema and/or data definitions
 - Often represents different domain paradigms
 - Different paradigms drive different semantics
 - Business rules may be encoded in schema or data definitions
 - Data sources often developed many years ago
 - *Ad hoc* data designs
 - Little documentation available

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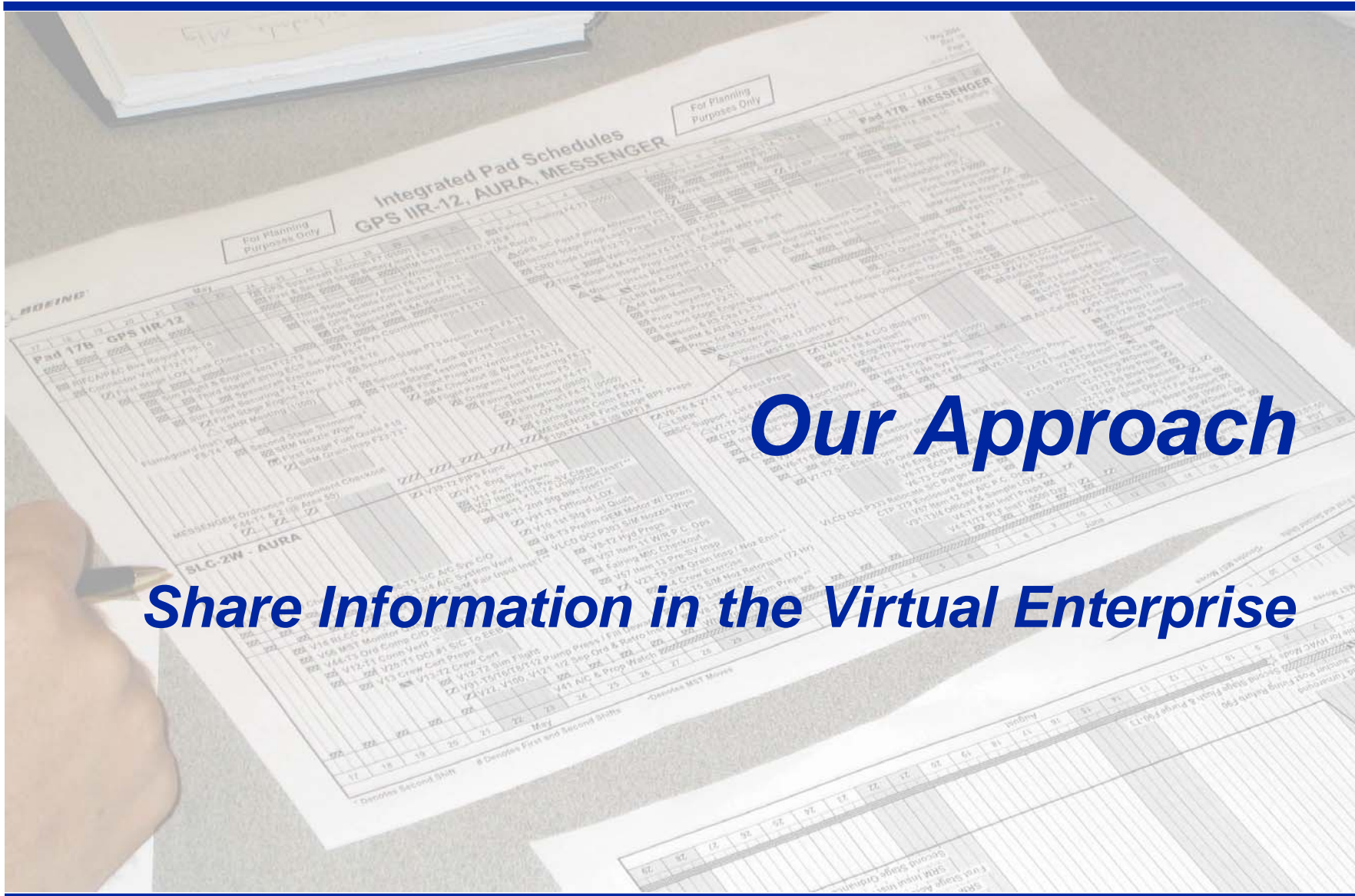


Technical Challenges

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- **Mapping data to a unified representation**
 - Building complex data models, ontologies, and metadata is an art
 - Requires expert data modelers/knowledge engineers
 - Requires subject matter expertise
 - Deciphering embedded business rules and encoded data is difficult
 - Available tools are limited
 - Unstructured data (email, documents, etc.) still a challenge
- **Data synchronization and currency**
 - Different sources have different data currencies
 - Different data currencies hamper synchronization
- **Handling conflicting data**
- **Rapidly evolving standards**
- **Performance issues due to size, connectivity and complexity**

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Our Approach

Share Information in the Virtual Enterprise

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Knowledge Management Building Blocks

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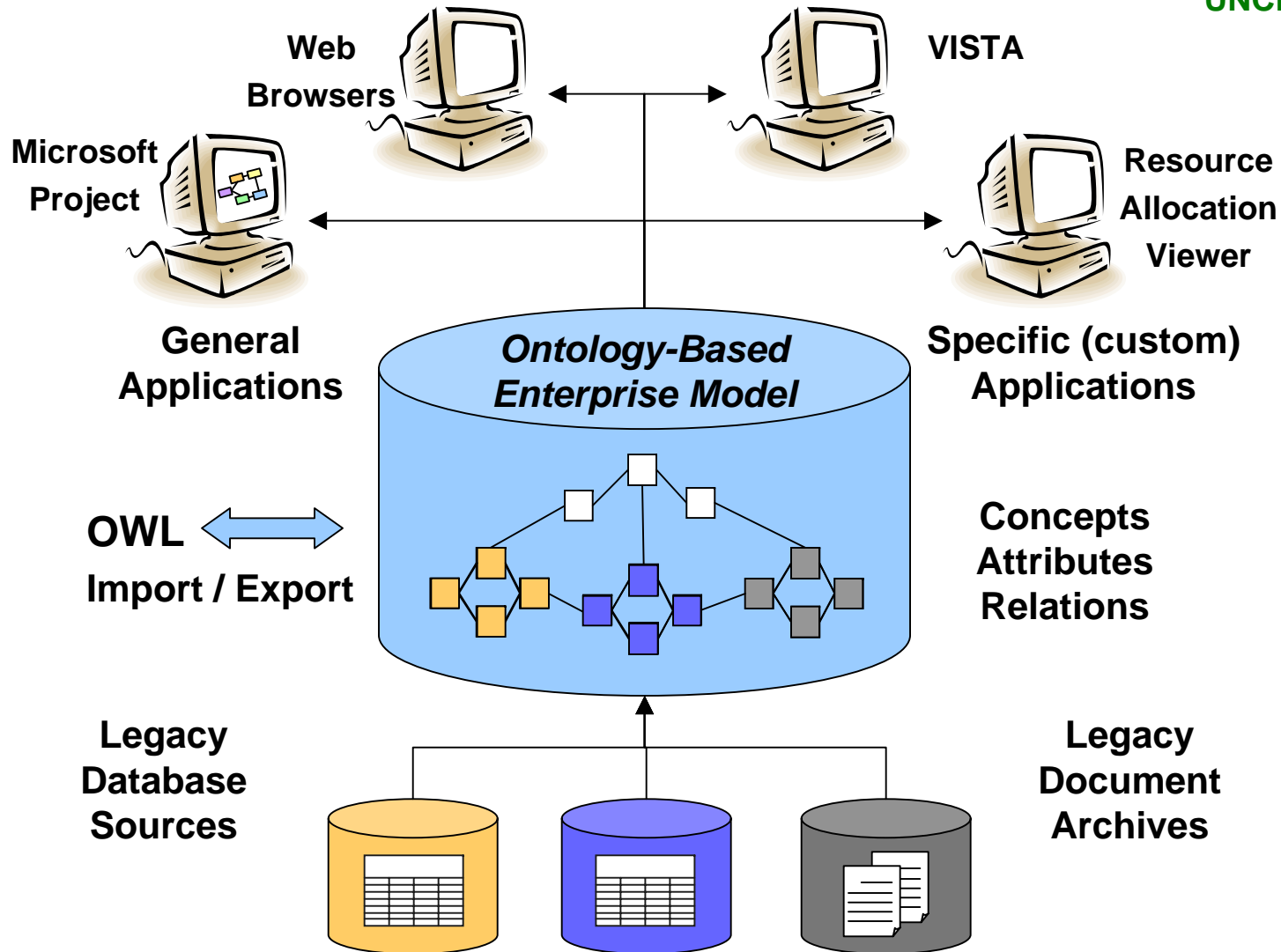


The Enterprise Model



Ontology-Based Enterprise Model

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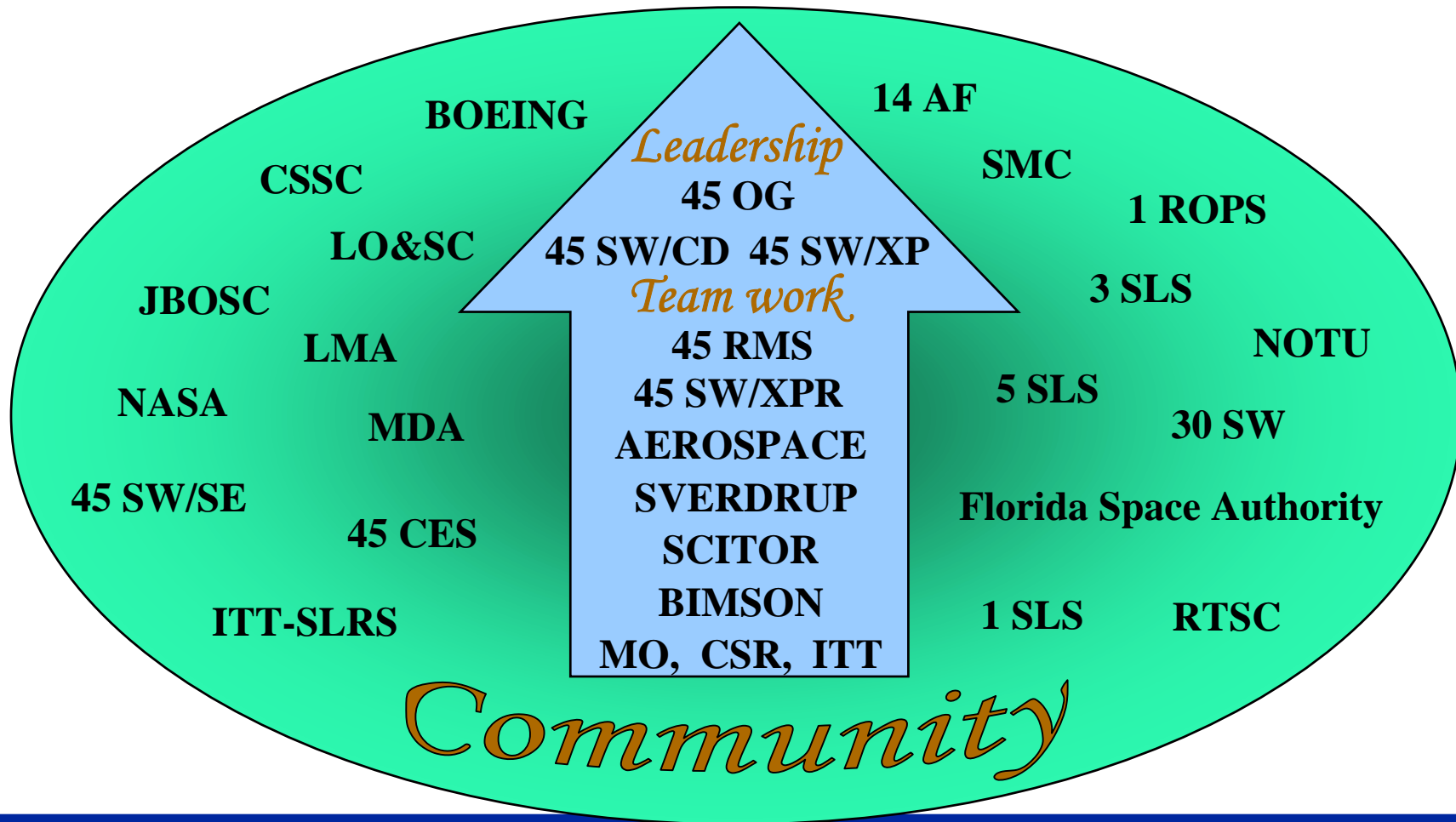
Community of Interest



Community of Interest

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Inclusive DoD term used to describe collaborative groups of users who must exchange information in pursuit of their shared goals.



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Building the Community

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- **Principles**
 - **Ownership**: The organization that owns the information controls the sharing of that information
 - **Share**: Share information unless there is a specific reason to not to share it
 - **Coordinate**: Do not change internal processes but do coordinate efforts
 - **Benefit**: Operate to benefit all participants
- **Come together via a *Terms of Reference***
 - Document signed by stakeholder organizations
 - Provides forum for coordinating the automated integration and sharing of information among stakeholders
 - Establishes structure for cooperation via a Steering Group, executive committee, and project working groups

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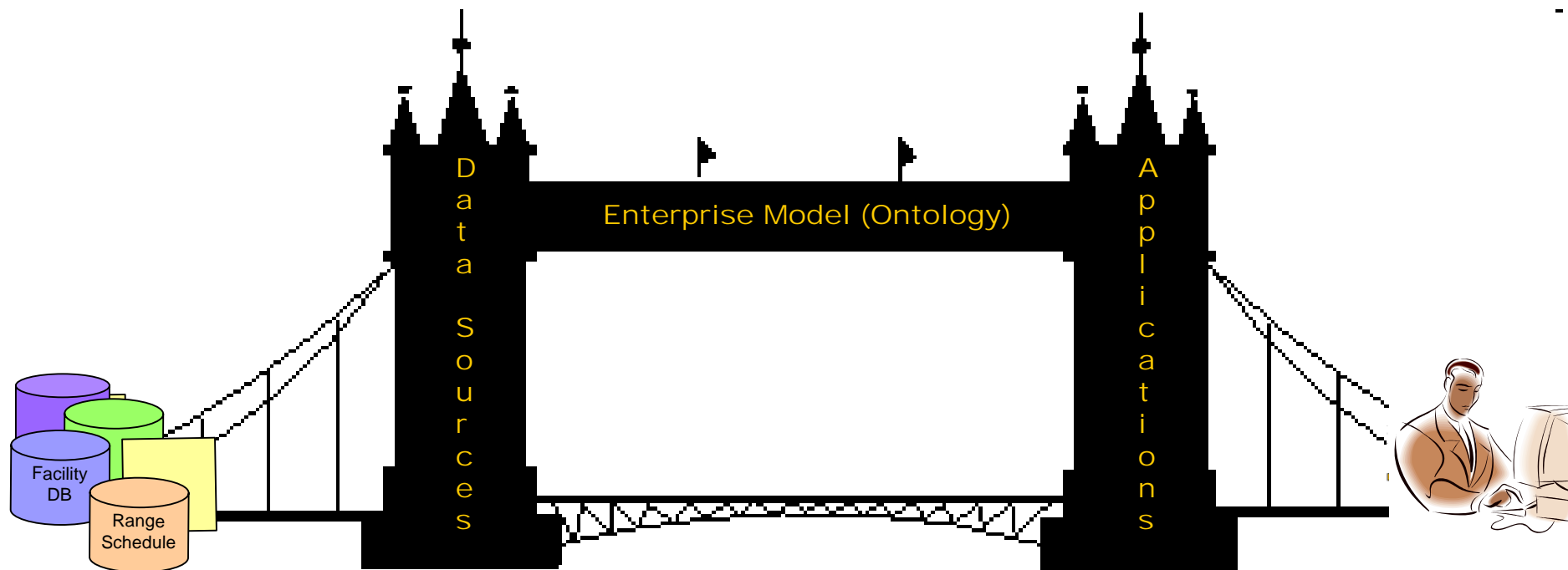
Knowledge Management Framework

Bridging Information Sources



Knowledge Management Framework

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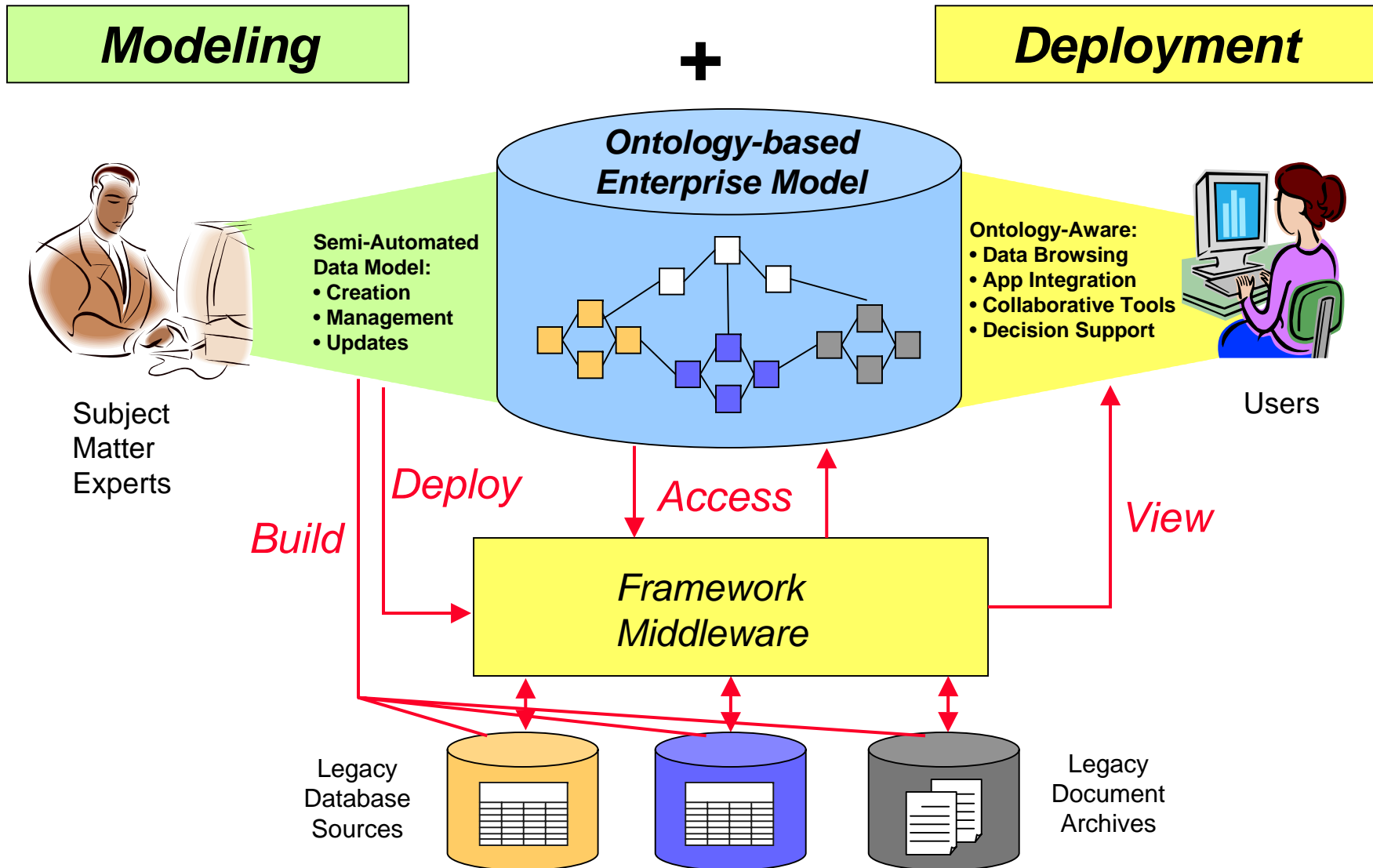


We need a *Bridge* that connects *Users* to *Data* through *Applications*
Knowledge Management Framework

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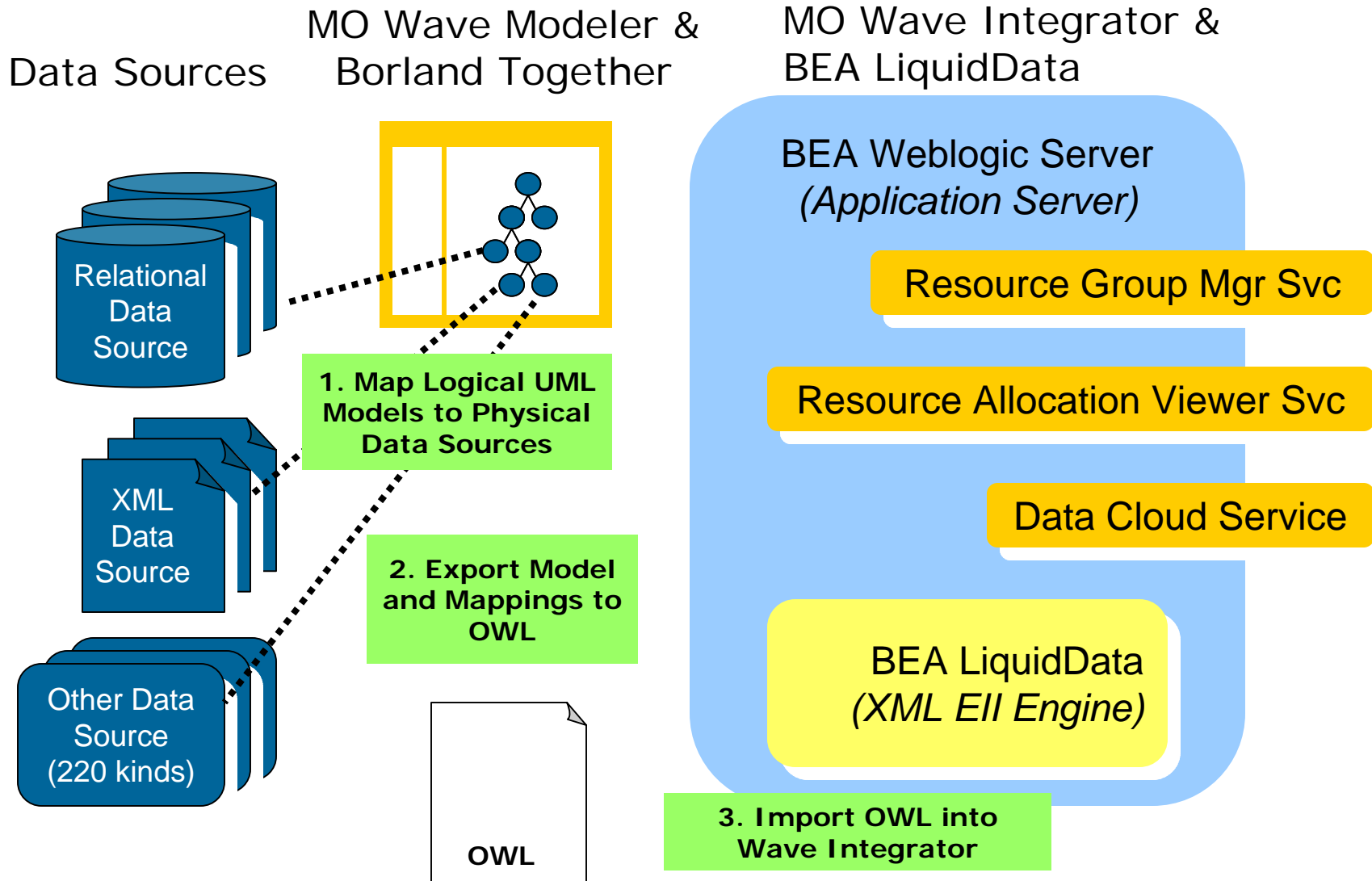


KMF Modeling & Deployment



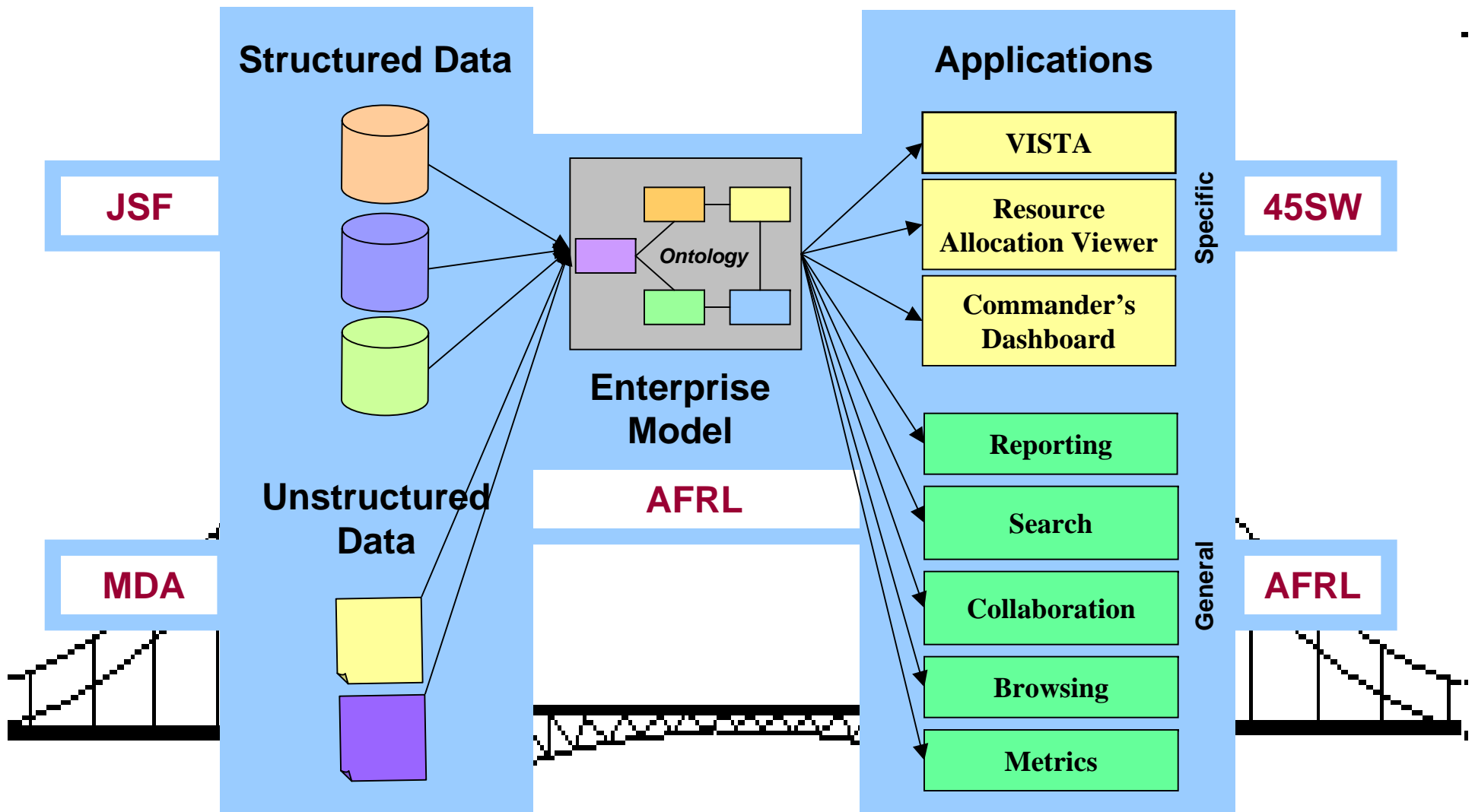


How the Architecture Works





Building the Bridge using SBIRs



Small Business Innovative Research (SBIR) Program



Applications

Creating a Single Integrated Range Picture



KM Applications and the SIRP

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- **Applications that use information from the enterprise model combine to create a Single Integrated Range Picture (SIRP)**
- **Key part of overall effort—what the user actually sees**
- **Built incrementally--drives development of enterprise model**
- **Each application must**
 - **Meet defined user needs and business case requirements**
 - **Have relatively low cost for high payoff**
 - **Be based on open standards**
 - **Support and fit overall architecture**
- **Two categories of applications**
 - **General purpose applications to search, browse or report across broad ranges of data unified by the enterprise model**
 - **Specific applications to solve specific problems**
- **Schedule visibility is first target for application development**
 - **Improve visibility into when activities occur by integrating schedule data from different organizations**

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Schedule visibility: VISTA

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VISTA shows user schedules and resource allocations

VISTA - Microsoft Internet Explorer
 Address: http://turboDev/vista/index.cfm?method=delta2.search&domain=delta2

VISTA Virtual Information System for Technical Analysis
 THE AEROSPACE CORPORATION
 45 SW Knowledge Management

Home Tasks **Delta II** Equipment Facilities About

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Delta II

Component Processing Administration Command & Control

1st Stage 2nd Stage 3rd Stage SRM Spacecraft

Search Delta II
 Mission: All
 Date From:
 Date To:
 Submit

Flowchart showing resource allocation for Delta II stages and SRMs, including facilities like Hangar M, Fuel Storage Area 5, Rocket Check-out Storage Building, and various processing and testing facilities.

Developed By: The Aerospace Corporation
 1106 since Jul 8, 2004

VISTA - Microsoft Internet Explorer
 Address: http://turboDev/vista/index.cfm?method=equipment.results&domain=equipment&productName=%25&dbS...

VISTA Virtual Information System for Technical Analysis
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Equipment [Back to Search Screen](#)

You can view additional equipment details by clicking on the headers and task/facility details by clicking on associated data.

JDMTA TAA 50 1 / 18650				
Facility	OpNo	Task	Begin Date	End Date
	S0266	JD TAA-50 (182) FORMAL	08/8/2004	08/8/2004
	S0266	JD TAA-50 (182) FORMAL	08/7/2004	08/7/2004
	S0268	JD TAA-50 (182) FORMAL	08/8/2004	08/8/2004
	S0265	JD TAA-50 (182) DR	08/7/2004	08/7/2004

JDMTA TAA 50 2 / 18651				
Facility	OpNo	Task	Begin Date	End Date
	05228	WET DRESS REH #2	08/8/2004	08/20/2004

TIMING / 18733				
Facility	OpNo	Task	Begin Date	End Date
	05228	WET DRESS REH #2	08/8/2004	08/20/2004
	05550	U2 FID TEST	08/7/2004	08/7/2004
	04741	SETUP FOR DELTA IV WDR#2	08/7/2004	08/18/2004
	04741	SETUP FOR DELTA IV WDR#2	08/8/2004	08/18/2004
	04973	SATCOM DATA FLOW	08/7/2004	08/7/2004

CTPS ABB / 18742				
Facility	OpNo	Task	Begin Date	End Date
	02229	CTPS TIME DELAY	08/6/2004	08/6/2004
	04873	SATCOM DATA FLOW	08/7/2004	08/7/2004

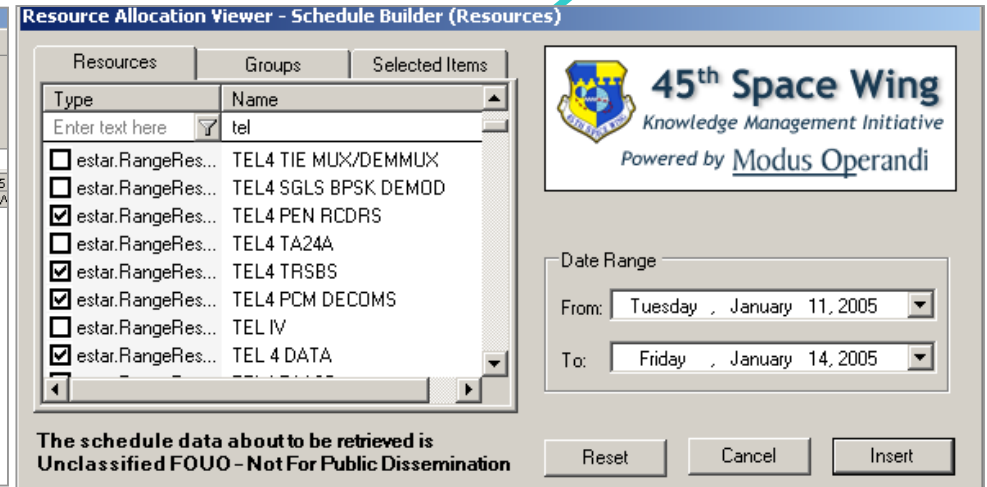
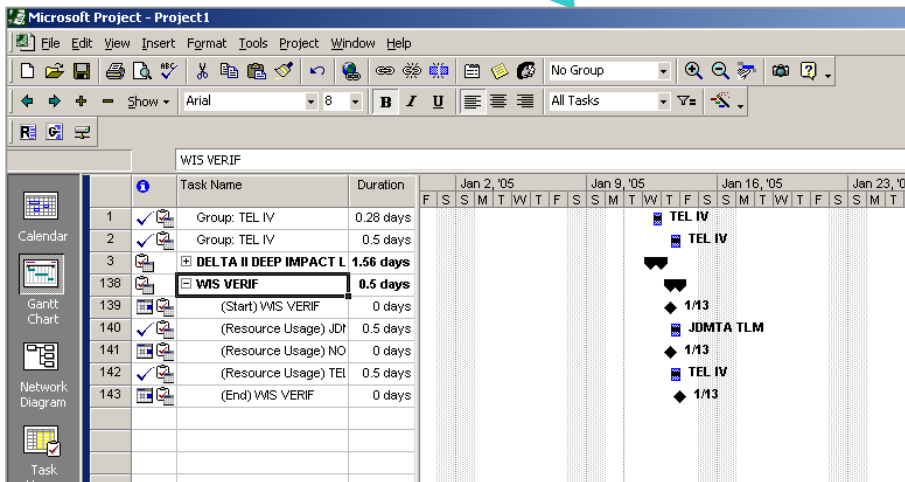
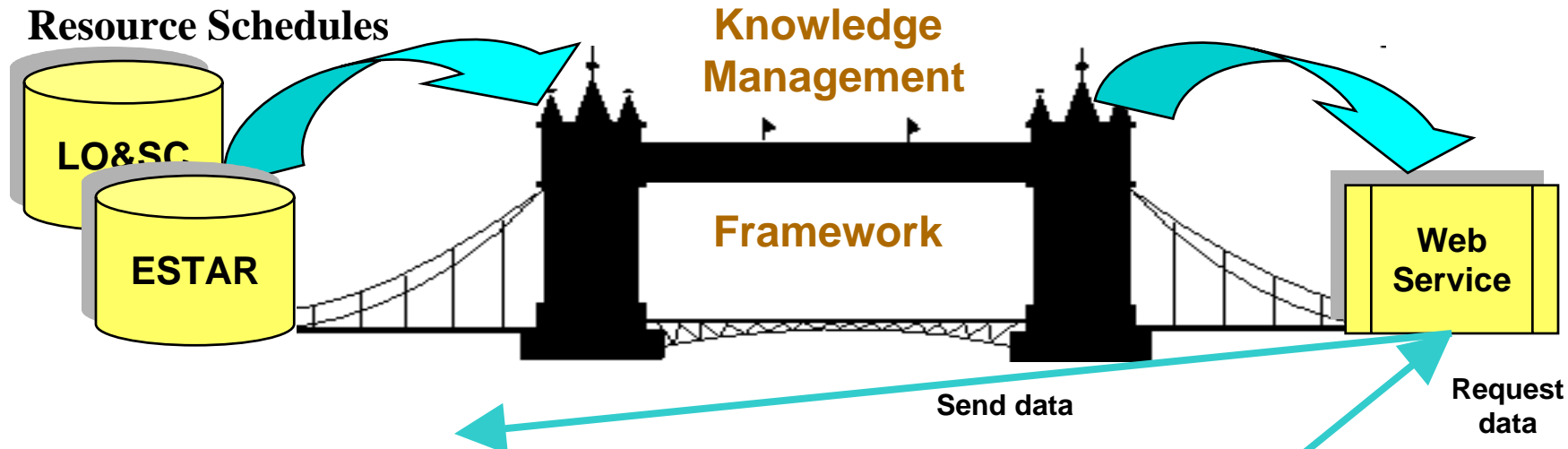
Connects user activity information with resource availability information

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Resource Allocation Viewer Extension: RAVE

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Resource Allocation Viewer Extension (RAVE) – MS Project Add-in

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People Drive Technology

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- **Organizational or people concerns constrain the approach and technology used**
 - Approach must address every organizational concern
 - Approach must be flexible--tailored to each different organization
 - Agreement on principles is key
 - Develop system in relatively small increments
 - Build trust and support with each successful step
- **Concern about losing control is one major source of reluctance**
 - Makes a central data warehouse concept difficult to “sell”
 - Federated approach seems more acceptable--organizations still “keep” data
 - Web services are key enabler of federated approach
- **Organizations concerned with their immediate needs**
 - Focus on specific applications that solve specific user problems
 - Use specific applications to incrementally build overall system

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Summary

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- The virtual enterprise at the Eastern Range has created many organizational and technical challenges for integrating and sharing information
- The vision of the Knowledge Management Initiative is to address these challenges by providing all stakeholders with a Single Integrated Range Picture
- Our approach to implementing the vision follows three parallel paths
 - Build consensus through participation in a *Community of Interest*
 - Build a framework for dynamically integrating information
 - Rapidly and incrementally build and deploy useful applications that access integrated information through the framework
- The Knowledge Management Initiative is an on-going effort
 - Need for sharing and integrating information continues to grow

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Acronyms

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- **45 SW** **45th Space Wing**
- **AFRL** **Air Force Research Laboratory**
- **EII** **Enterprise Information Integration**
- **JBOSC** **Joint Base Operations Support Contract**
- **JSF** **Joint Strike Fighter**
- **KM** **Knowledge Management**
- **KMF** **Knowledge Management Framework**
- **KMI** **Knowledge Management Initiative**
- **LOSC** **Launch Operations and Support Contract**
- **MDA** **Missile Defense Agency**
- **MO** **Modus Operandi, Inc.**
- **OWL** **Web Ontology Language**
- **RAVE** **Resource Allocation Viewer Extension**
- **RTSC** **Range technical Services Contract**
- **SBIR** **Small Business Innovative Research**
- **SIRP** **Single Integrated Range Picture**
- **VISTA** **Virtual Information System for Technical Analysis**

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