Primitives and Style: A Common Vocabulary for SOA - Reducing Risk and Costs while Improving Collaboration and Agility

September 15, 2010
Missions of the DoD

Warfighter Mission Area

Business Mission Area

Intel Mission Area

Enterprise Information Environment Mission Area

Dennis E. Wisnosky, DoD BMA CTO & Chief Architect in the Office of the Deputy Chief Management Officer (DCMO)
Missions of the DoD

Warfighter Mission Area

Business Mission Area

Intel Mission Area

Enterprise Information Environment Mission Area

SECDEF

DEPSECDEF CMO

DCMO

ASD(HD)

ASD (NII)/CIO

USD (C)

USD (I)

USD (P&R)

USD (AT&L)

Dennis E. Wisnosky, DoD BMA CTO & Chief Architect in the Office of the Deputy Chief Management Officer (DCMO)
The Business Operating Environment

Reach of the Business Mission Area
The Secretary of Defense is responsible for a half-trillion dollar enterprise that is roughly an order of magnitude larger than any commercial corporation that has ever existed. DoD estimates that business support activities—the Defense Agencies and the business support operations within the Military Departments—comprise 53% of the DoD enterprise.
"The Secretary of Defense is responsible for a half-trillion dollar enterprise that is roughly an order of magnitude larger than any commercial corporation that has ever existed. DoD estimates that business support activities—the Defense Agencies and the business support operations within the Military Departments—comprise 53% of the DoD enterprise."
The Challenge

I want to make sense out of this. How do I do that?
The Challenge

Issue: Infrastructure
57% of DoD I.T. Costs are in Infrastructure

<table>
<thead>
<tr>
<th>OMB Budget Grouping</th>
<th>Number of Programs</th>
<th>FY2010 IT Spending - $ Billions</th>
</tr>
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<tbody>
<tr>
<td>Communications and Computing Infrastructure</td>
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SOURCE: http://www.whitehouse.gov/omb/e-gov/
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Issue: Redundancy
DoD Contractors Build Separate Infrastructures & Dictionaries

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Small Slice of the As-Is
A Small Slice of the As-Is
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We Must Make Sense Out of This!
A Small Slice of the As-Is

We Must Make Sense Out of This!

Game-Changing Innovations!
If we can precisely state requirements and precisely describe data/services, we will be able to find them and know how to use them to facilitate:

- Integration and Interoperability

We must describe both the data/services and requirements with enough precision to accomplish the goal.

We use:

- BPMN/Primitives for business mission descriptions
- OWL and RDF for domains, services, data, capabilities and requirements descriptions
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As-Is: To-Be

Ad-Hoc, improvised linkages between applications

Systematic, standardized service interfaces with robust connectivity

Composite assemblies of reusable services drawing on functionality from multiple sources

Dynamic, event-driven reconfiguration of services

Source: What’s New!
IBM SOA Maturity Model
As-Is:To-Be

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IBM SOA Maturity Model

DoD Business Operations Strategy and Roadmap!

Ad-Hoc, improvised linkages between applications
Systematic, standardized service interfaces with robust connectivity
Composite assemblies of reusable services drawing on functionality from multiple sources
Dynamic, event-driven reconfiguration of services
Strategy and Roadmap for DoD Business Operations

Past
(BMA Federation Strategy version 2.4a)

Present
(BOE Execution Roadmap)

Future
(BMA Architecture Strategy version 3.0)

BEA 3.0

Version 2.4a

Roadmap:
Architecture
Governance
Socialization
Services
Infrastructure

Vision & Strategy
Planning & Roadmap
Infrastructure
Governance

BOE Vision

DCMO/CIO Policies

CIO – DIEA, Segment Archi.
CV & Primitives
Arch. Fed.
MDR
Biz. Intelligence
Federation Implementation Plan

Initial BOE Experience

Semantic Information

Data Integration
Business Intelligence
Common Vocabulary (Ontologies)
Rules/Workflow
Security

BEA 8.x

(BTI) NCES/CES

DBSMC/IRBs
DCMO/DCIO; EGB; BECCM

DoD Strategic Mgmt. Plan (SMP)
Performance Measures

Data Sharing and BI Enablement

Enterprise Stds.
RDF
OWL
other

9/15/2010

DWiz DoD DCMO BMA CTO & CA
Strategy and Roadmap for DoD Business Operations

Past
(BMA Federation Strategy version 2.4a)

Present
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Future
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BioE 3.0

Version 2.4a

BOE Vision

Roadmap:
Architecture
Governance
Socialization
Services
Infrastructure

Copyright
Vision & Strategy
Planning & Roadmap
Infrastructure
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DCMO/ CIO Policies

CIO – DIEA, Segment Archi.
CV & Primitives
Arch. Fed.
MDR
Biz. Intelligence
Federation Implementation Plan

Initial BOE Experience

DoD Strategic Mgmt. Plan (SMP)

Performance Measures

Data Sharing and BI Enablement

Semantic Information

Data Integration
Business Intelligence
Common Vocabulary (Ontologies)
Rules/Workflow
Security

BEA 8.x

(BTI) NCES/CES

CIO/DISA – Federal Cloud

Vision & Strategy
Planning & Roadmap
Infrastructure
Governance

DBSMC/IRBs

DCMO/DCIO; EGB; BECCM

Business Operations thru Semantic web Solutions

9/15/2010
Business Operations thru Semantic Web Initiative

- Business IT development methodology 3-step pattern
  - Modeling the business capability to be deployed
  - Preparing and populating a modern information model and data store
  - Implementing the capability by deploying business services

- “Model-Data-Implement” semantic web pattern is designed to field capabilities in 60-90 days; this supports the Departments goal to move away from monolithic systems that take years to deploy

- Current application of this pattern to achieve high performing business operations:
  - Enterprise Information Web (EIW)
  - Performance Data Automation (PDA)

- DCMO is preparing policy and instructions to fully instantiate the Semantic Web initiative and take advantage of W3C and OMG standards and semantic technologies that the commercial sector is widely deploying
Business Operations thru

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Standards-based Architecture - Primitives

Modeling the business capability to be deployed

- Standards Best Practices
- Architecture Primitives
- PrOnto Ontology (Lexicon)
- Different Frameworks
- PriMo Modeling Guide

Engineering Language and Symbols:
- **Resistor** symbol
- **Capacitor** symbol

*This agreed upon representation of electrical engineering allows a common understanding…*

- DoDAF 2.0 serves as the foundation for architecture primitives
- Use Cases being developed and used to drive pilots

Music Language and Symbols:
- **Music Scale** symbols
- **Notes** symbols

*This agreed upon representation of music allows a common understanding…*

Standard Language (terms and definitions)
Standards-based Architecture - Primitives

Modeling the business capability to be deployed

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Well Documented Intentions!
Architecture Primitives Series

Modeling the business capability to be deployed

DoD Architecture Framework Processes Best-Practice

Architecture Primitives Series
Modeling the business capability to be deployed

DoD Architecture Framework Processes Best-Practice


Primitives lead to Patterns
Patterns & Primitives

Modeling the business capability to be deployed

- Provides basic definitions of the architecture model semantics
- Provides elementary rules for the connectivity of primitive constructs
- Provides foundation building blocks for constructing architecture products
- Caveat: A common vocabulary by itself does not guarantee high quality products

PrOnto

- A style guide provides subjective advice that will ensure the design of high quality products
- A style guide advises on
  - Choice of words
    - Which constructs are appropriate in a given situation
  - Choice of grammar
    - How to combine constructs to maximum effect

PriMo

Dictionary
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**Patterns & Primitives**

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**NEWS FLASH!**

**BPMN 2.0 Analytic Conformance Class**

= DoD Primitives!
Patterns & Primitives

Modeling the business capability to be deployed

NEWS FLASH!

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A style guide provides subjective advice that will ensure the design of high quality products

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Will Industry Care?
We Are Underway!

Modeling the business capability to be deployed
We Are Underway!

Modeling the business capability to be deployed
**BEA Solution Statement**

Modeling the business capability to be deployed

- **Virtualization**: pull & display (vice store!) enterprise information directly from the authoritative data sources

- **Agility**: plug-and-play federated environment so new systems or analytical needs can come online and go offline without disrupting the overall environment

- **Federation**: build **federation** into the solution

- **Standards**: leverage BPM and Semantic Web technology standards (RDF/OWL) developed by DARPA and approved by W3C and OMG

- **Savings**: People readable Architecture, Machine readable Architecture, Executable Architecture, Long-term re-use of authoritative data
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9/13/2010

DWiz DoD DCMO BMA CTO & CA
Interoperability (Federation) in BEA Approach

Modeling the business capability to be deployed

• Federation:
  ✓ The Interstate highway system
  ✓ The railroad system
  ✓ The United States of America
  ✓ DOD is a federation

• Steps
  1. Build Domain Vocabularies: describe all of the artifacts in each domain using RDF/OWL standards
     • DoD currently does this description work, but without standards – often in Excel, Word, Powerpoint, Visio, etc
  2. Relate Domains: use RDF/OWL based descriptions to say how domains are related
     • This is the big missing piece of the current “standards” approaches
  3. Relate domain data to Domain Vocabulary: Use RDF/OWL to say how all of the data in each domain is related to the Domain vocabulary
  4. Query the Domain Vocabulary for any information

• Result: BEA Enables Enterprise Information Web
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Agility in the BEA Approach

Preparing and populating a modern information model and data store

- Agility in process:
  - “Agile” development method; quarterly “deliverables”; lessons learned influence next deliverable;

- Agility in product:
  - Once assets are unambiguously described, whole environment becomes “plug and play”
  - Eg: New CIO policy issued:
    - Today: additions/changes to relational environment very costly
    - BEA: RDF/OWL graph-based information model is infinitely extensible and inexpensive to change; just add concept to the graph and point to its authoritative data source (ADS)

- Agility in query development
  - Queries are machine and human readable
  - Fast to develop across disparate ADSs

NOTE: up-front time and labor cost of unambiguously describing assets is not trivial
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Example Savings in this BEA Approach

Preparing and populating a modern information model and data store

- **Flexibility & Data accuracy**
  - Current “standards” approaches force rigid conformity in understanding and representation of data. Result: very painful and expensive retroactive coding. Semantic approach allows for variation in understanding while prescribing conformity in representation. Result: flexibility at the instance level and accuracy at the enterprise level

- **Interface development**
  - E.G.: 5 systems require interfaces to each other (20 interfaces). If each system’s information model is semantically described, only have to describe 5 interfaces

- **Portfolio Management**
  - Once information assets are semantically described, Domain vocabulary can assess gaps in the portfolio and the architecture
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(notional depiction only)
Preparing and populating a modern information model and data store

DoD BEA Ontology

References
- Shows which authoritative documents concepts have been extracted from

Analytic Requirements
- Models analytic requirements for the Domain Vocabulary and how they relate to the concepts in the Domain Vocabulary, including SPARQL queries

Domain/ Common Vocabulary
- Description of concepts in Enterprise Domain

Standards Ontologies
- Description of Standards – definitions, permitted values, usage, business rules, reference documents, etc.

ADS Mapping Ontology
- Mapping of domain vocabulary terms to the physical data elements they represent in the Authoritative Data Sources (ADS)

Process Ontology
- Translation of BPMs to OWL. Activity/Message descriptions include relationships to domain vocabulary terms.
DoD BEA Ontology

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**Example: SMP-E2E**
Example SMP to End to End (E2E) Process
Priority 5 – Strengthen DoD Financial Management

“Procure to Pay” (P2P) Level 1 E2E in the BEA

Prepare and populating a modern information model and data store

“Perform Receipt Acceptance & Return” P2P Level 2 E2E in the BEA

SMP Metrics also to be rolled up to Level 1

Leaf Level decomposition used to identify and define requirements “rolled up” to and visualized at Level 1
Example SMP to End to End (E2E) Process
Priority 5 – Strengthen DoD Financial Management

"Procure to Pay" (P2P) Level 1 E2E in the BEA

SMP Metrics also to be rolled up to Level 1

"Perform Receipt Acceptance & Return" P2P Level 2 E2E in the BEA

SMP Metrics linked at Leaf Level (e.g., Level 2)

Leaf Level decomposition used to identify and define requirements “rolled up” to and visualized at Level 1

Common Vocabulary is Necessary!

Preparing and populating a modern information model and data store
Common Vocabulary Development

Preparing and populating a modern information model and data store

- Identify information to communicate
- Agree on terms and contextual use
- Communicate

“Now! That should clear up a few things around here!”
Common Vocabulary Development

Preparing and populating a modern information model and data store

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“Now! That should clear up a few things around here!”

DoD BMA Architecture Methodology
Building Common Vocabularies

Preparing and populating a modern information model and data store

What is the architecture supposed to achieve?

Define Capabilities

Items:
- Objectives
- Features
- Services

Which processes/activities will provide the capabilities?

Define Activities

Items:
- Verbs

Which data/resources will be consumed or produced?

Define Resources

Items:
- Nouns

Who/What will be involved?

Define Performers

Items:
- Roles
- Systems
- Actors

Preparing and populating a modern information model and data store
Building Common Vocabularies

Prepating and populating a modern information model and data store

What is the architecture supposed to achieve?

Which processes/activities will provide the capabilities?

Which data/resources will be consumed or produced?

Who/What will be involved?

**Capability Vocabulary**

- Items:
  - Objectives
  - Features
  - Services

**Activity Vocabulary**

- Items:
  - Verbs

**Resource Vocabulary**

- Items:
  - Nouns

**Performer Vocabulary**

- Items:
  - Roles
  - Systems
  - Actors

**Capability View**

**Process View**

**Data & Rule View**

**Process View**
Building Common Vocabularies

Preparing and populating a modern information model and data store

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Items: • Verbs

**Resource Vocabulary**

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**Performer Vocabulary**

Items: • Roles • Systems • Actors

**Capability View**

Process View

Data & Rule View

Process View

**Common Vocabulary in Action!**

Preparing and populating a modern information model and data store.
Ontology – Based Information Representation

Preparing and populating a modern information model and data store

Graph1

DBpedia (Wikipedia) Dataset

DoDAF Wizdom

hasTitle

book

writtenBy

Dennis Wisnosky

hasName

hasTitle

University of Pittsburgh

hasName

University of Dayton

California University of Pennsylvania

hasName

graduatedFrom

person

hasName

University of Pittsburgh
Who wrote “DoDAF Wizdom”?
Preparing and populating a modern information model and data store

Ontology – Based
Information Representation

Graph

DoD HR Dataset

person

hasName

Dennis Wisnosky

bornIn

Washington

locatedIn

Pennsylvania

yearOfBirth

19XX
Ontology – Based Information Representation

Where was Dennis Wisnosky born?

Graph2

DoD HR Dataset

person

hasName

Dennis Wisnosky

bornIn

Washington

locatedIn

Pennsylvania

yearOfBirth

19XX
Preparing and populating a modern information model and data store

Information Merging

DBpedia (Wikipedia) Dataset

DoDAF Wizdom

hasTitle

book

writtenBy

Dennis Wisnosky

graduatedFrom

university

hasName

California University of Pennsylvania

hasName

University of Dayton

hasName

University of Pittsburgh

hasName

person

Graph3
Preparing and populating a modern information model and data store

**Information Merging**

- **DoDAF Wizdom**
  - hasTitle: book
  - writtenBy: Dennis Wisnosky

- **Dennis Wisnosky**
  - graduatedFrom: California University of Pennsylvania
  - university: University of Pittsburgh

- **University of Dayton**

- **Person**
  - hasName: Dennis Wisnosky
  - yearOfBirth: 19XX
  - bornIn: Washington
  - locatedIn: Pennsylvania

**DBpedia (Wikipedia) Dataset**

**DoD HR Dataset**

**Graph3**
Preparing and populating a modern information model and data store

**Information Merging**

- **DoDAF Wizdom**
  - hasTitle: book
  - writtenBy: Dennis Wisnosky

- **Dennis Wisnosky**
  - graduatedFrom: California University of Pennsylvania
  - hasName: Dennis Wisnosky
  - hasName: 19XX
  - bornIn: Washington, DC
  - locatedIn: Pennsylvania

- **University of Pittsburg**
  - hasName: University of Pittsburgh

- **University of Dayton**
  - hasName: University of Dayton

**Graph3**

**DBpedia (Wikipedia) Dataset**

**DoD HR Dataset**
Preparing and populating a modern information model and data store

Information Merging

DBpedia (Wikipedia) Dataset

DoD HR Dataset

Wikipedia Dataset: Who wrote “DoDAF Wizdom”?

DoD HR Dataset: Where was Dennis Wisnosky born?

Combined Dataset: Where was the person who wrote DoDAF Wisdom born?
Preparing and populating a modern information model and data store

Information Merging

Wikipedia Dataset: Who wrote “DoDAF Wizdom”?  
DoD HR Dataset: Where was Dennis Wisnosky born?  
Combined Dataset: Where was the person who wrote DoDAF Wisdom born?

Crawl, Walk, Run - EIW
HR Enterprise Information Web (EIW)

Implementing the capability by deploying business services

- Building an HR Common Vocabulary that will make future integration and development simpler
- Building an executable information model to provide accurate and timely enterprise Personnel Visibility for the first time
- Making “compliance” (eg: SFIS, IRB, BEA) exercises simpler, faster, meaningful, easier to maintain
HR Enterprise Information Web (EIW)

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HR Domain Ontology

Implementing the capability by deploying business services

- Information discovery, interoperation, and integration all depend on description
  - If we do not know what something is we cannot possibly know how to integrate it with other things or even how it should be used
- If we describe everything, we are in a position to have a knowledge-based web
  - Rich analytics
    - Requirements gap analysis
    - Authoritative Data Source discovery
    - Answer any Personnel & Pay question
  - Integrate and interoperate
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BPM Informs Ontology
Goal: Develop correct, consistent, human and machine readable, high quality business process models

Approach:

Benefits:
- Consistent, semantically aligned (end-to-end HR) business processes
- Communicate effectively with the Services
- Machine readable (queryable) business processes
  - Perform gap analysis
  - Standards based models result in fewer errors during implementation

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Community Workspace: www.Common Vocabulary.army.mil

https://www.commonvocabulary.army.mil/ui/groups/HR_EIW

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Implementing the capability by deploying business services

Human Resources
Community HR_EIW vocabulary Human_Resources

Contents
1 Technical Specifications
1.2 Overview

Technical Specifications

Overview

Ontology Name
http://www.knooldl.com/ui/groups/DIMHRS/vocab/Human_Resources/

Dependencies
Namespaces

HR EIW & H2R E2E
HR EIW and H2R E2E

Implementing the capability by deploying business services

Personnel Visibility not possible if DoD doesn’t understand the Enterprise H2R E2E processes, information flows, data sources, integration points, standards and exceptions

Eg: how does the “Pay” process work across DoD in the E2E?

Need to know: where in E2E, which ADS, semantics (meaning) of data, and access
HR EIW and H2R E2E

Implementing the capability by deploying business services

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90 Day Deliverables – POD 1
Objectives Achieved:
- Web Service
- DKO CAC Authentication
- Data Virtualization
- ETL Process
- DMDC MOU
- P&R HR Ontology Models
- DIMHRS Reuse

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90 Day Deliverables – POD 2

Implementing the capability by deploying business services
RDF Warehouse Architecture (POD2)

Implementing the capability by deploying business services

User Agent (Web Browser)

Host Network

- RDF Triple Store
  - RDF/Relational Mapping
  - ETL (Semantic Mapping)

Relational Data Source

- DIMHRS – HRTS2 Scrambled DB

Presentation & Business Logic

- SPARQL Data Access
- Wiki Content
- Modeling

Model Driven Analytics

Model Driven ETL

IETF

HTTPS

API

RDF Load

Real Time Interface

Batch Process

API

SPARQL

Real Time Interface

Batch Process

API

Real Time Interface

Batch Process

API
Implementing the capability by deploying business services

User Agent (Web Browser)

HTTPS

NIPRNet / Internet

RDF Warehouse Architecture (POD2)

Model Driven Analytics

Triple Store

90 Day Deliverables – POD 3
POD3 Goals
- Support multiple triple stores
- Map/Load/Query multiple data sources
  - Army (DIMHRS), USMC (MCTFS)
- Model based ETL with COTS
- Increase analytic capability
  - Army & USMC data from single query
  - Drill down by Service/Component
  - Expand Transition queries (TBD)
  - Compensation queries (TBD)
  - Demo at least one report (TBD)
  - Scenario based demo (scenarios TBD)

Implementing the capability by deploying business services
RDF Web Extensibility (POD3)

POD3 Goals

- Support multiple triple stores
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  - Army (DIMHRS), USMC (MCTFS)
- Model based ETL with COTS
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  - Army & USMC data from single query
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  - Demo at least one report (TBD)
  - Scenario based demo (scenarios TBD)

Identical data loaded into both triple stores.

Use Case!
Operations – Country View: User Defined Query
Operations – Country View: User Defined Query

Interoperability through: Model – Data – Implement!
Interoperability through “Model-Data-Implement”

Policy, Processes & Tiered Accountability

Common Architecture
Methodology

Common Vocabulary

Standard Representation
and Composition

Primitives & Design Patterns

Authoritative Data Sources

Component Data Stores

External Data Services

Semantic Technologies

End-to-End Processes

Agile Business Services Delivery

DWiz DoD DCMO BMA CTO & CA

9/15/2010
Interoperability through “Model-Data-Implement”

Governance

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DoD Semantic Landscape
DoD Business Operations Semantic Landscape

Enterprise Standards
RDF, OWL, Pronto, etc.

Semantic Foundation

Upper Ontology

Common Vocabulary

Domain Ontologies

Business Rules
(W3C Rules Interchange Format for standard exchange of rules)

Shape and Control the Transformation

Transactional Data Stores

Transform

RDF Triple Stores

Semantic Data Mediation & Transformation

Systems & Services Interoperability

Semantic Foundation

Provide semantic foundation and mappings to drive data integration (mediation & transformation)

Provide semantics-based facts (RDF) and connections to Common Vocabulary (Ontologies) and Rules for machine reasoning

Business Intelligence:
Data Sharing
Reporting
Ad Hoc Query
Knowledge Exploration

Achieving Net-Centricity:
Data Sharing

EiW is first BI realization of this

27/02 PPT 9/15/2010 DWiz DoD DCMO BMA CTO & CA 39
DoD Business Operations Semantic Landscape

- **Enterprise Standards**: RDF, OWL, Pronto, etc.
- **Domain Ontologies**: Provide semantic foundation and mappings to drive data integration (mediation & transformation)
- **Common Vocabulary**: Provide semantics-based facts (RDF) and connections to Common Vocabulary (Ontologies) and Rules for machine reasoning
- **Semantic Data Mediation & Transformation**: Systems & Services Interoperability
- **Upper Ontology**: Shape and Control the Transformation
- **Transaction Data Stores**: RDF Triple Stores
- **Business Rules**: (W3C Rules Interchange Format for standard exchange of rules)

**The One Takeaway**

EIW is first BI realization of this

**Business Intelligence:**
- Data Sharing
- Reporting
- Ad Hoc Query
- Knowledge Exploration

**Achieving Net-Centricity:**
- Data Sharing
Agile, Architecture-Driven, DoD Business Capability Delivery

Governance
Policy, Processes, Tiered Accountability

Model
Common Architecture Methodology
Common Vocabulary
Standard Representation and Composition
Primitives and Design Patterns

Data
Authoritative Data Sources
Semantic Technologies

Implement
Phased Implementations
Agile Business Services Delivery
Agile, Architecture-Driven, DoD Business Capability Delivery

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Implement
Phased Implementations
Agile Business Services Delivery

Model to Guide Transformation
Data to Improve Performance
Implement to Deliver Capabilities
Thank you!

Questions?
Dennis.Wisnosky@osd.mil
Pull!
The Power of the Semantic Web to Transform Your Business

David Siegel
Author of Reform Your Enterprise