Semantic Technology in the Department of Defense, Business Mission Area

Dennis E. Wisnosky,
DoD BMA CTO &
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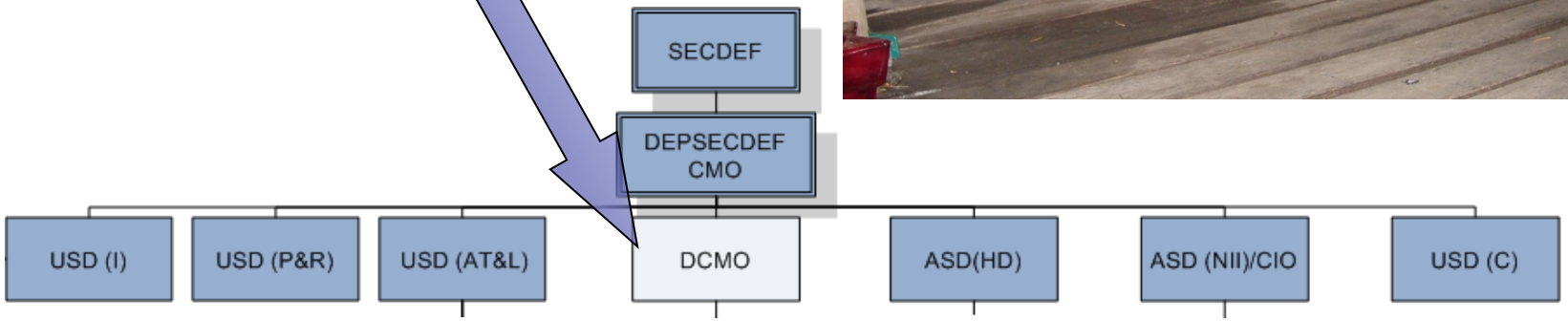
Office of the Deputy Chief
Management Officer

October 28, 2010

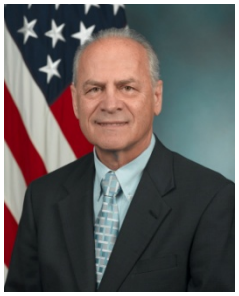
DCMO CTO/CA

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)



Global Reach!

The Business Operating Environment

"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."

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

OMB Budget Grouping	Number of Programs	FY2010 IT Spending - $ Billions
Communications and Computing Infrastructure	1,547	$16.3
Information Assurance Activities	353	$3.2
Functional Area Applications	3,244	$13.2
Related Technical Activities	156	$1.0
Total DoD IT Spending	5,300	$33.7

SOURCE: http://www.whitehouse.gov/omb/e-gov/

Issue: Infrastructure

DoD Contractors Build Separate Infrastructures & Dictionaries

$ Billions	FY05	FY06	FY07
Total DoD I.T. Spending	$28.7	$29.9	$30.4
DoD Spending on Contractors	$21.1	$22.6	$24.1
% of I.T. Spending Contracted Out	73.5%	75.6%	79.3%

Issue: Redundancy

DoD Projects Have Own Data

Projects	07 Budget $ Millions	Number of Projects	% of Total Budget $	% of Projects
Project - > $100 Million	$10,301	43	33.9%	1.3%
Projects - > $10 Million	$15,013	525	49.4%	15.4%
Projects - < $10 Million	$5,066	2,832	16.7%	83.3%
Total	$30,380	3,400	100.0%	100.0%

Issue: Data

Small Slice of the As-Is

A Small Slice of the As-Is

We Must Make Sense Out of This!

Game-Changing Innovations!

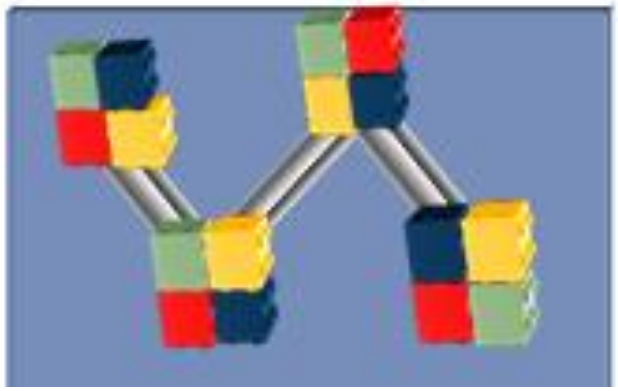
Game-Changing Innovations

Common Vocabulary and Primitives

- 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

To-Be State

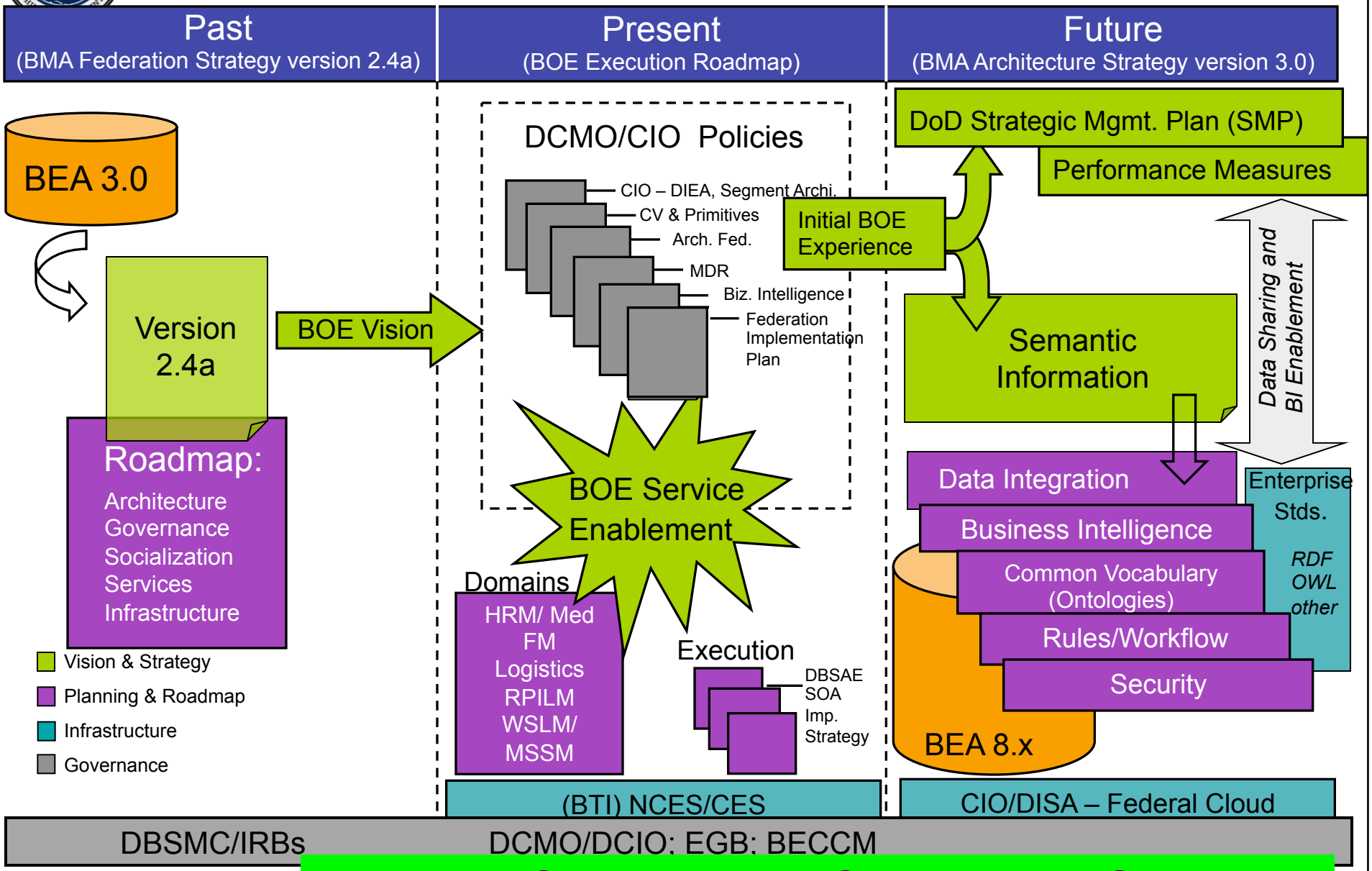
To-Be State



Dynamic, event-driven reconfiguration of services

DoD Business Operations Strategy and Roadmap!

Strategy and Roadmap for DoD Business Operations Transformation



Business Operations thru Semantic web Solutions

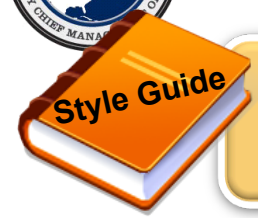
Business Operations thru Semantic web Solutions

- 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

Modeling: Primitives!

Standards-based Architecture - Primitives

Modeling the business capability to be deployed



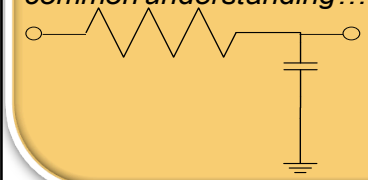
Standard Symbols

Engineering Language and Symbols:

Resistor symbol

Capacitor symbol

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



Architecture Primitives

Standards
Best Practices

informed by

influences

PriMo
Modeling Guide

foundation for

PrOnto
Ontology (Lexicon)

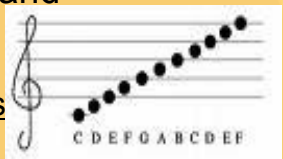
input for

Different Frameworks

Architecture Primitives

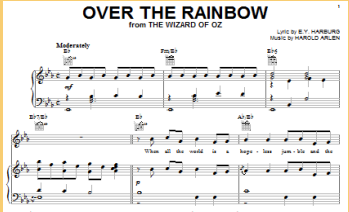
Music Language and Symbols:

Music Scale symbols

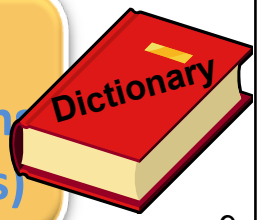


Notes symbols

This agreed upon representation of music allows a common understanding…



Standard Language (terms, definitions)

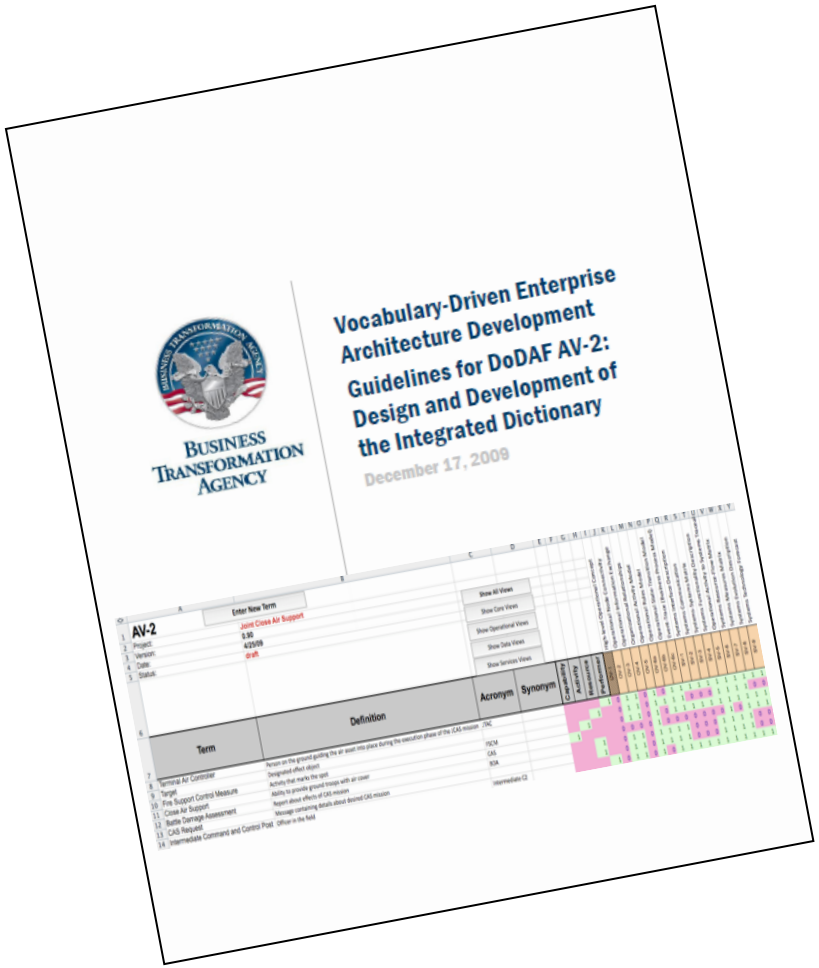


- DoDAF 2.0 serves as the foundation for architecture primitives
- Use Cases being developed and used to drive pilots

Well Documented Intentions!

Architecture Primitives Series

Modeling the business capability to be deployed



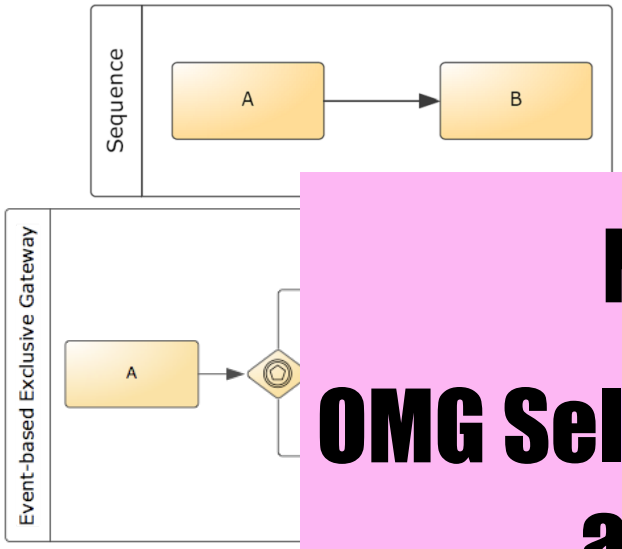
DoD Architecture Framework Processes Best-Practice

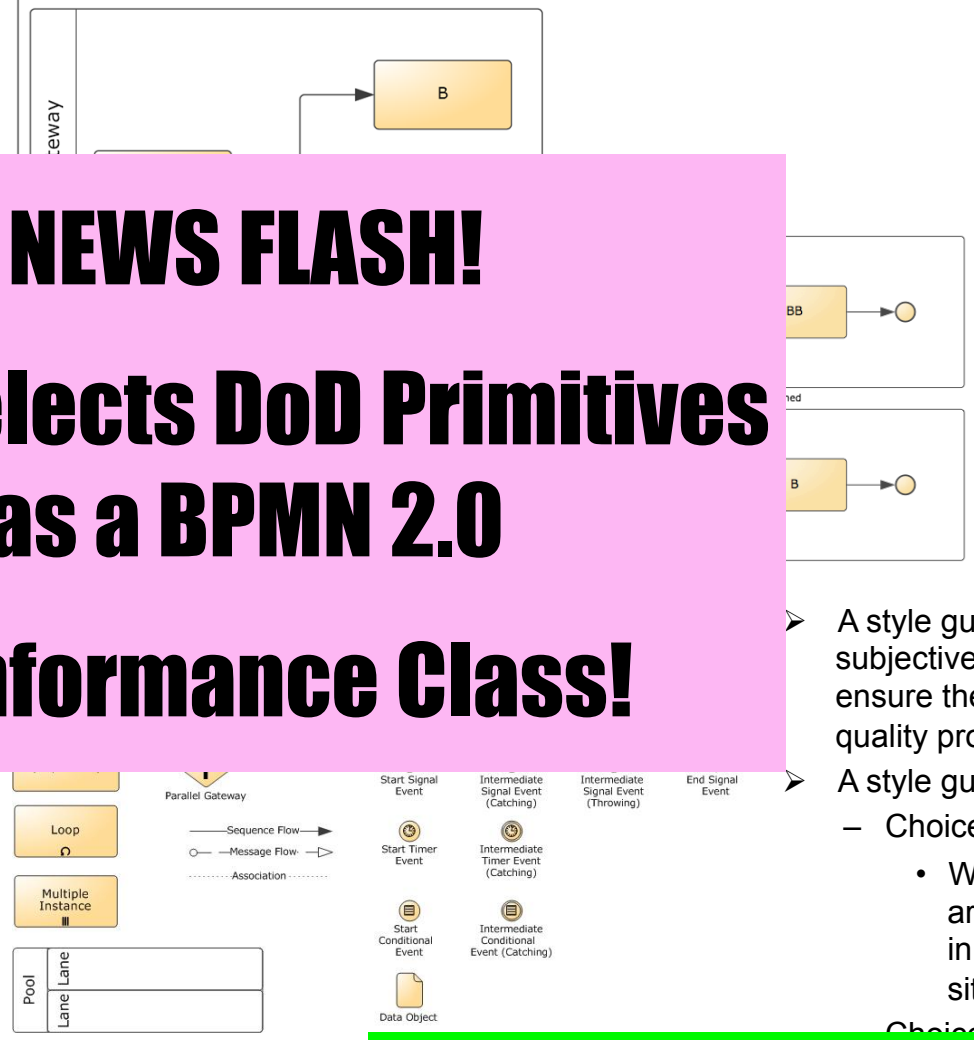
http://cio-nii.defense.gov/sites/dodaf20/journal_exp3.html

Primitives lead to Patterns

Patterns & Primitives

Modeling the business capability to be deployed





NEWS FLASH!

OMG Selects DoD Primitives as a BPMN 2.0 Conformance Class!

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

PriMo

- 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
  - combine
    cts to
    maximum effect

Will Industry Care?

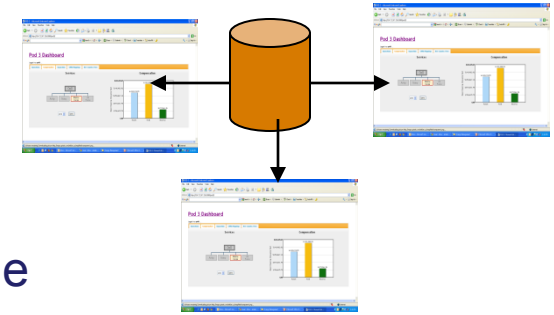
We Are Underway!

Modeling the business capability to be deployed

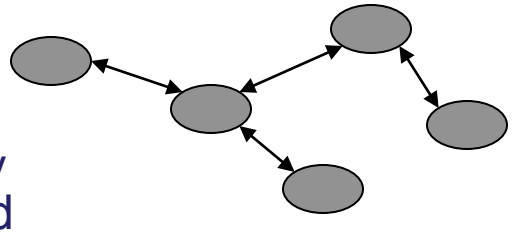
BEA Solution Statement

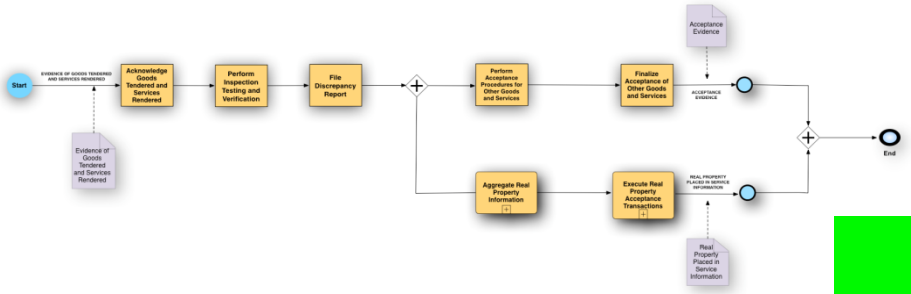
BEA Solution Statement

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



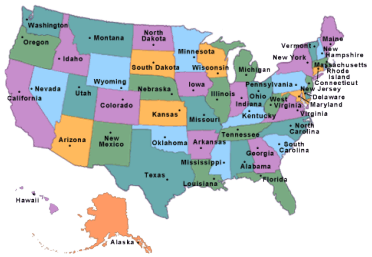


Interoperability

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

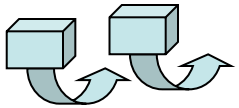


- Steps
  1. Build Domain Vocabularies: describe all of the artifacts in each domain using RDF/OWL standards
     - DoD currently does this description work, but without standards – often in Excel, Word, Powerpoint, Visio, etc
  2. Relate Domains: use RDF/OWL based descriptions to say how domains are 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

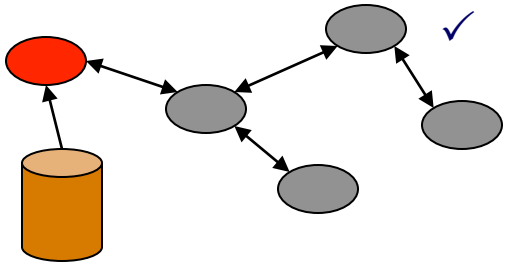
Agility

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

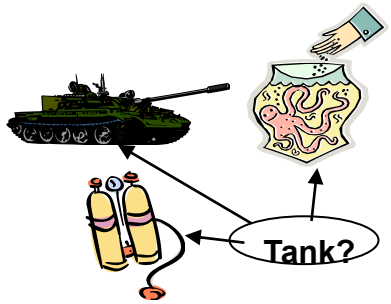
NOTE: up-front time and labor cost of unambiguously describing assets is not trivial

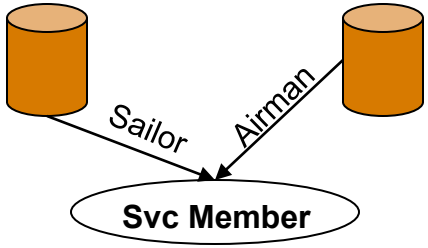
Savings

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 unambiguously described, Domain vocabulary can assess gaps and redundancies in the portfolio and the architecture based on factual assessments



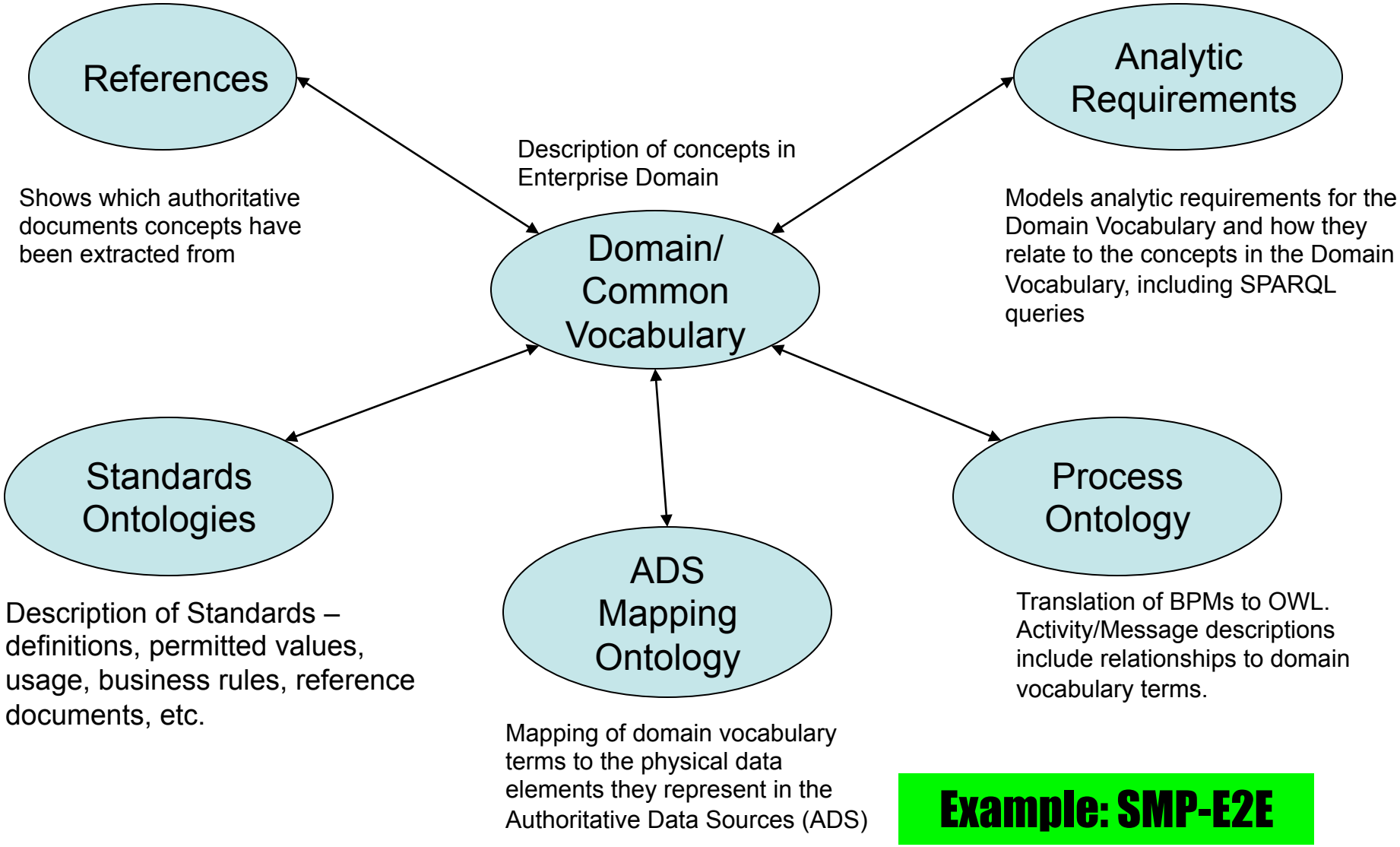


Data	Concept	System	DV to Arch?
Airman	Svc Mem	Pers Sys	
Soldier	Svc Mem	Pers Sys	
Sailor	Svc Mem	Pers Sys	
Lawyer	Svc Mem	Pers Sys	

(notional depiction only)

DoD BEA Ontology

Preparing and populating a modern information model and data store



Example: SMP-E2E

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

Preparing and populating a modern information model and data store

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

SMP Metrics also to be rolled up to Level 1

Radio_Frequency_ Identifier
The Radio Frequency Identifier must be assigned only if referenced by contract in DFAR Clause 252.211-7006

Invoice_Date
The Invoice Date must be assigned for each invoice number

Unit_ Price_Amount
The Unit Price Amount must be assigned for each Unique Item Identifier (UII) item

MILSTRIP_Number
The MILSTRIP Number must be assigned

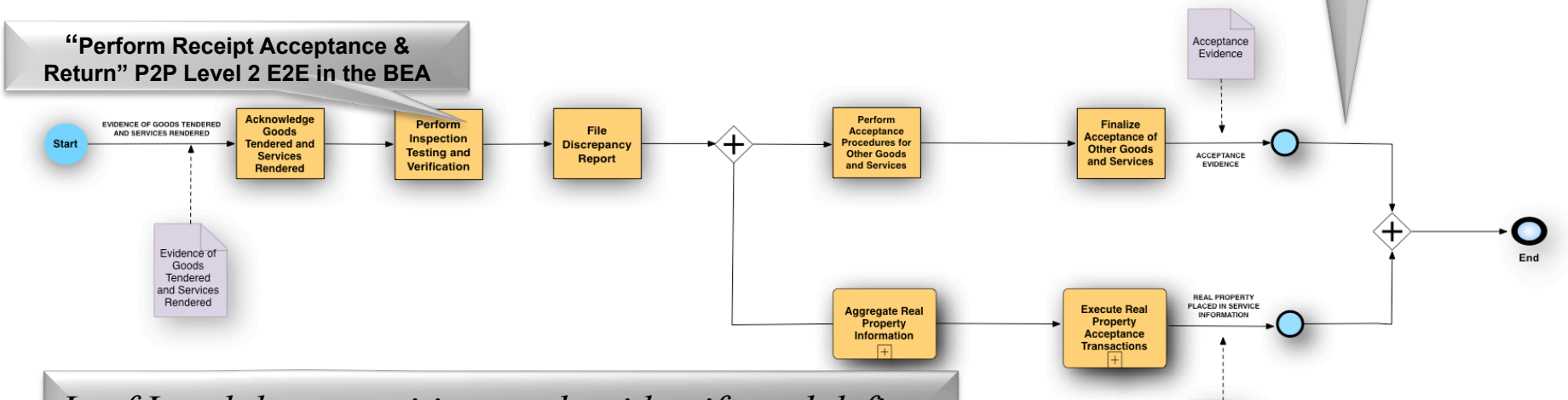
Acceptance Evidence (Sample Business Rules)
City_Acceptance
Invoice_Date
City_Ship_To
Contract_Issue_Date
Country_Code_Ship_To
MILSTRIP_Number
Issuing_Agency_Code
Item_Unique_Identifier
Original_Part_Number
Postal_Code_Ship_To
Serial_Number
Received _Date
Unit_Price_Amount
Shipment_Discrepancy_Code
Shipment_Mode_ Code
Radio_Frequency_Identifier

Acceptance Evidence

Acceptance Evidence (Sample Minimum Data Elements)
Acceptance_Date
Reciept_Quantity
Site_Unique_ Identifier
Property_Action_Category_Code
Property_Work_CIP_Phase_Indicator
Radio_Frequency_Identifier
Real_Property_Facility_Number
Shipment_Unit_Final_Shipment_Indicator
Trading_Partner_Indicator_Code
Transaction_Amount

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

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



Leaf Level decomposition used to ident
requirements "rolled up" to and visual

Common Vocabulary is Necessary!

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!"

DoD BMA Architecture Methodology

Building Common Vocabularies

Preparing 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 → **Activity Vocabulary** → **Resource Vocabulary** → **Performer Vocabulary**

Items:
- Objectives
- Features
- Services

Capability View

Items:
- Verbs

Process View

Items:
- Nouns

Data &

Items:
- Roles
- Systems
- Actors

Process

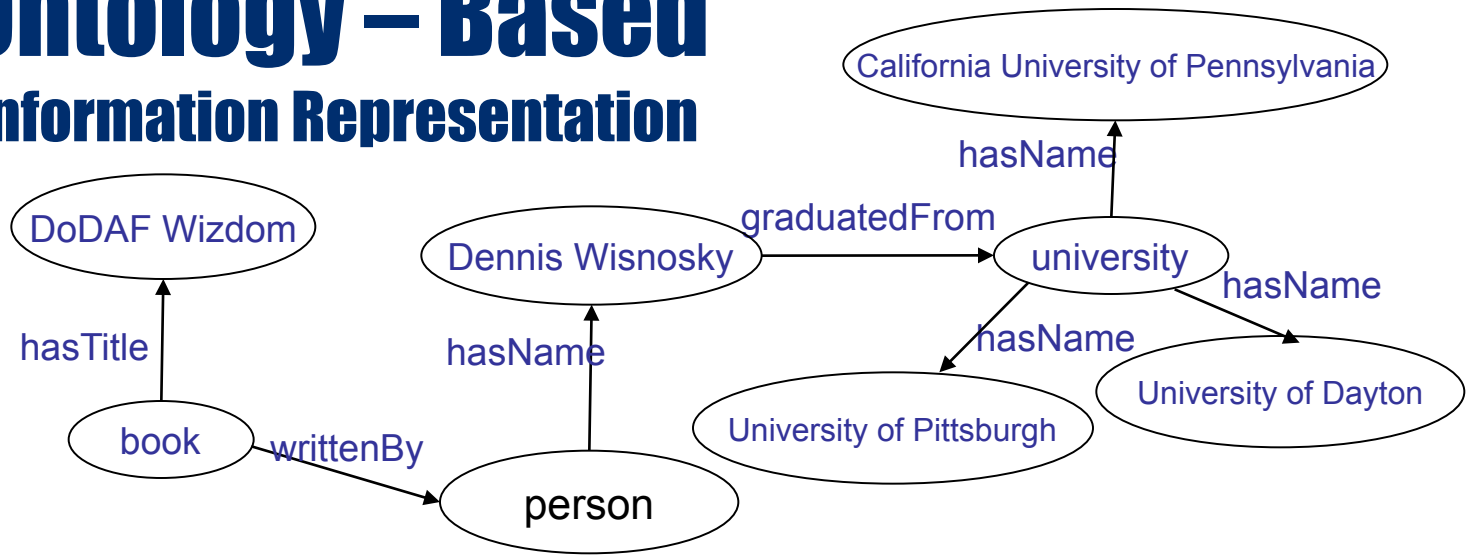
Common Vocabulary in Action!

Ontology – Based

Information Representation

DBpedia (Wikipedia) Dataset

Graph1



Who wrote "DoDAF Wizdom"?

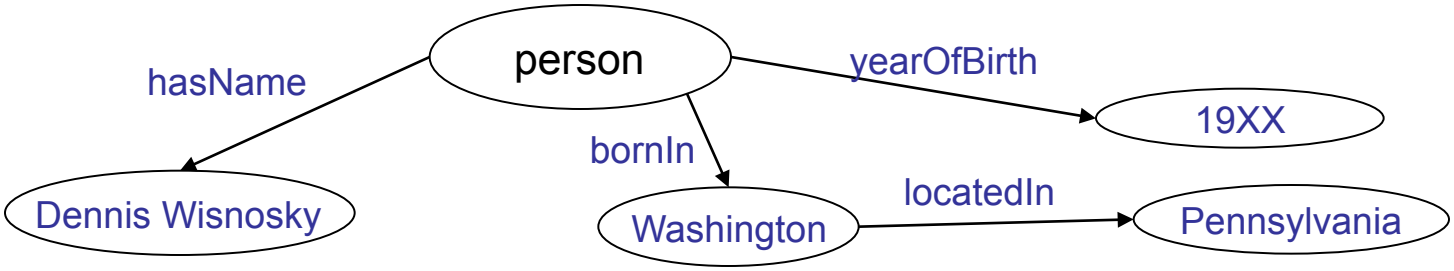
Ontology – Based

Information Representation

Where was Dennis Wisnosky born?

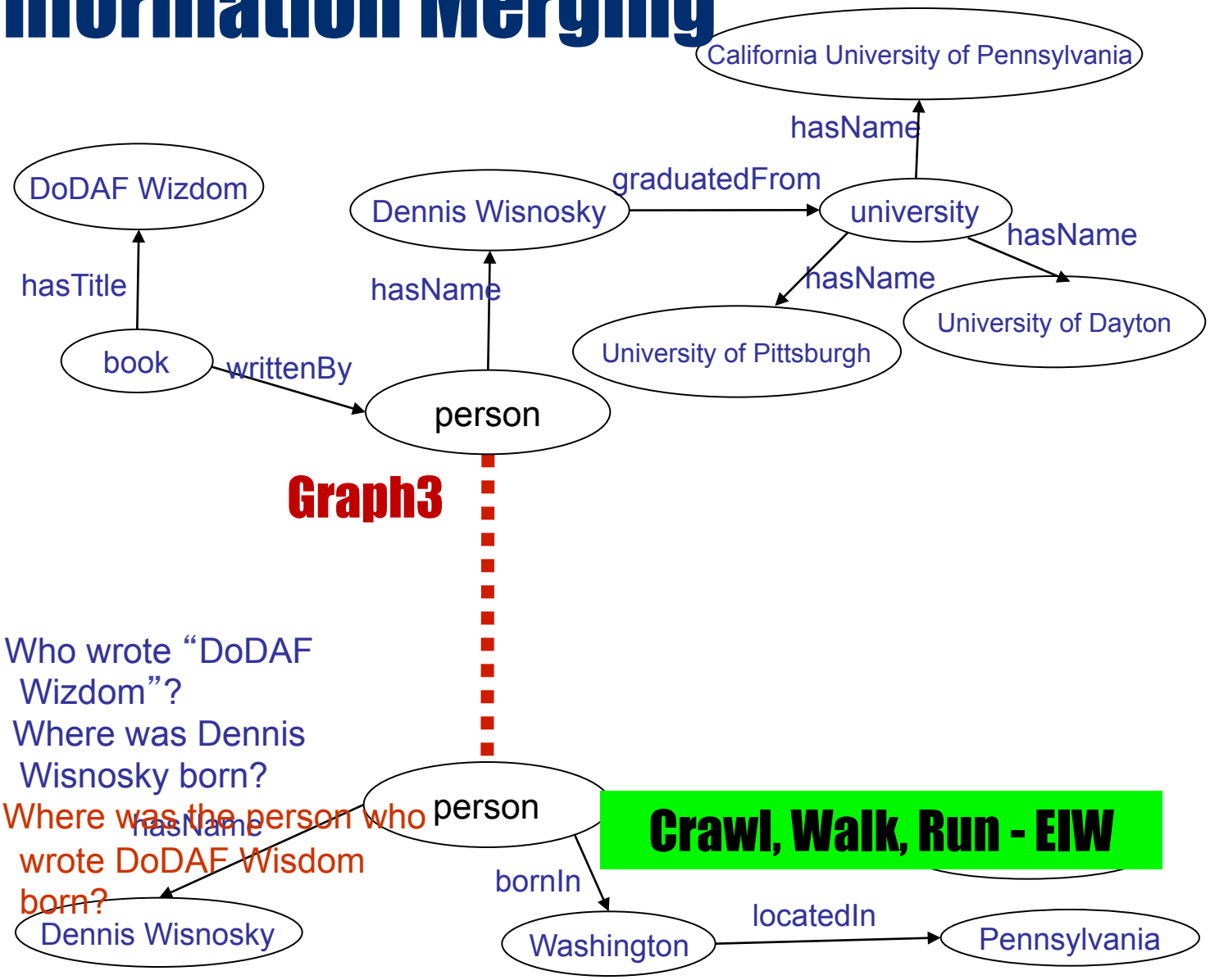
Graph2

DoD HR Dataset



Information Merging

DBpedia (Wikipedia) 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?

DoD HR Dataset

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

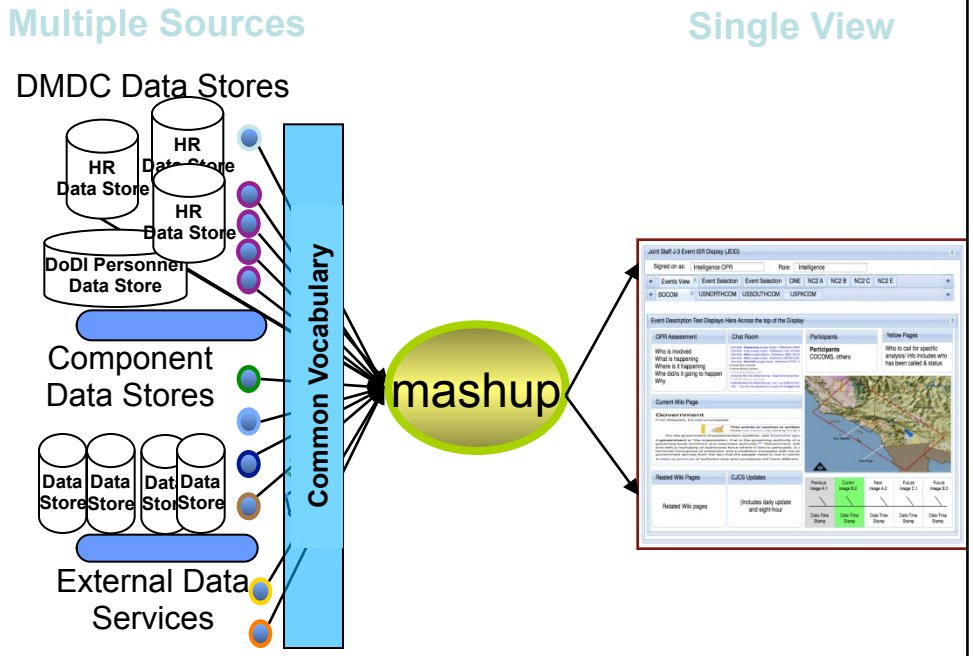
EIW Roadmap

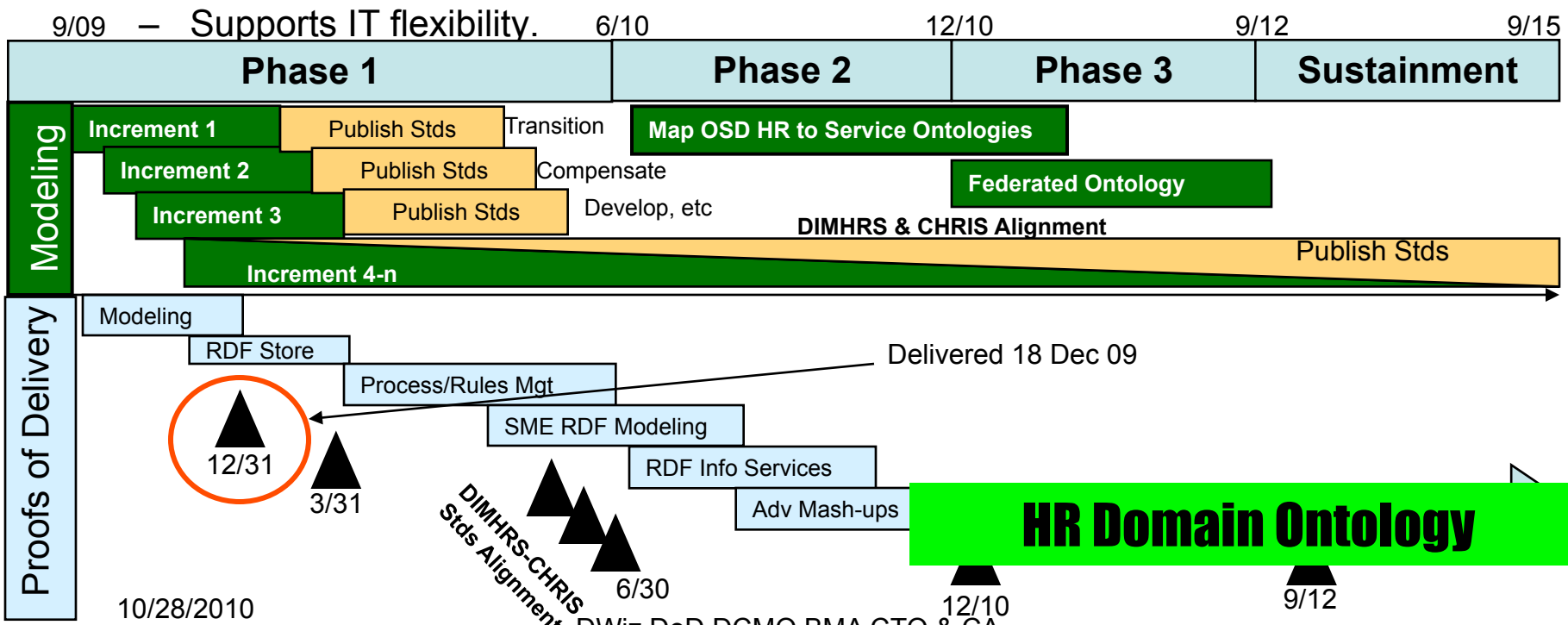
Implementing the capability by deploying business services

HR EIW

The HR EIW is a mechanism for reaching into service applications to satisfy enterprise HR information needs. It accomplishes three things:

- Reports real-time, authoritative HR information on-demand.
- Supports HR enterprise information standards.
- Supports IT flexibility.





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
- RDF & OWL are the technology used to describe "things"
  - both machines and people can understand the descriptions

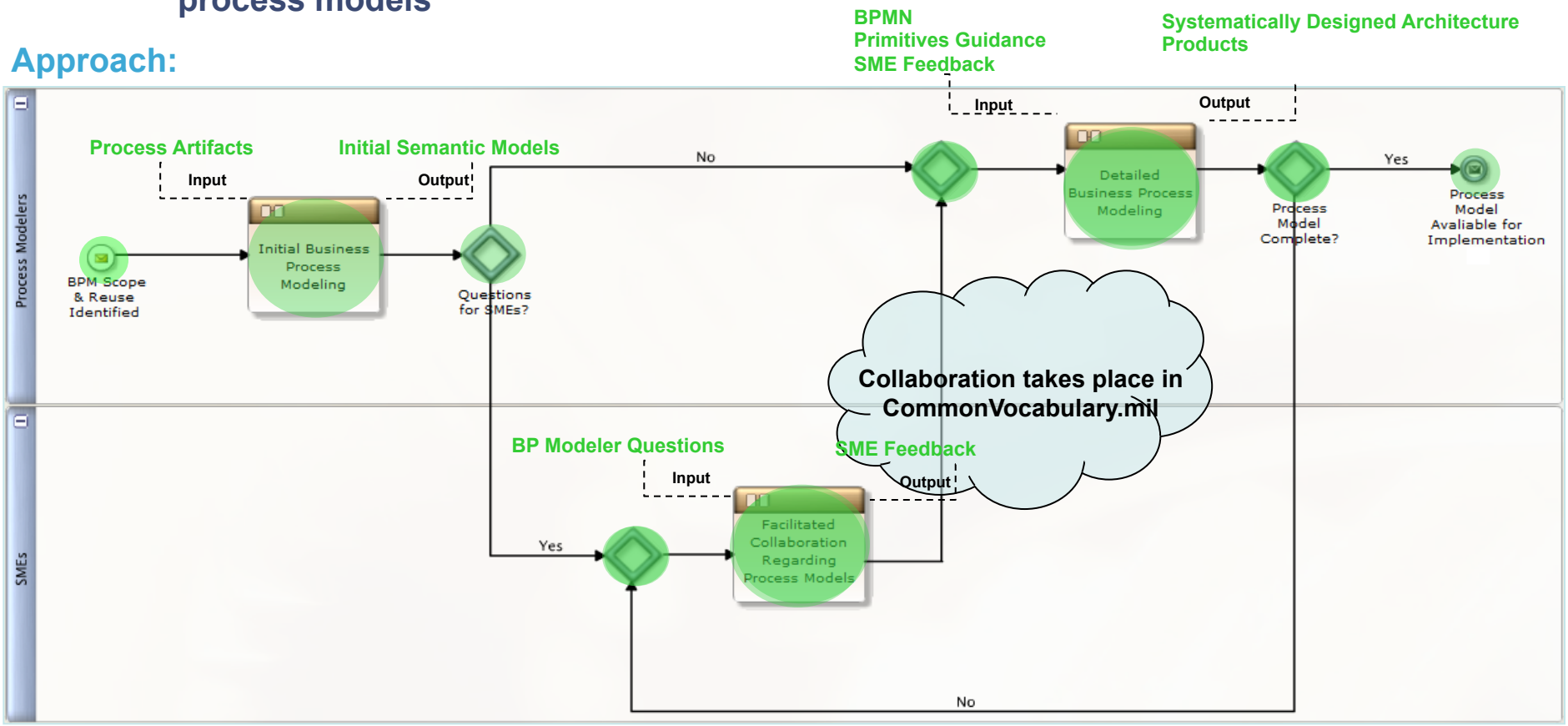
BPM Informs Ontology

Implementing the capability by deploying business services

BPM Methodology

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 implemen

Collaboration

Community Workspace: www.Common Vocabulary.army.mil

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

Implementing the capability by deploying business services

CommonVocabulary- Human Resources - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address https://www.commonvocabulary.army.mil/ui/groups/HR_EIW/vocab/Human_Resources

CommonVocabulary

Find: search this vocabulary Search ehtambo6 Log out

CommonVocabulary My account Community File Edit RSS Feeds

Human Resources

Community HR_EIW vocabulary Human_Resources

Classes Properties

(Acc...Cas)
- Accumulator
- AdditionalProperty [d2rq:]
- Address
- AgreementType
- Allotment
- AllotmentDesignee
- AllowedValuesClasses
- Application
- Application_Status
- Application_Type
- Attachment
- BankAccount
- CasualtyAssistancePackage
- CasualtyIncidentHostilityType
- CasualtyInvestigationRequirement
- CasualtyReport
- CasualtySituationNotificationType

(D2R...Mem)

View Graph RDF Discussion History

Contents
1 Technical Specifications
1.2 Overview

Technical Specifications

Overview

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

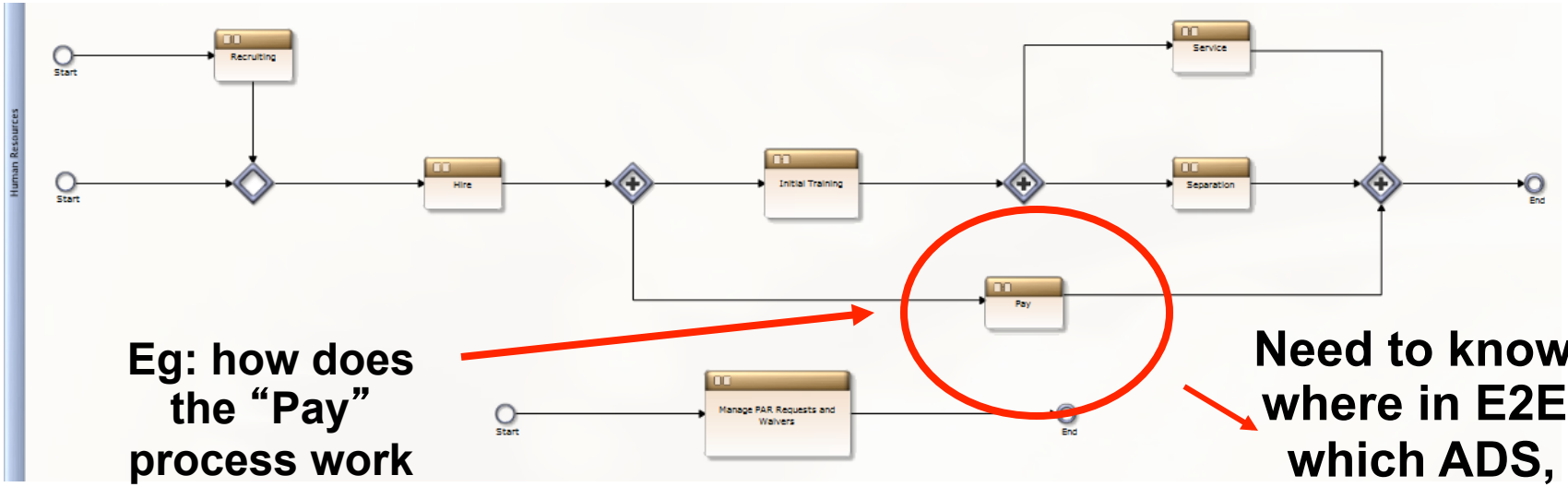
Dependencies
Namespaces
http://www.knoodl.com/ui/groups/DIMHRS/voca
d2rq: http://www.wiwiss.fu-berlin.de/suhl/bizer/D2RQ
d2rq-ext: http://www.knoodl.com/group/DIMHRS/vocab/D
dc: http://purl.org/dc/elements/1.1/
ja: http://jena.hpl.hp.com/2005/11/Assembler#
ns4: http://www.knoodl.com/ui/groups/DIMHRS/vocab/Debts/

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



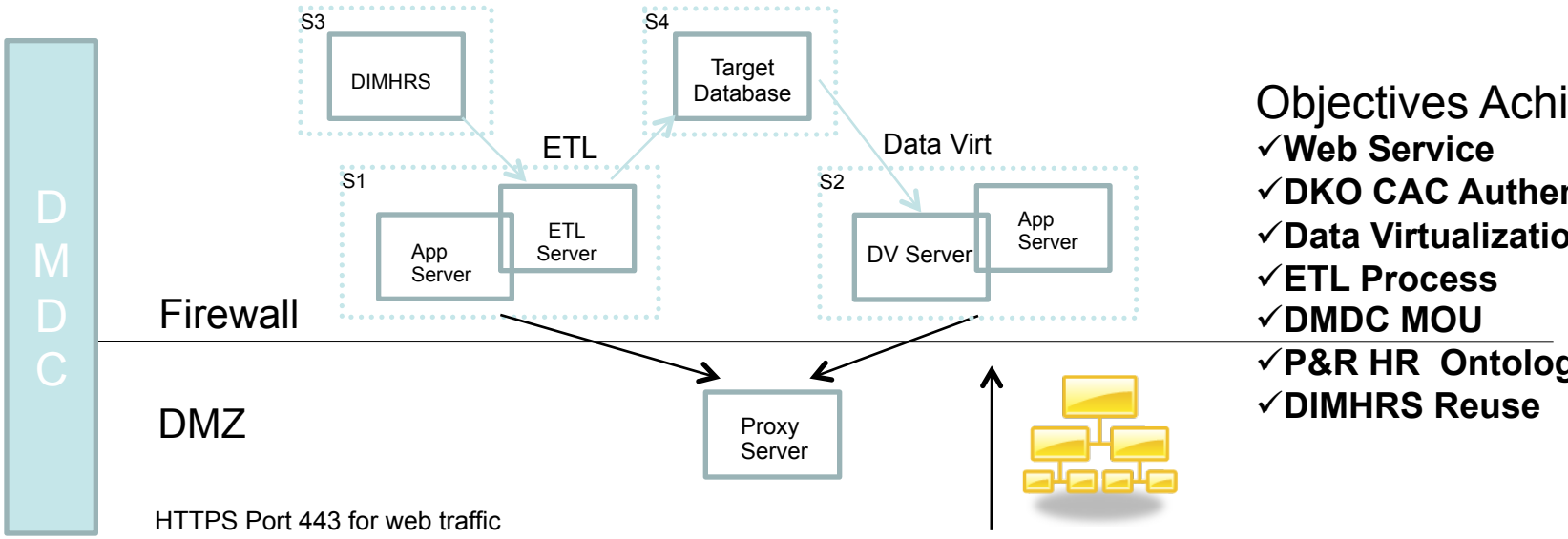
Eg: how does the "Pay" process work across DoD in the E2E?

Need to know: where in E2E, which ADS, semantics and access

90 Day Deliverables – POD 1

Implementing the capability by deploying business services

Backend PoD1 Architecture



Objectives Achieved:

- ✓**Web Service**
- ✓**DKO CAC Authentication**
- ✓**Data Virtualization**
- ✓**ETL Process**
- ✓**DMDC MOU**
- ✓**P&R HR Ontology Models**
- ✓**DIMHRS Reuse**

SOAP/XML

XML File

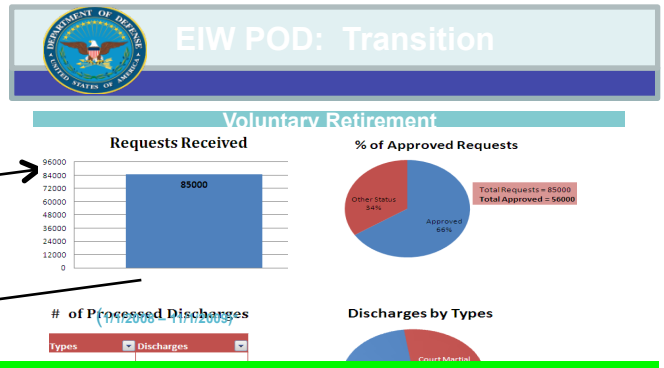
Web Service Call (bind)

DKO

Port 443 open for web traffic to DMDC

HTML

HTTPS



90 Day Deliverables – POD 2

RDF Warehouse Architecture (POD2)

Implementing the capability by deploying business services

User Agent
(Web Browser)

HTTPS

NIPRNet / Internet

Host Network

Presentation & Business Logic

SPARQL Data Access

Wiki Content

Modeling

Web / Application Server

✓ Model Driven Analytics

SPARQL

SPARQL

API

SPARQL Endpoint

Schema

Triples

RDF Triple Store

✓ Triple Store

RDF Load

RDF/ Relational Mapping

ETL (Semantic Mapping)

SQL

DIMHRS – HRTS2 Scrambled DB

Relationa

Real Time Interface

90 Day Deliverables – POD 3

Implementing the capability by deploying business services

RDF Web Extensibility (POD3)

User Agent
(Web Browser)

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)

NIPRNet / Internet

DMDC Network

Real Time Interface
Batch Process
API

HTTPS

Presentation & Business Logic
SPARQL Data Access
Wiki Content
Modeling
Web / Application Server

SPARQL
SPARQL
SPARQL
API

SPARQL Endpoint
Ontology
Triples
Triple Store

SPARQL Endpoint
Ontology
Triples
Triple Store

OWL + Relational Mappings

Manual File Transfer
(No System Interface)

Data Scramble
MCTFS ODSE
USMC Network

Scrambled
USMC Records
(No PII Allowed)

MCTFS ODSE – USMC Test Records
(No PII)

USMC Records (Relational)

DIMHRS – Army Test Records
(No PII)

Army Records (Relational)

ETL
(Model Based)

Army + USMC (Triples)
Army + USMC (Triples)

Identical data loaded into both triple stores.

Use Case!

DRAFT 04-22-20

Operations – Country View: User Defined Query

Google Maps Demo

http://184.72.247.236:8080/pod3/

Spry Enterprises, Inc. | M3O.mil | CommonVocab | Queries and Views | Templates | Calendar | Pandora Radio - List... | Personal Email | M3O | BigTime: Main Menu | Other bookmarks

Pod 3 Dashboard

Tabs

Map | Compensation | Separation | UCC Country View

Language | Other | Other

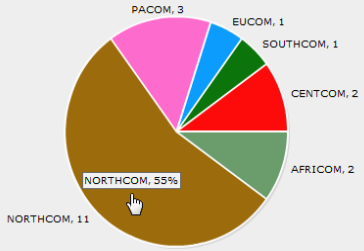
Select Desired Language:

- [x] FRENCH
- [x] HAITIAN CREOLE

Select months since members last deployment: 6

Select months until member is eligible to retire: 6 6

Submit



Members

SSN	First Name	Last Name	Loc.	Rank	Primary MOS	uuc
664887701	CukymGrNzY	PAqimqJlmX	51	MAJ	MOS180	NORTHCOM
1040784003	dqKfjpcLeZ	cIXksHOlTs	06	1STSGT	MOS8999	NORTHCOM
2060149898	TjzzRuUcrw	FaWZnSxZOs	06	SGT	MOS321	NORTHCOM
2886040741	XnazuYKSEg	cFAWmVTlUm	08	LTCOL	MOS202	NORTHCOM
240226098	KcVVSFohqY	kBkWlCmTaI	51	SGT	MOS3531	NORTHCOM
2768415363	VFybafiiyC	RRmreZLQgb	BG	SSGT	MOS2671	PACOM
3395337019	qVEhcxUKOp	IPGiibVqOr	51	CPL	MOS4641	NORTHCOM
2313602753	SIUhsCyABW	sOionznFxr	BG	SGT	MOS341	PACOM
350157891	TlbKjntNAK	VXStisZPDM	51	SSGT	MOS431	NORTHCOM
613173606	lOjwiuEErp	GpZbpatiMy	IZ	LTCOL	MOS302	CENTCOM
2803128426	siaTKGHIuh	SPJGquuHvF	51	GYSGT	MOS6276	NORTHCOM

Total Members:20

Dialog

About

Semantics is a Team Sport!

Semantics is a Team Sport: EIW Extended Team

BTA: Developer of the EIW

OUSD (P&R): Functional sponsor and owner of the HRM Enterprise Standards (HRM ES) & Common Human Resource Information Standards (CHRIS)

Joint Staff, COCOMs, OSD analysts: Future User Community

DMDC: Future hosting site for the EIW

DCMO: Oversight

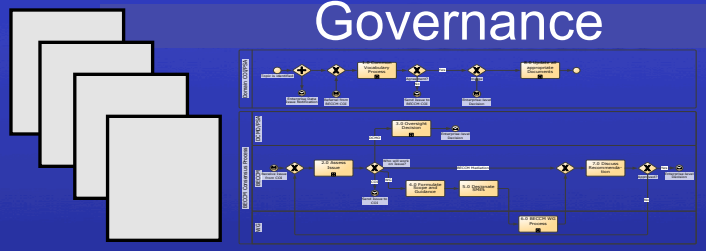
DFAS: Assessing HR-related pay requirements for the EIW

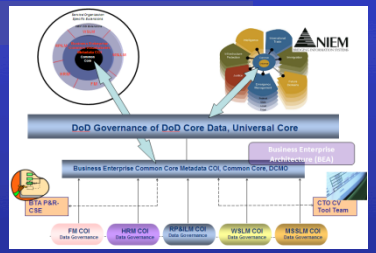
Military Services: Identifying ADSs, validating modeling

Interoperability through: Model – Data – Implement!

Interoperability through "Model-Data-Implement"

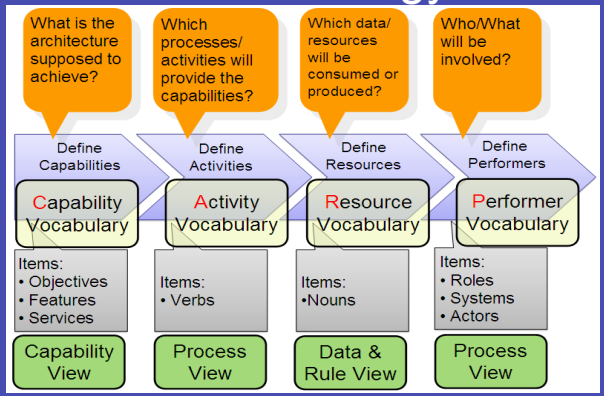
Governance





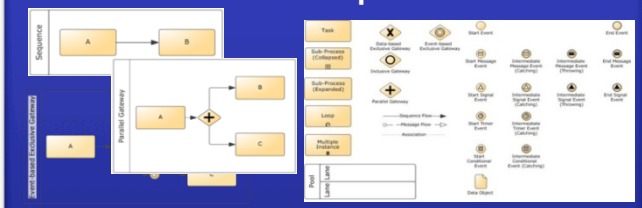
Policy, Processes & Tiered Accountability

Common Architecture Methodology



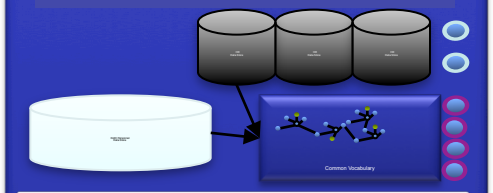
Common Vocabulary

Standard Representation and Composition



Primitives & Design Patterns

Authoritative Data Sources

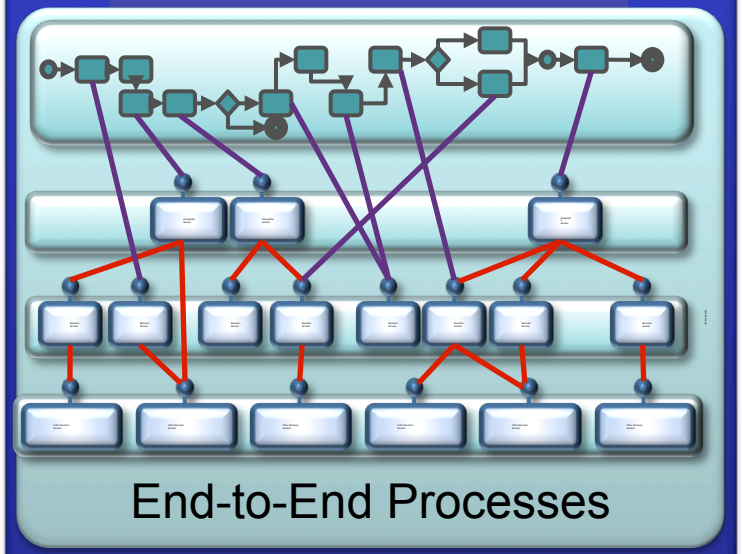


Component Data Stores

External Data Services

Semantic Technologies

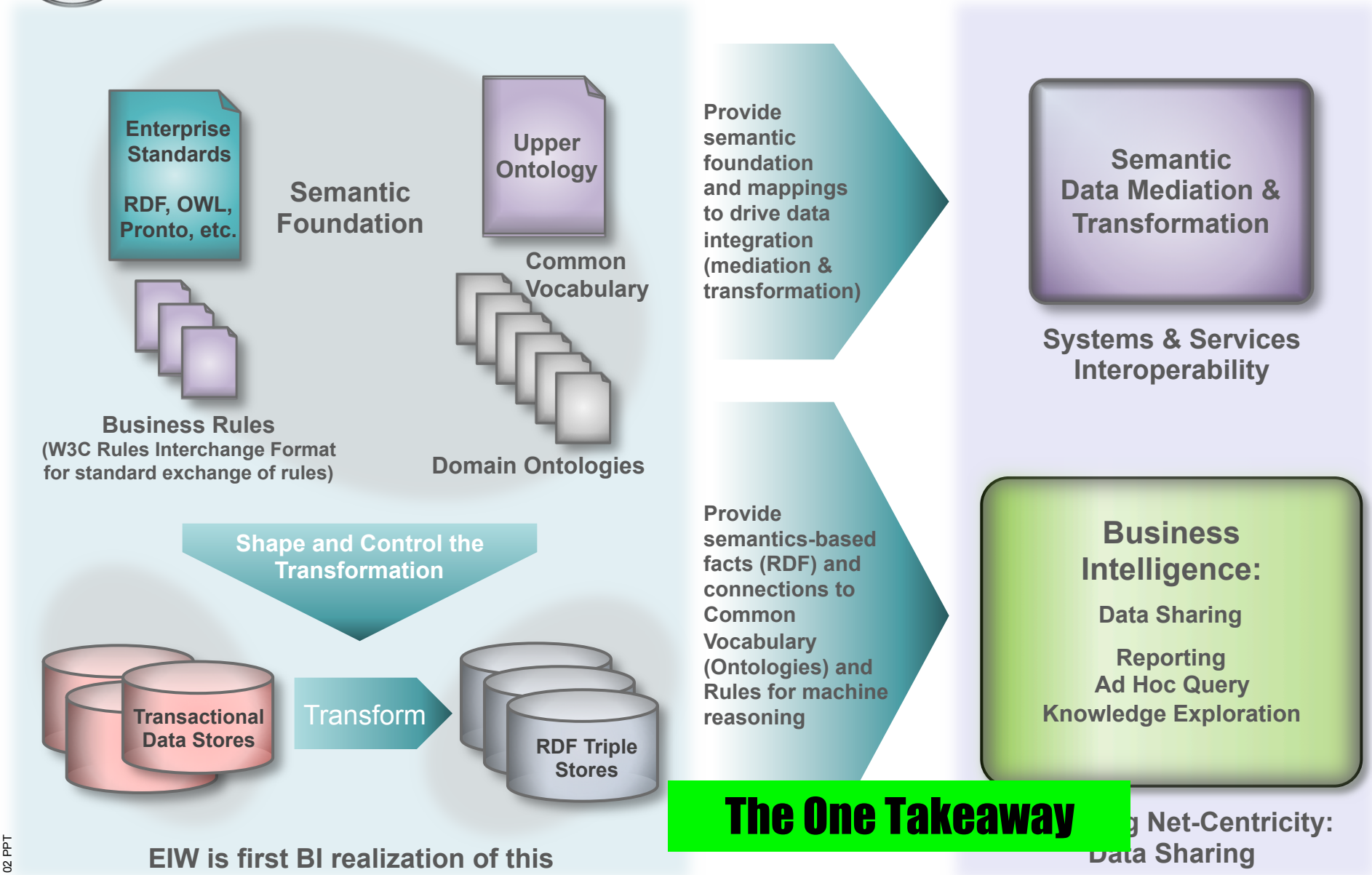
Phased Implementations



Agile Business Services Delivery

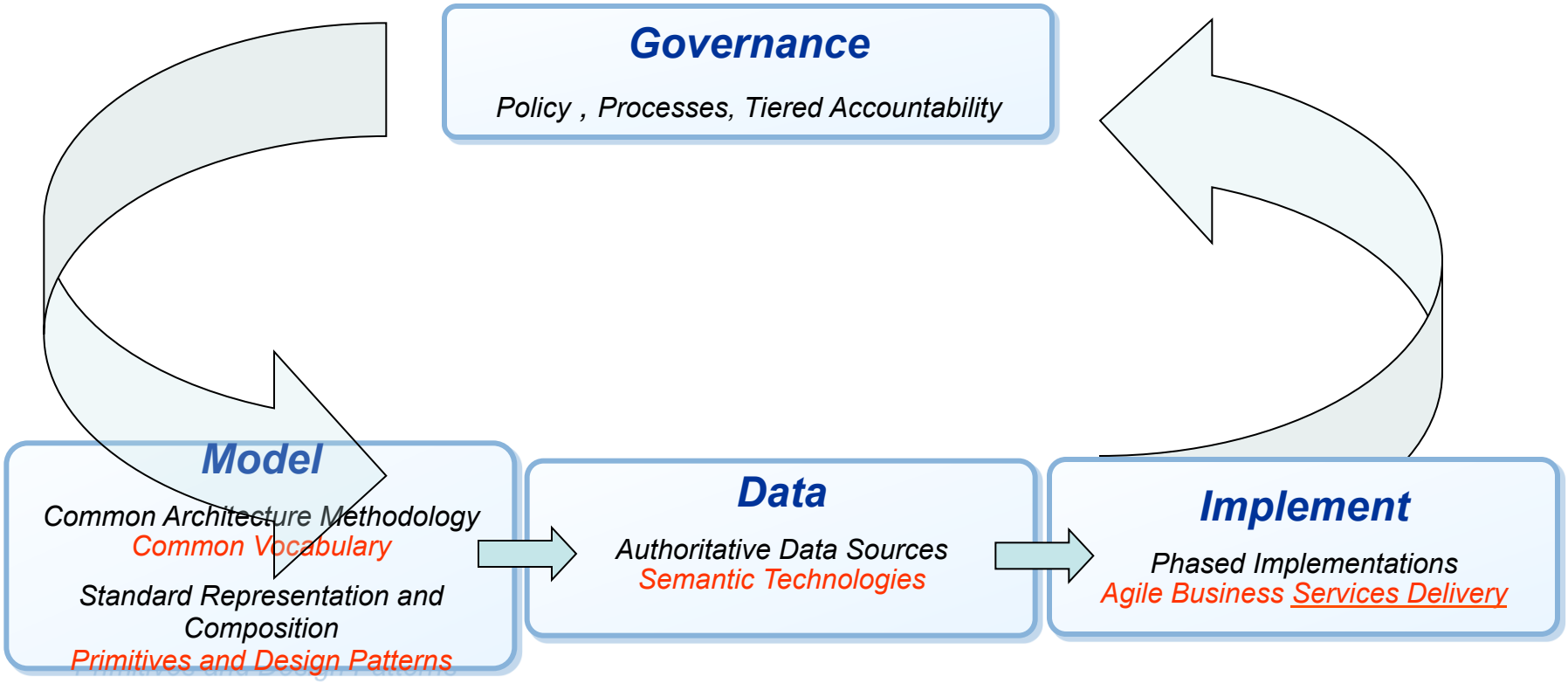
DoD Semantic Landscape

DoD Business Operations Semantic Landscape

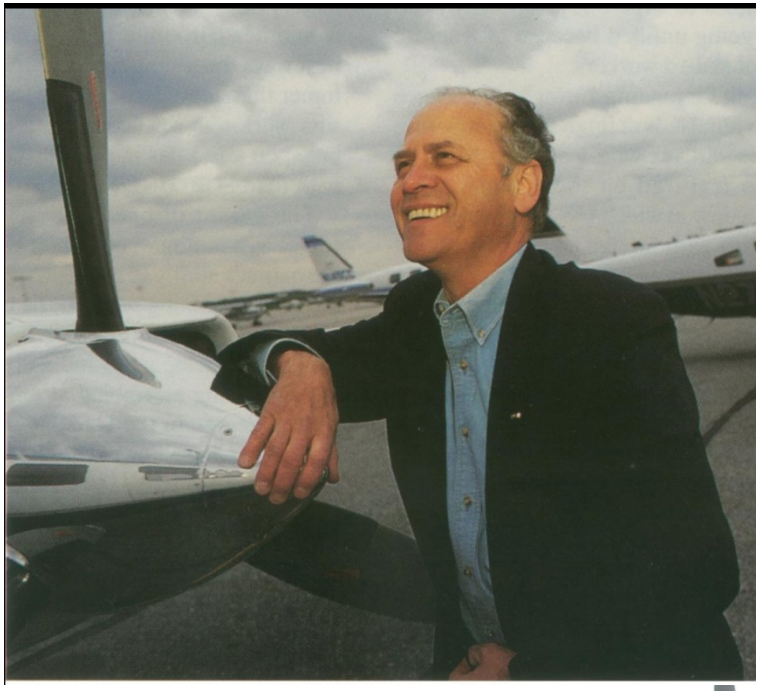


02 PPT

Agile, Architecture-Driven, DoD Business Capability Delivery



Model to Guide Transformation
Data to Improve Performance
Implement to Deliver Capabilities

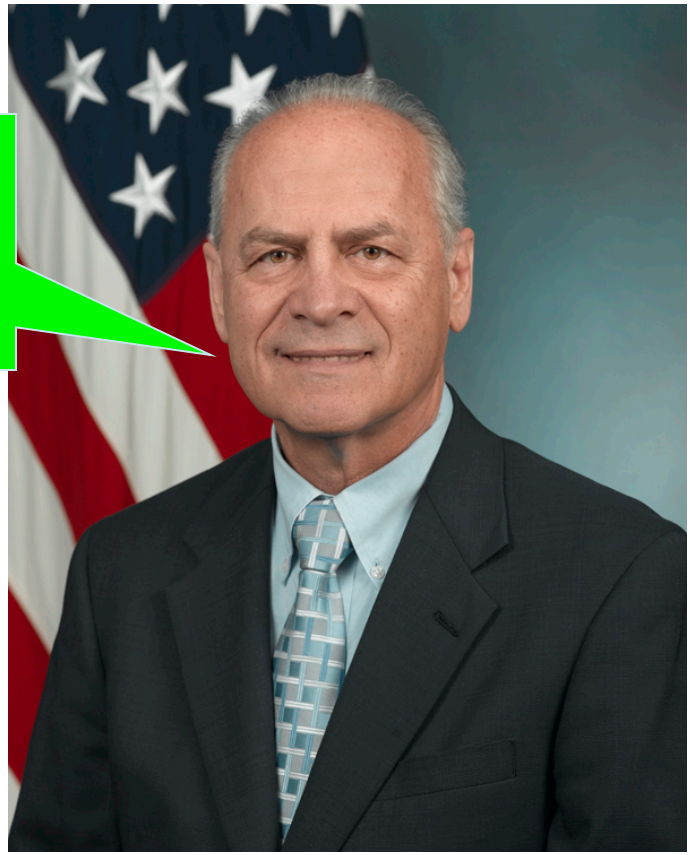


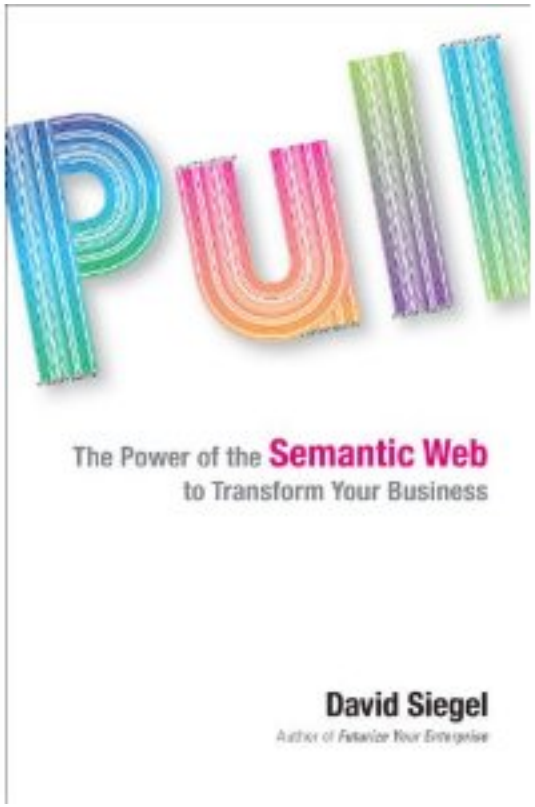
My own transformation…

Thank you!

Questions?

Dennis.Wisnosky@osd.mil




Pull
The Power of the Semantic Web
to Transform Your Business
David Siegel