



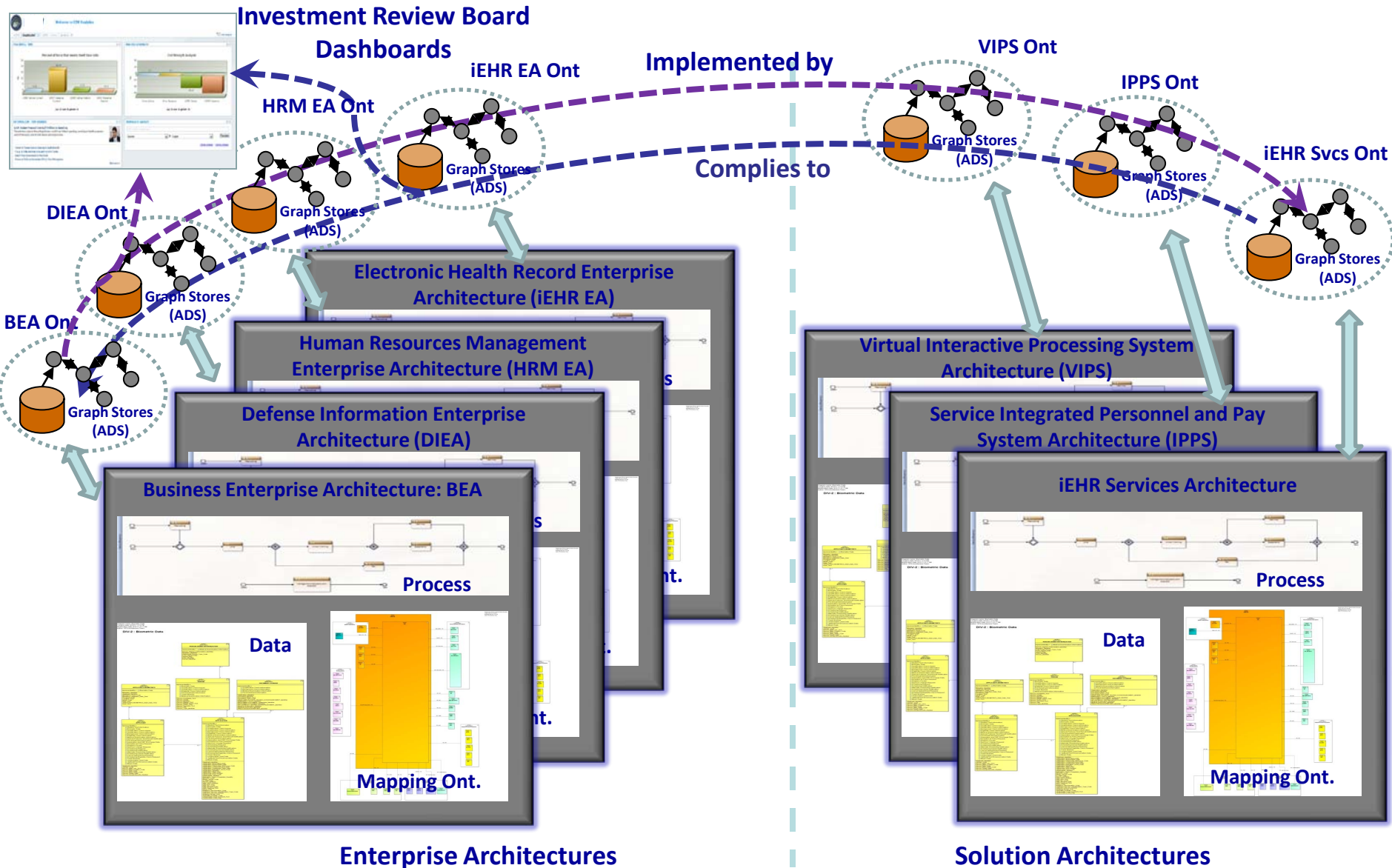
Office of the  
**DEPUTY CHIEF MANAGEMENT OFFICER**

# BEA Ontology Development

March 1, 2012

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# Federation through Semantic Architecture



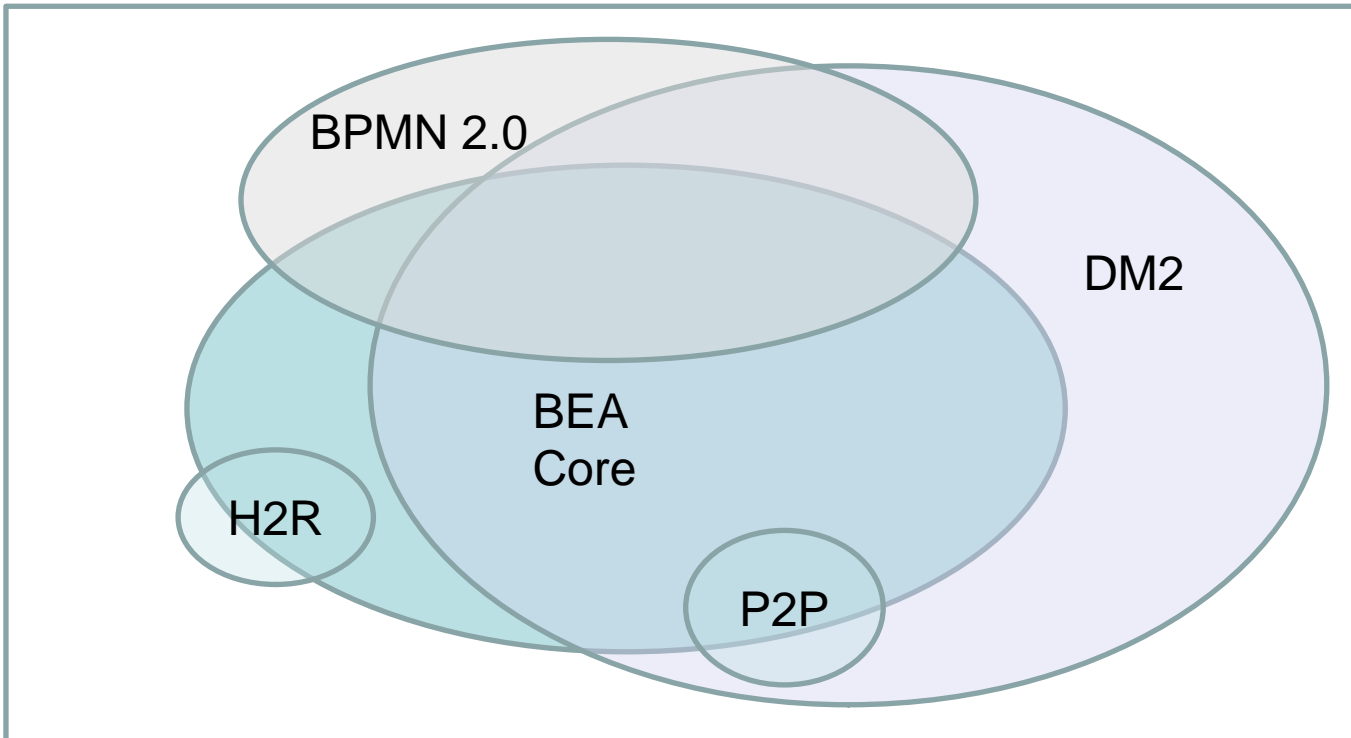


- Design and create a BEA ontology that establishes and integrates BEA, DM2, BPMN 2.0, and other domain ontology OWL files
- Migrate existing BEA data to RDF store that reflects new integrated ontology
- Test the BEA RDF store with queries from TopBraid Composer (desktop)
  - Query from BEA, BPMN, and DM2 perspective



# Notional BEA Ontologies

## BEA Ontology





- **Created BPMN 2.0 Ontology**
  - Use BPMN 2.0 specifications as guidelines to create ontology
  - Ontology closely resembles specifications
  - Flesh out BPMN Ontology with Signavio generated XML data
  - \*Plan to programmatically migrate BPMN xml generated from tool, into “BPMN RDF”
- **Created DM2 Ontology**
  - Based on DM2 Logical and Conceptual Model
  - Replaced IDEAS constructs with OWL constructs
- **Transformed BEA non-BPMN data (SPIN & SPARQLMotion)**
  - Non-BPMN data: (OV2, OV5a, OV5b, SV1, Svc, CV-2) to BEA Core Ontology
  - Mapped concepts to DM2 directly or indirectly(through non-BPMN ontology)
- **Transformed BEA BPMN related data (SPIN & SPARQLMotion)**
  - BEA BPMN data: (Ov-6c, \*E2E)
  - Replaced BEA BPMN related concepts with BPMN 2.0 Ontology concepts
- **Created BPMN Ontology Mappings(SPIN and Rules)**
  - Mapped appropriate BPMN 2.0 classes to DM2 classes (sub-classing)
  - Mapped appropriate DM2 properties to BPMN properties (rules & chaining axioms)



- **OWL2 (OWL-DL)**
  - Why OWL2 over OWL1?
    - Improved data types
    - Additional features support for more powerful reasoning; e.g. property chains
  - Why OWL Description Logic(DL)
    - Maximum expressiveness
    - Reasoning with completeness and decidability
- **SPARQL 1.1**
  - Why SPARQL 1.1?
    - Useful new features; e.g. “Aggregate”



# Implementation Overview

- Migrated BEA data to BEA “flat” RDF store (leveraged eTools and Jena)
- Created and integrated BPMN, DM2, BEA Ontologies
- Used TopBraid SPIN & SPARQLMotion to map and migrate data from BEA flat RDF to new BEA structured RDF (based on new Ontologies)
- Query new BEA RDF with SPARQL based on use cases from TopBraid



- TopBraid Composer & Protégé
- eTools(custom built)
- Jena
- Eclipse





BEA Diagram Data flat RDF



SPARQL Motion example

BEA Diagram Data flat RDF

SPIN Mapping Rules

sm:next



Constructs (diagrams created not using SPIN)



Constructs (of definitions)

sm:next



New non-BPMN ontology

sm:next



New non-BPMN RDF store





- DM2
- BPMN 2.0
- Mapping BPMN to DM2
- BEA legacy data to integrated ontology



# Outstanding Items\*

- **DM2:**
  - Measures (work with CIO)
  - Modify Predicate names?
  - DM2 use cases testing
- **BPMN 2.0:**
  - Run through use cases and modifications
- **Complete Mapping BPMN to DM2:**
  - Test chain axiom mappings with updated Pellet(Stardog)
- **BEA legacy Transformations:**
  - Work through remaining mappings
  - Div 2, Div 3
- **Create Target RDF Stores**
  - BPMN RDF
  - Non-BPMN RDF
  - \*\*Build fully combined Mapping Ontology RDF



- Develop specific use cases and test
- Continue to flesh out Ontologies
- Finish outstanding mappings...
- Generate full RDF



# Example Class Mappings

TopBraid - DCO-BPMN/BPMN20Mapped.ttl - TopBraid Composer ME

File Edit Navigate Project Model Inference Scripts Resource Window Help

TopBraid Resource TopBraid\_Jay

Classes

- bpmn:SignalStartEvent
- bpmn:TerminateEndEvent
- bpmn:TerminateEvent
- bpmn:TimerEvent
- bpmn:TimerIntermediateCatchEvent
- bpmn:TimerStartEvent
- dm2:Activity
  - bpmn:Activity
  - bpmn:Event
  - bpmn:Process
- dm2:Capability
- dm2:Condition
- dm2:Guidance
- dm2:Location
- dm2:Project
- dm2:Representation

Task

Navigator

- BPMN20Mapped.ttl [http://www.dcmo.mil/or...
- BPMND1.owl [http://www.omg.org/spec/BPM...
- catalog-v001.xml [file:///DCO-BPMN/catalog...
- changes.txt
- changesfromMZBPMN.txt
- complex.ttl [http://www.dcmo.mil/ontologies...
- DC.owl [http://www.omg.org/spec/DD/2010...
- DI.owl [http://www.omg.org/spec/DD/2010...
- MyProcess.owl [http://www.dcmo.mil/ontolo...
- RPLM.owl [http://www.dcmo.mil/ontologies/2...
- simple.ttl [http://www.dcmo.mil/ontologies/b...
- simpleM2.ttl [http://www.dcmo.mil/ontologies...
- vssver2.scc
- DM2
  - .project
  - bea-example.owl [http://www.dcmo.mil/ont...
  - catalog-v001.xml [file:///DM2/catalog-v001...
  - changes.txt

BPMN20Choreograph... BPMN20Mapped.ttl BPMN20.owl

### Class Form

URI: <http://www.w3.org/2000/01/rdf-schema#Datatype> Ok

**Annotations**

rdfs:comment The class of RDF datatypes.

rdfs:isDefinedBy rdfs:

rdfs:label Datatype

**Class Axioms**

rdfs:subClassOf rdfs:Class

**Other Properties**

activityProducesResource

bpmn:artifact

bpmn:assignment

bpmn:assignmentFromExpression

bpmn:assignmentToExpression

bpmn:attachedToRef

bpmn:businessRuleTask

bpmn:calledElement

bpmn:completionCondition

bpmn:conditionExpression

bpmn:container

bpmn:continueConversationFrom

bpmn:dataInputOutput

bpmn:dataState

bpmn:default

bpmn:error

bpmn:escalation

bpmn:eventDefinition

bpmn:eventDefinitionRef

bpmn:expression

bpmn:errorMessage

has

Form Browser Diagram Graph Form Layout Source Code

Instances Domain Relevant Properties SPARQL Imports Inferences

Query Editor Query Library [ss]

```
SELECT ?ss
WHERE {
  ?s rdfs:subClassOf owl:Thing .
  ?s rdfs:subClassOf ?ss .
  ?ss rdfs:type owl:Restriction .
  ?ss owl:onProperty ;hasImplementation .
}
```



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