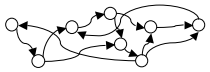
Enterprise Architecture in SOA: Models and Methodologies

Going Semantic

May 23rd, 2005



Ralph Hodgson

CEO, TopQuadrant

email: rhodgson@topquadrant.com
blog: http://topquadrant.typepad.com/ralph_hodgson

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Coverage

- Semantic technology
- Enterprise architecture and semantic technology
- Enterprise architecture maturity model
- Capabilities of *semantic enterprise architecture*
- The US Federal Enterprise Architecture (FEA) Case study - using OWL ontologies for FEA and agency extensions to FEA.

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Introduction: Ralph Hodgson

- Object Technologist since 1982
- Came to US in 1994 to help create IBM's Object Technology Practice
- Founding member of IBM's Java and Emerging Technology Practice and IBM's Portal Practice
- Co-founder of TopQuadrant, Inc. in 2001
  - Ontology development, solution envisioning and solution architecture for semantic web applications
- Recent work:
  - NASA Space Engineering Ontologies and model-based life-cycles
  - GSA for FEA-RMO ontologies
  - FEA extensions, DOD and DODAF ontologies

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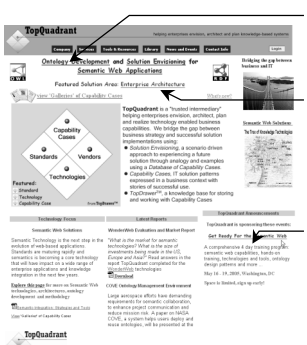
Introducing TopQuadrant: Consultants in Semantic Technology



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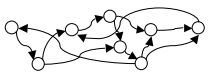
Semantic technology is about putting Ontologies to work

- So, what is an ontology?
  - It is a run time model of information
  - Defined using constructs for:
    Concepts – classes
    Relationships – properties (object and data)
    Rules – axioms and constraints
    Instances of concepts – individuals (data)
- Semantic web ontologies are defined using W3C standards: RDF/S and OWL



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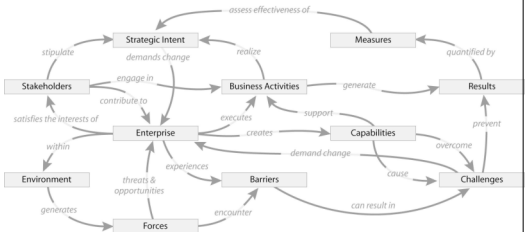
This is an Ontology



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Ontologies are like and unlike other IT models

- Like databases ontologies are used by applications at run time (queried and reasoned over)
  - Unlike databases, relationships are first-class constructs
- Like object models ontologies describe classes and attributes (properties)
  - Unlike object models, ontologies are set-based
- Like business rules they encode rules
  - Unlike business rules, ontologies organize rules using axioms
- Like XML schemas they are native to the web (and are in fact serialized in XML)
  - Unlike XML schemas, ontologies are graphs not trees and used for reasoning

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Realizing a semantic solution: Required Components

- Triple Store:
  - Kowari, Oracle, RDFGateway™, Sesame
- Query Engine:
  - RDFGateway, Cerebra, HP Jena
- Inferencing Engine:
  - Cerebra™, OntoBroker, Pellet, Racer, …
- Application Builder:
  - RDFGateway™, Haystack
- Visualization:
  - K-Infinity™, GraphViz,
- Ontology Builder:
  - Protégé, SWOOP, …
- Content Acquirers:
  - Translators, Scripts, TopBraid™, Semagix Freedom™, …

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Realizing a semantic solution: Vertical Application Platforms

- Knowledge and Content Management
  - Semagix
  - SemanTX Life Sciences
  - Siderian
  - Profium
- Semantic Interoperability
  - Cerebra
  - OntoBroker
  - OntologyWorks
- IT Management
  - Metallect
  - Unicorn Solutions

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An Impressive list of vendors are adopting Semantic Web Standards

- Adobe
- BT
- Cisco
- IBM
- Oracle
- SAP
- Software AG
- Verio
- …

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Large Enterprises with Semantic Web Pilots in Progress

- Audi
- Daimler Chrysler
- GE
- GM
- HP
- Microsoft
- NASA
- Sun
- Time Warner
- US Customs
- US GSA
- Cisco
- …

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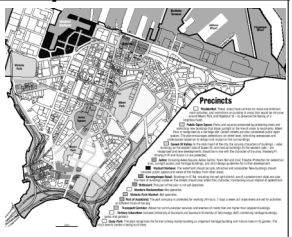
Why is semantic technology relevant to Enterprise Architecture?

- An EA is a model of an enterprise expressing how:
  - people in roles,
  - performing activities,
  - using capabilities,
  - provided by systems and resources,
  - overcome challenges and generate value
  - with measurable results for realizing business goals



This is a "Knowledge Model".

Semantic Web Technologies are about modeling knowledge

source of the plan:
www.nzherald.co.nz/index.cfm?ObjectID=10007286.
http://media.apn.co.nz/webcontent/image/gif/districtplan.GIF

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Ontology can express the relationships in the Enterprise Architecture

- Bridges the gaps between business, technology and IT
- Makes Value Nets "Navigate-able"
- Makes Capabilities "Knowledge-able"
- Makes Components "Knowledge-able"
- Uses Semantic-Enabled Collaborative Tools

"Connects the dots" across:
Business, technology and IT models

"Line of Sight" across:
extended enterprise business units
within business units
to measures of effectiveness

Capability knows:
why it exists,
what enterprise activities need it used,
what it depends on,
its measures of effectiveness

Component knows:
where it is used,
how it is realized,
what it depends on,
its measures of effectiveness

Knowledge Model using Semantic Technology
Behavior Model for inferencing
Federated Architecture
Analytical Tools
Decision Support

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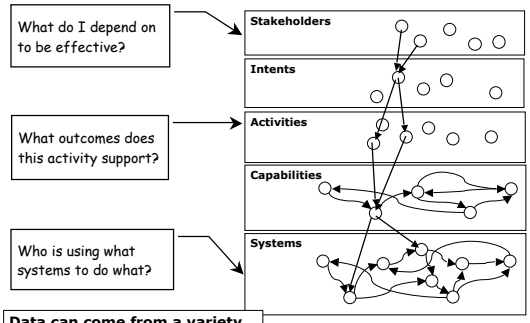
Semantic Systems infer answers from a knowledge base

What do I depend on to be effective?

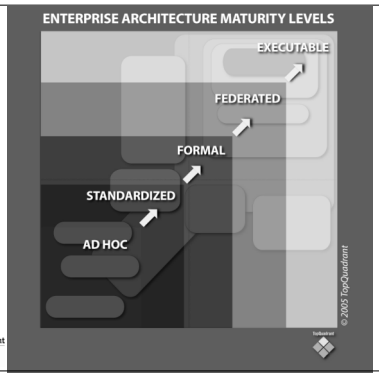
What outcomes does this activity support?

Who is using what systems to do what?



Data can come from a variety of sources. Semantic model merges and integrates.

Enterprise Architecture Maturity Model



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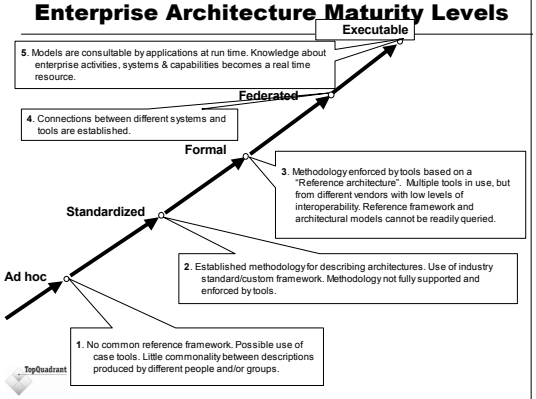
Enterprise Architecture Maturity Levels



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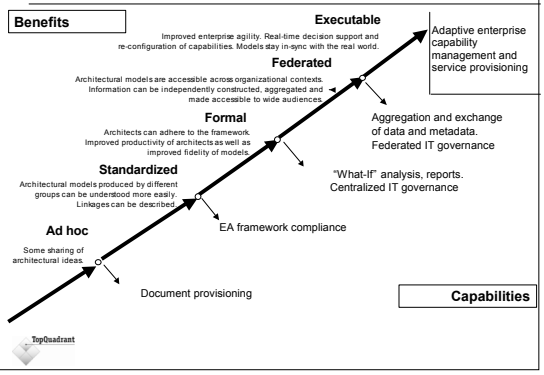
Enterprise Architecture Capabilities



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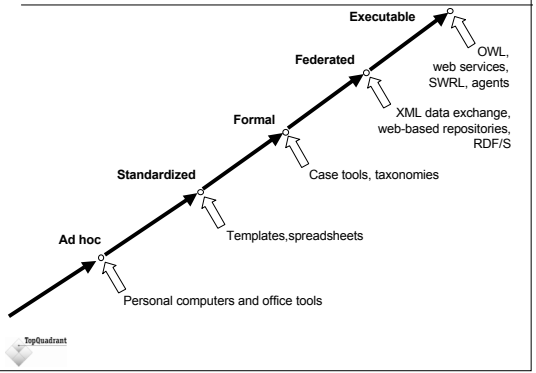
Enterprise Architecture Technologies



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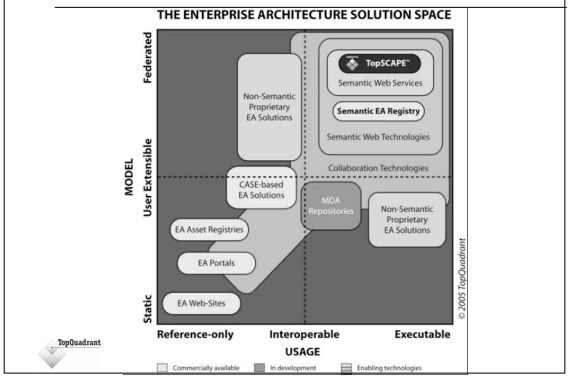
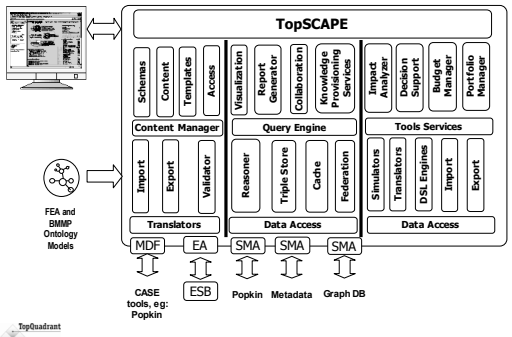
The Evolution of the EA Solution Space



TopSCAPE™ Semantic EA Platform



What can a Semantic Enterprise Architecture do?

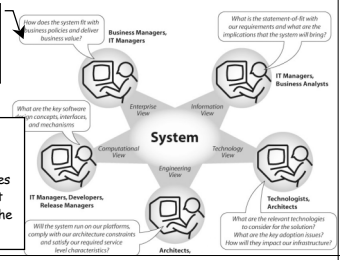
- For people, it can answer questions like:
  - Who is using what business systems to do what?
  - Who is using what technologies and products to do what?
  - What systems and business processes will be affected if we upgrade a software package?
  - What technologies are supporting a given business process?
  - Where components are being re-used or could be re-used?
  - Who can we partner with at our agency and other agencies?
  - How is our agency architecture aligned with the FEA?
  - How new technologies (ie; XML, Web, Security) are being taken up at our agency and at other agencies? Are they mature enough for e-government?
  - ...
- For applications, using an SOA, it can provide "An Active Enterprise Architecture", that is "Consultable" ➔ "Executable"

The power of semantic technology for EA: Revealing Knowledge through Inferencing

Application *provides* Capability
Capability *enables* Capability
Capability *supports* Activity
Activity *realizes* Intent
Intent *isGoalOf* Mission

***enables* is a Transitive Property**
provides* isSubPropertyOf *enables
supports* isSubPropertyOf *enables

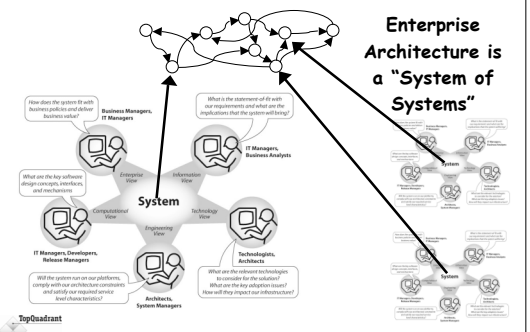
➔ Given a capability and how it enables others, we can infer what activities it supports, how it realizes intent and the goals of the mission



TivoliPolicyDirector *provides* Authentication
Authentication *enables* SecureAccess
SecureAccess *supports* MissionOperations

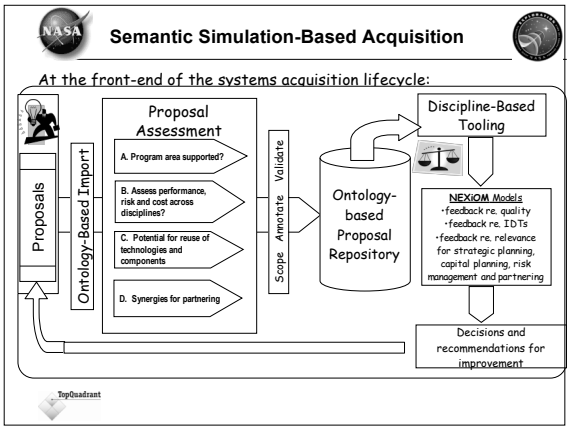
➔ TivoliPolicyDirector *enables* MissionOperations

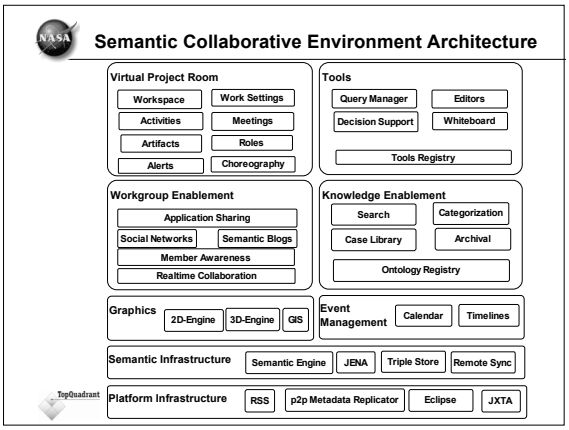
The power of semantic technology for EA: Achieving Aggregation through Federation

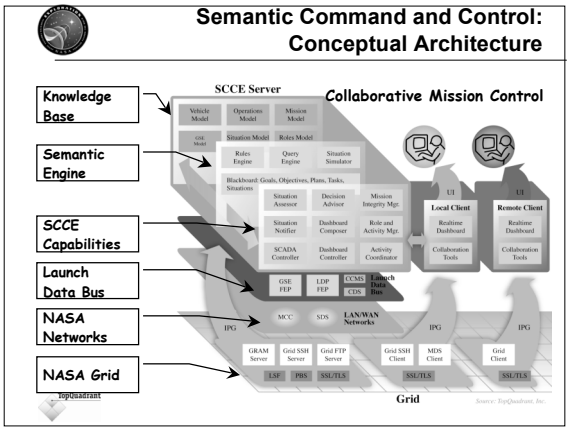


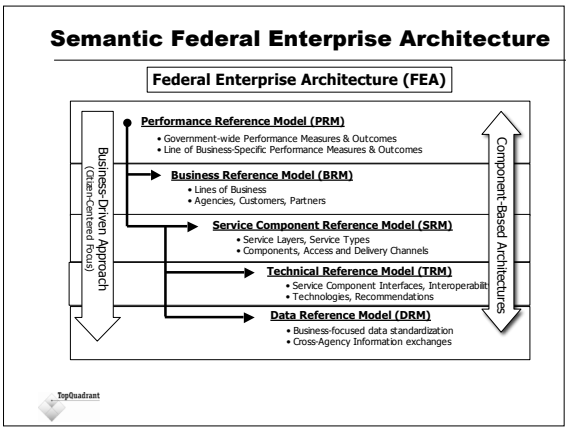
What else becomes possible once a semantic foundation has been built?

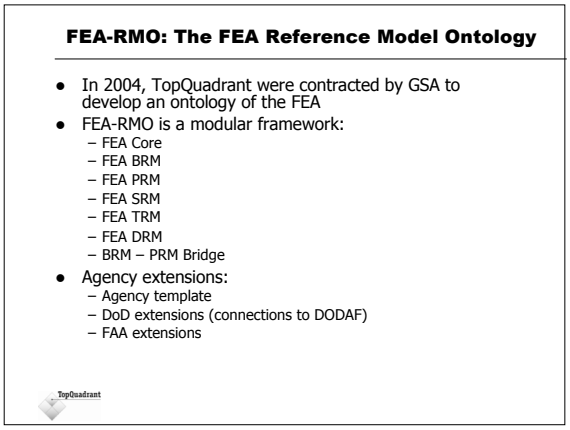
- New value propositions and new categories of applications
- Examples:
  - NASA: Semantic Simulation-Based Acquisition (SBA)
  - NASA: Semantic Collaborative Engineering Environment
  - NASA: Semantic Command and Control
  - Federal Government: Semantic FEA-RMO Registry

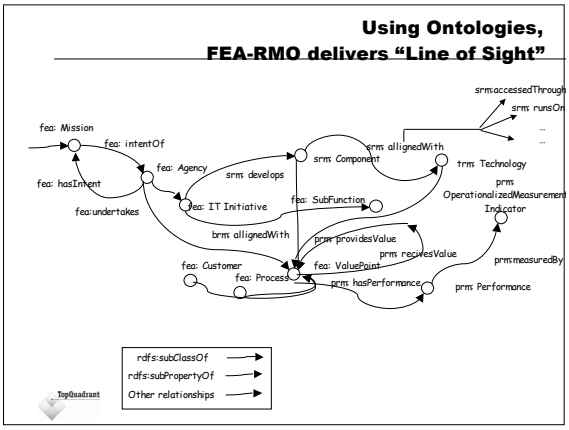












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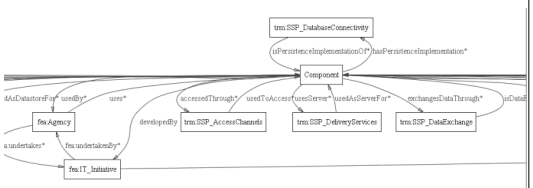
FEA RMO Component – partial view



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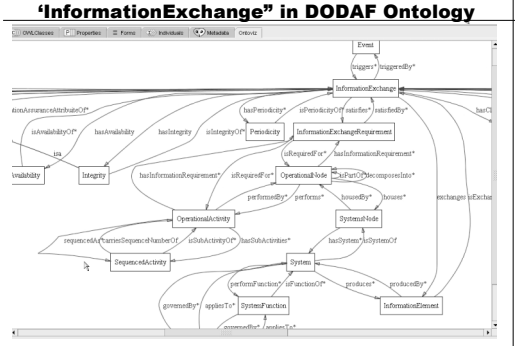
Towards "Executable EA": 'InformationExchange" in DODAF Ontology



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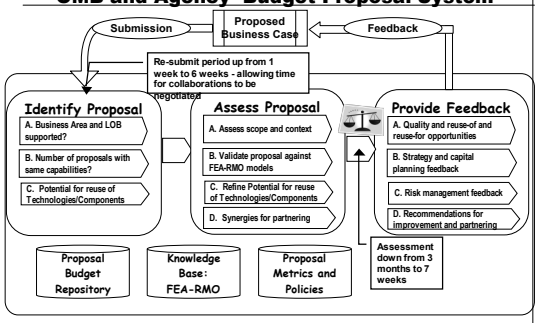
An Envisioned Semantic FEA Solution: OMB and Agency Budget Proposal System



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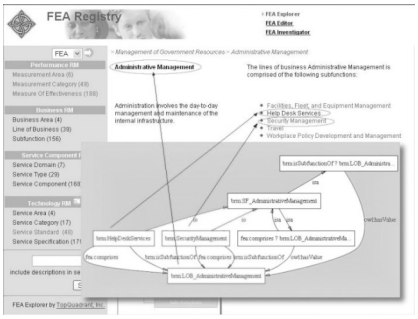
Towards TopScape: Semantic FEA Registry



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Current Capabilities

- Agency-specific extensions
  - Replacements, additions, deletions while preserving traceability
  - Architected for interoperability
- Component Registry, describing components:
  - Business process support according to the BRM and the SRM
  - Performance measurements according to the PRM
  - Technology platforms and use according to the TRM
- Merge, federation and query
- Analytics and reporting

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Future Work

- Completing FEA-RMO with revisions to DRM
- More reports, visual query
- Using Ontologies for a Semantic Enterprise Service Bus
  - Applying FEA-RMO to service provisioning
  - Semantics-Driven translation between EDOC and BPEL
  - Smart ESB
- Using OWL-S for Services Composition and Composite Applications

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Take-Away Points

- Semantic Technology is here and now
- Growing number of vendors with different approaches, capabilities and maturity – technology selection is key
- With the Semantic Web standards rich models (ontologies) can be federated and re-used across applications
- Key capabilities are:
  - **Integration of disparate data sources**
  - **Application interoperability**
  - **Business – IT alignment**
  - **Knowledge Management – sharing, reuse, terminology reconciliation**
  - **Service discovery and composition**
  - **Agile enterprise**
- Semantic modeling is not the same as object or data modeling, so skills need to be developed

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and we are not alone

- WebServices Journal, Dec 2004,
  - **"Was the Universal Service Registry a Dream?**
    A combination of the features in UDDI and RDF may just make the dream come true" by: Fred Hartman; Harris Reynolds, BEA
    "... Combining the capabilities of the current state of UDDI with the capabilities of RDF and OWL promises to resurrect the quest for the Universal Service Registry..."
    http://webservices.sys-con.com/read/47278.htm
- April, 2005 interview with the chief architect of Software AG
  - **"We recently announced the first globally available information integration product (called Enterprise Information Integrator v2.1) to incorporate Semantic Web technology. So my expectation is that you will see us using three core sets of standards and specifications as key components of our technology strategy: XML, WS-* and the Semantic Web Standards such as OWL."**

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References

- BMMP Business Enterprise Architecture (BEA) March 31, 2005 Update
  - http://www.dod.mil/comptroller/bmmp/products/architecture/BEA_3_31_05/iwp/default.htm
- Dean Allemang, Irene Polikoff, Ralph Hodgson, Paul Keller, Jason Duley and Paul Chang: "*COVE – Collaborative Ontology Visualization and Evolution*", IEEE Aerospace Conference, Montana, 2005
  - http://www.aeroconf.org/aeroupload/finishedpdf/F1458_2.pdf
- Jim Cockrell and Ralph Hodgson, ""*Proposed Wire Data Management System Improvements for Space Shuttle Orbiter Ground Operations*", 8th Joint NASA, FAA, DOD Conference on Aging Aircraft, Palm Springs, CA, 31st January – 3rd February 2005,
  - http://www.jcaa.us/AA_Conference2005/Wiring/Ses40/40_1100_Cockrell.pdf
- TopQuadrant White Paper on FEA-RMO, 2/21/2005
  - http://www.topquadrant.com/tq_ea_solutions.htm

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Books on Semantic Technology - 1


Johan Hjelm, "*Creating the Semantic Web with RDF*", John Wiley, 2001


John Davies, Dieter Fensel & Frank van Harmelen:, "*Towards the Semantic WEB – Ontology Driven Knowledge Management*", John Wiley, 2002


Vladimir Geroimenko (Editor), Chaomei Chen (Editor), "*Visualizing the Semantic Web*", Springer-Verlag, 2003


Sheller Powers, "Practical RDF", O'Reilly, 2003


Dieter Fensel: "*Ontologies: A Silver Bullet for Knowledge Management and Electronic Commerce*", Springer Verlag, 2001


Dieter Fensel, Wolfgang Wahlster, Henry Lieberman, James Hendler (Eds.): "*Spinning the Semantic Web: Bringing the World Wide Web to Its Full Potential*", MIT Press, 2002


Michael C. Daconta, Leo J. Obrst, Kevin T. Smith: "*The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management*", John Wiley, 2003


M. Klein and B. Omelayenko (eds.), "*Knowledge* Transformation *for the* Semantic Web", Vol. 95, Frontiers in Artificial Intelligence and Applications, IOS Press, 2003

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Books on Semantic Technology - 2


Thomas B. Passin, "Explorer's Guide to the Semantic Web", ISBN 1932394206, June 2004


Lee W. Lacy, "OWL: Representing Information Using the Web Ontology Language", Trafford Publishing, 2005


Jeff Pollock and Ralph Hodgson, "Adaptive Information: Improving Business Through Semantic Interoperability, Grid Computing, and Enterprise Integration", John Wiley, September 2004


Grigoris Antoniou and Frank van Harmelen, "A Semantic Web Primer", The MIT Press, April 2004

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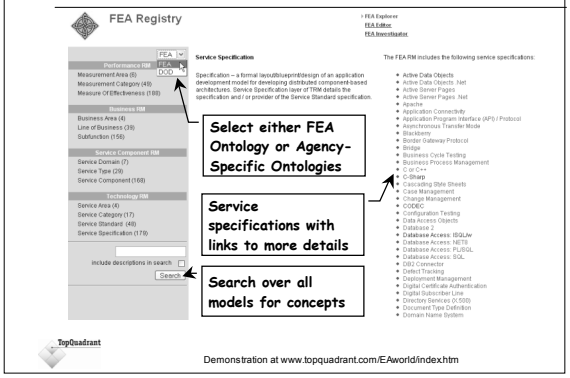
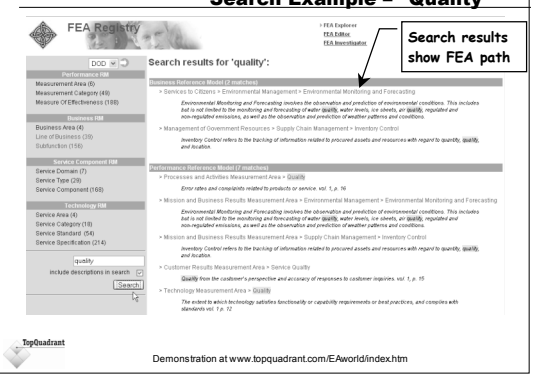
Ontology-Based EA Registry: TopSCAPE-EA FEA and DOD extensions



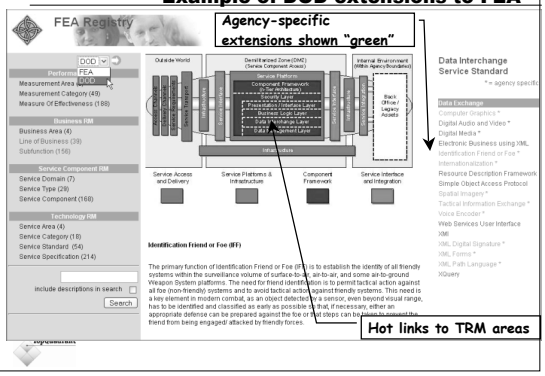
Demonstration at www.topquadrant.com/EAworld/index.htm

TopSCAPE-EA: Search Example – "Quality"

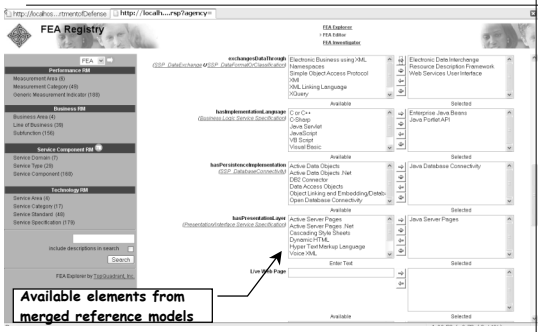


Demonstration at www.topquadrant.com/EAworld/index.htm

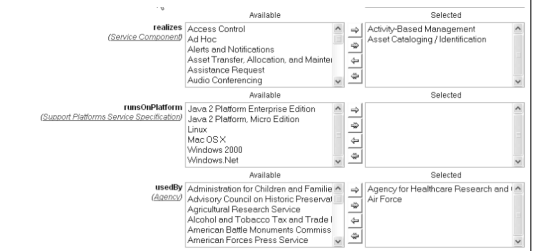
TopSCAPE-EA Example of DOD extensions to FEA



Mapping Components to the FEA Models - 1



Mapping Components to the FEA Models - 2



Mapping Components to the FEA Models - 3

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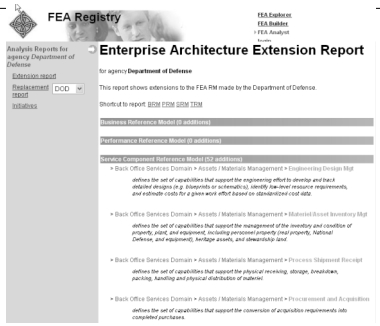
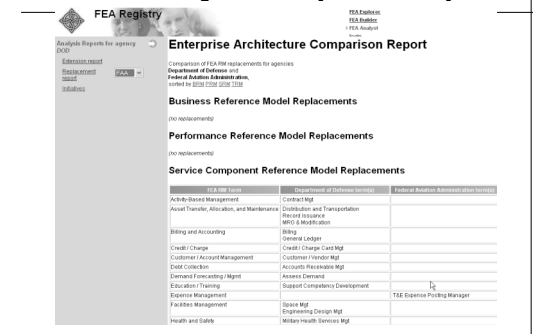
EA Analyst – Extension Report



EA Analyst – Comparison Report



EA Analyst – Initiatives Report

Example of Exporting OWL: FAA

```
<?xml version="1.0" ?>
- <rdf:RDF xmlns:fea="http://www.osera.gov/owl/2004/11/fea/fea#"
    xmlns:srm="http://www.osera.gov/owl/2004/11/fea/srm#"
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    xmlns:owl="http://www.w3.org/2002/07/owl#">
- <owl:Ontology rdf:about="http://www.topquadrant.com/owl/2005/03/fea/faasrm">
  <owl:imports rdf:resource="http://www.osera.gov/owl/2004/11/fea/srm" />
  </owl:Ontology>
- <srm:BusinessComponentSystem
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    rdf:resource="http://www.osera.gov/owl/2004/11/fea/srm#TimeReporting" />
  <srm:usedBy
    rdf:resource="http://www.osera.gov/owl/2004/11/fea/brm#FederalAviationAdministration" />
  <ns1:hasDeploymentStatus
    rdf:resource="http://www.topquadrant.com/owl/2005/03/fea/faasrm#CommissionedInitialDeployment" />
  <rdfs:label rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Air Traffic CRU-X System</rdfs:label>
  </srm:BusinessComponentSystem>
```