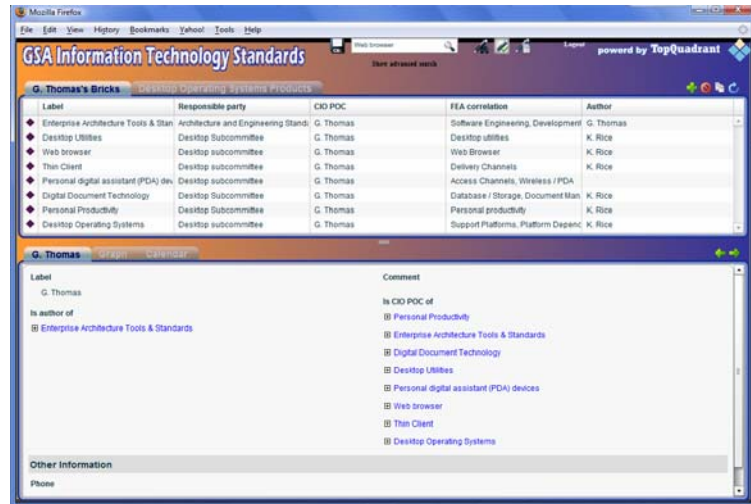
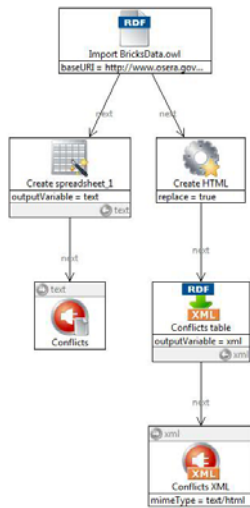




Towards Executable Enterprise Models: Building Semantic Enterprise Architecture Solutions with TopBraid Suite™



What is Enterprise Architecture and Why is it Important to Business?

Enterprise Architecture (EA) captures “what is happening” in the enterprise: how the enterprise’s activities, processes, capabilities, systems and components, information resources and technologies relate to the enterprise’s missions, goals and measurement system. To do this, EA expresses the interrelated structure of an enterprise’s processes, capabilities systems, information resources and technology dependencies. The objective of EA is to be able to understand the relationships between these elements; analyze and continuously adjust them for alignment with the business strategy, improved effectiveness and quality of service.

When a Business Executive asks “*what is an enterprise architecture and why is it useful?*” a typical answer is “*a model of how the enterprise works.*” Useful, because it explains how business activities and processes use capabilities; how capabilities map to competencies and IT systems; how systems depend on technologies; and, how value is generated with measurable results that realize business goals.

Increasingly, the demands of modern enterprises to both optimize their day to day operations and develop strategic capabilities and resources in their organizations, processes and infrastructures are driving the need for higher levels of Enterprise Architecture (EA) solutions. EA has emerged from a pure IT discipline to an embedded business tool that can focus on business-centered capability management. To support the business needs of complex, distributed enterprises, Enterprise Architecture practice and enabling technology/tools are evolving from Reference-only (text, models) to Interoperable (standards based) to Executable (federated, model-based, semantic-enabled). EA models that are able to be distributed, federated and executable will be essential for realizing the vision of an agile enterprise that can adapt its IT and enterprise models to changing situations and opportunities.

If these trends in the sophistication of EA capabilities are real, which we believe is much in evidence, the availability of technologies suited to provide these capabilities is critically important. Semantic web technologies, which are W3C standards and are increasingly supported by tools and products, are an excellent fit. In this brief whitepaper, we make the case that *ontologies and semantic web technologies are important to the future of the EA*. Indeed, the shift of EA from today as a discipline to, in the future, an embedded business tool marks the emergence of *semantic enterprise architectures*.

In this whitepaper, we outline the value and need for dynamic models of enterprises, and point to semantic web technologies and TopBraid Suite™ as the most promising way to do this.

- First, we briefly review the stages of evolution in the representations and purposes for which EA models have been developed and used. We observe that EA models that could be distributed, federated, and executed will be essential to support enterprises needs to respond rapidly to opportunity and change. As the value propositions, applications and uses of EA move toward executable models, we note that ontologies and semantic web standard languages are well suited for the next generation of EA solutions.
- Next we present a case study of the implementation of a semantic EA prototype application for GSA (“GSA Bricks”) using semantic web standards and the capabilities of TopBraid Suite for the rapid construction of semantic web applications.
- We conclude with a view toward the future directions of EA solutions and a summary of the business benefits of using semantic web standards and TopBraid Suite capabilities for developing and delivering the next generation of EA applications.

Charting the Evolution of EA as a Discipline & Business Solution Tool

The capabilities of Enterprise Architecture solutions are highly dependent on the way models are expressed and can be accessed. In Table 1, we articulate an informal ‘maturity model’ or framework for EA representations and capabilities (using a ‘playful’ metaphor of clothing) that relates levels of expressiveness of

EA models, their respective capabilities (and limitations) in providing enterprise solutions and the types of enabling technologies needed to support them.

Maturity Level	Features	Benefits	Enabling Technology	EA Solution Capabilities
5 Executable "Spacesuit"	Models are consultable by applications at run time. Knowledge about enterprise activities, systems and capabilities becomes a real time resource.	Improved enterprise agility. Real-time decision support and re-configuration of capabilities. Models stay in-sync with the real world	Agents, web services with dynamic orchestration	Adaptive Enterprise Capability Management and Service Provisioning Aggregation and exchange of Data and Metadata
4 Federated "Tuxedo"	Connections between different systems and tools are established. Reference framework and architectural models can be queried and aggregated	Architectural models are accessible across organizational contexts. Information can be independently constructed, aggregated and made accessible to wide audiences.	Web-based repositories, RDF/S, OWL	Cross-departmental "What-If" Analysis and Reports Federated IT Governance
3 Formal "Suit"	Methodology enforced by tools. Reference architectures Multiple tools in use, but from different vendors, with low levels of interoperability. Reference framework and architectural models cannot be readily queried Established methodology for describing architectures.	Architects can adhere to the framework. Improved productivity of architects as well as improved fidelity of models.	Case tools, taxonomies	Localized "What-If" Analysis and Reports Localized IT Compliance
2 Standardized "Toga"	Use of industry standard/custom framework. Methodology not fully supported and enforced by tools. No common reference framework.	Architectural models produced by different groups can be understood more easily. Linkages can be described.	Templates, spreadsheets	EA Framework Awareness and some level of Compliance
1 Ad hoc "Loin Cloth"	Possible use of case tools. Little commonality between descriptions produced by different people or groups.	Some sharing of architectural ideas.	Personal computers and office tools	Document Provisioning

Table 1: A 'Maturity Model' for Enterprise Architecture Representations and Capabilities

Ad hoc Models

Ad hoc models serve basic goals of communication and documentation. They are usually developed using simple and inexpensive tools such as Microsoft Visio® or even a set of PowerPoint® presentations.

This approach to enterprise architecture, though a natural, common and easy place to start, does not scale well. Any sizeable organization generally has more than one person or a single group doing enterprise

architecture work. If they take an ad hoc approach to this work, then linkages or cross-relationships among models they create – representing diverse aspects of the enterprise -- quickly become challenges.

Standardized Models

Architecture frameworks offer a unified and ‘disciplined’ approach to describing enterprise architecture. Frameworks combine a modular but integrated way of an expressing an architecture together with methods needed to perform the modeling work. Well known examples of such ‘standard’ frameworks include the Zachman Framework, Reference Model-Object Development Group (ISO/IEC 10746), and in more recent times the Department of Defense Architecture Framework (DODAF). Organizations adopting a standard or framework-based approach generally move quickly beyond PowerPoint presentations and spreadsheets to using case tools (such as Telelogic’s *System Architect*® and Troux’s *Metis*®) for enterprise architecture work.

Formal Models

More formal models of enterprise architecture are based on reference architectures and are most effective when enforced by tools. Reference models are usually implemented as controlled vocabularies and/or taxonomies of terms. The Open Group Architecture Framework (TOGAF) with its Technical and Integrated Information Infrastructure reference models is a good example of this approach.

The U.S. Government’s Federal Enterprise Architecture (FEA) (OMB 2004) partitions the EA space into five reference models describing standard hierarchies of business functions, performance measures, application (system components), technology, and data. The goal of the FEA is to enable aggregation and analysis of the information about systems developed by different agencies with the ultimate goals of ensuring collaboration between government agencies and interoperability between their IT systems. This, however, has proven to be difficult without having a representation of the framework that can be unambiguously referenced and used directly by the different implementation of the EA tools and practices at each agency.

Federated Models

With the growing complexity of systems and technologies, supporting enterprise management of IT and IT investments is now a key challenge for most large organizations. This has created a strong movement towards harnessing EA as an IT management tool. This is reflected in the critical need to answer the following types of questions -- a pressing goal today for many enterprise architects and IT managers:

- How does this technology contribute to business results?
- What systems are supporting this business function?
- If we change a business policy, what systems must change?
- If we sunset this system, what processes and user groups will be impacted?
- If we upgrade to the next release of this software product, what will be affected?
- What licenses do we have for this product?
- Has anyone else in the organization used or evaluated this product?

To provide support for answering these questions, an EA tool must interoperate with diverse repositories of information. Interoperation requires that the terminology, use and meaning of information be reconciled across potentially diverse data repositories and applications. A simplistic approach to interoperability -- the adoption of a single common vocabulary -- is a tremendous challenge in any large enterprise and can easily become counter-productive. There are always good reasons for different stakeholders to have local policies and contextualized ways of speaking about enterprise concepts. While a single vocabulary may not be practical, mapping, translating and mediating terminologies and data models is a necessity. In addition, EA models and the answers they can provide need to be accessible to many people. As the circle of users grows, ease of use is facilitated by retaining local conventions.

Enterprise Architecture *is* knowledge. Building EA models requires acquisition and aggregation across diverse sources. This necessitates the use of a knowledge representation that is both semantically rich and

unambiguous. Prior to the recent emergence and availability of W3C sponsored semantic web languages and standards, EA repositories (and case tools) have, by necessity, used “home-grown” approaches to knowledge representation. Unfortunately, though capable of capturing complex conceptualizations, the use of such proprietary representations generally results in a number of significant shortcomings. For instance, they do not have rich semantics that are explicitly expressed or accessible in a standard way. As a consequence, a typical model in such a language, no matter how complete and intricate, is still open to multiple interpretations and can result in inconsistent use. In the next section we briefly discuss how semantic web ontologies provide a standards-based approach to federating models.

Executable Models: Enterprise Architecture as a Run-time Resource

In current practice, it is typical to use EA knowledge for decision support. EA models are implemented as registries designed primarily for development-time queries from analysts, architects and managers. Run-time use is rare. Yet there are many situations where it would be beneficial for applications to know how business capabilities are dependent on IT systems. For example, if a Call Center goes down it is useful to know what business processes are affected. Even more useful, is to know how those processes can be supported by alternative systems.

With an active knowledge model, a Semantic EA Registry can be consulted at run-time by both humans and programs to provide critical knowledge in the right form to the right people and applications. For the user, intelligent search, dialog-based user interfaces and personalization are all capabilities that are well supported by ontologies. For applications, the ability to consult EA knowledge at run-time is provided by query engines and inferencing over the knowledge base. This is what we mean by “Executable Models” – active knowledge models that can be consulted by applications as well as humans.

Enterprise Architecture Capabilities: Charting the State of Practice

Figure 1 below depicts a trajectory of more capable EA solutions as measured by more flexible, extensible and distributed models of enterprise resources (y-axis) and more dynamic and automated usage requirements (x-axis). As shown in the diagram, basic EA solutions and tools are reference-only, with fixed (static, non-extensible) meaning. Their primary use is for reference consultation by architects. In the last few years a new set of EA tools have gradually appeared. They are called by a variety names, such as federated asset repositories, metadata repositories or IT governance systems and dashboards. Putting aside differences in the details of their functionality, these types of EA solutions have a key common characteristic. They all use enterprise architecture models to aggregate distributed information in real time about the enterprise and present it over the web to users from diverse groups.

We believe that this reflects a key trend toward more comprehensive, distributed and executable EA models that will continue to expand. Why is this happening? Fundamentally because EA must support the operations of enterprises that are increasingly complex, distributed, and must have the flexibility to respond rapidly to opportunity and change. Today, most enterprises are experiencing a shift in the business model to virtual enterprises. The new enterprise operates as a network of companies that share experience, knowledge and capabilities. In fact, the key challenges of flexibility and agility that many organizations face today are not those of participating in one virtual enterprise, but rather those of participating in several (possibly many) virtual enterprises. The historical approach to supporting inter-working through common systems or through enforcement of rigid standards is no longer feasible.

Technologies and standards have become available whose capabilities were explicitly designed to address many of the challenges and requirements of complex, distributed enterprises. These are called “*semantic technologies*”. Their use in Enterprise Architecture is for knowledge representation. Their layering on top of the existing web infrastructure is known as the “*Semantic Web*”.

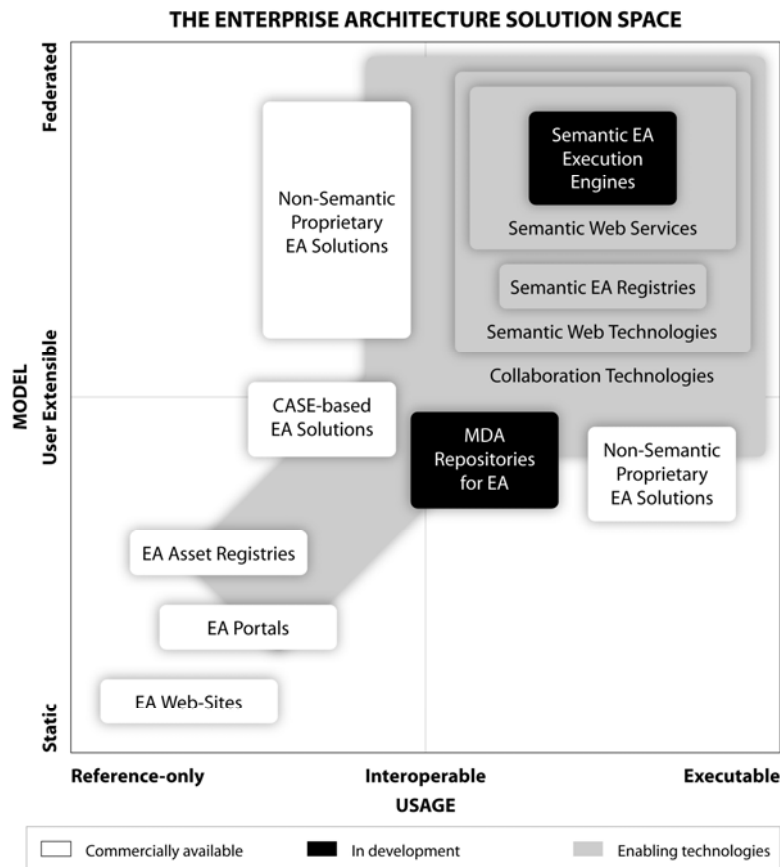


Figure 1: EA Model and Usage Comparison

Harnessing the Capabilities of Semantic Technologies

The Semantic Web is an ongoing effort, led by the World-Wide Web Consortium (W3C) and has had strong support in critical phases from the Defense Advanced Research and Projects Agency, as well as several European research programs. The overall vision of the Semantic Web is to make semantic content accessible over the web so that it can be intelligently processed by web-based applications. The goal of the Semantic Web is to enable the automation of many functions that currently require human intervention and direction.

Semantic technologies are concerned with the representation, negotiation and integration of meaning within and across context boundaries. They use knowledge models with explicit, shareable meaning that computers can process (based on web standards). These knowledge models are also called ontologies or semantic models. W3C offers the following definition: "Ontology is a term borrowed from philosophy that refers to the science of describing the kinds of entities in the world and how they are related. An ontology may include definitions of *classes*, *properties* and their instances."

Semantic Technologies: State of the Art and Practice

More than two years ago W3C standard languages for web-based knowledge representation (semantics) officially reached the status of *recommendation*. The tool support is growing. In addition to a number of smaller innovative vendors, large players such as Oracle are now offering support for the Semantic Web standards in their flagship products.

With this development, we have been motivated to explore the applicability of Semantic Technology to EA. Can Semantic Web languages be used to express enterprise architecture? What benefits do they bring? Before addressing these questions, we first provide a few definitions:

- The Semantic Web languages Resource Description Framework (RDF), RDF Schema (RDFS) and Web Ontology Language (OWL) are W3C standards for representing semantic models:
 - RDF provides an infrastructure for uniquely identifying and merging distributed data and metadata
 - RDFS offers a simple vocabulary for describing schemas or metadata
 - OWL provides a richer vocabulary (on top of RDFS) with a set of pre-built formalisms for expressing logical definitions and constraints
- Semantic Web ontologies are formal models akin to UML class diagrams or Entity Relationship (ER) model. Unlike UML and ER models, ontologies are used at run time. They come with built-in executable formalisms that enable querying and reasoning.
- SPARQL (SPARQL Protocol and RDF Query Language) is a W3C standard for querying data and metadata. It is a very important addition to the semantic web 'stack' of standards and languages, as it defines a standard way in which to communicate with RDF-based services on the Web. Until SPARQL became a W3C recommendation, interoperability between different RDF tools was hampered by the lack of a common standard. The introduction of SPARQL has made a significant step forward for achieving the vision of semantic web – the web as a database -- where each RDF resource can be seen as a table; all resources can be accessed and queried using SPARQL, as simple as querying tables using SQL.

As knowledge models, ontologies built using RDF and OWL enable *integration of distributed evolving knowledge*. They *deliver incremental value without assuming a single, monolithic, centrally controlled knowledge base*. They also enable progressive capturing of new insights, shared understanding and formal structures. Additionally, SPARQL supports key scenarios for using RDF that are critical to EA, such as semantic interoperability, data integration, information search and retrieval (rather than the typical web searching). Enterprises and/or departments within organizations can share and exchange data meaningfully, as well as query each other's data using RDF and SPARQL.

Based on these strengths, we believe that the intelligent application of the Semantic Web standards will play a vital role in supporting the next generation of EA solutions. Semantic Web technology not only makes it easier to aggregate and analyze information, but also paves the road to active or executable enterprise architectures driven by federated models.

The Power of Semantic Web Technologies for Enterprise Architecture

An EA model represents knowledge about the operations and rationale of the enterprise. For this reason knowledge representation languages have direct relevance. In this whitepaper, we posit that it is becoming increasingly necessary and valuable to represent enterprise architecture as "enterprise ontologies". With this premise, semantic web technologies become very important to the future of Enterprise Architecture solutions. In particular, using semantic web ontologies to describe enterprise architecture yields a number of advantages:

- Semantic expressivity and formal precision enables reliable aggregation of models using a consistent approach.
- The ability to capture and relate distributed models at multiple levels and from multiple viewpoints supports the appropriate use of local vocabularies while preserving integrity of the chosen framework
- Rigorous typing, categorization and consistency checking ensures conformance to the reference frameworks and makes it possible to break large models into smaller interconnected modules
- Reuse, substitution and extension become possible using the web as an integration and knowledge discovery platform
- Industry standard inference engines offload significant portions of the business logic and its processing needed to implement management reports and analytics

To illustrate some of these points, we briefly outline how *categorization*, *aggregation*, *reasoning* and *executable models* are supported by RDF/OWL:

- **Categorization.** An organization can define a class of 'non-compliant' systems as those that use 'out-of-profile' technologies. When an ontology-based EA environment learns that a system uses an 'out-of-profile' technology, the system can be automatically classified as 'non-compliant'.
- **Aggregation.** The information about the system can come from any data source that has been 'mapped' to an ontology. The definition of 'out-of-profile' technologies can vary depending on local and/or global rules.
- **Reasoning.** OWL ontologies support reasoning using properties and sub-properties in addition to classes and subclasses. For example, we can assert an 'enables' relationship (property) between a system and a process. Similarly, we can specify a 'uses' relationship between a process and a business function that uses it. We can further assert that each of these two relationships is a sub-property of a transitive 'supports' relationship. If we then specify that a system S enables process P, which in turn is used by department D, an ontology will automatically infer that system S supports department D without explicit specification.
- **Executable Models.** As more organizations transition to Service-Oriented Architectures, EA ontologies will become an important enabler not just for architects and managers, but also for systems and applications – executable EA models are consultable by applications at run time. For example, an order taking web service will be able to query an EA ontology to identify a next step in the business process or to inquire what payment authorization service it can use. RDF and OWL are also being extended to support custom, domain specific rules.

The Role of TopBraid Suite in Supporting Semantic EA Solutions

TopBraid Suite (TBS) exploits the W3C Semantic Web standards to provide an open, flexible, configurable and standards-based platform making it easy to rapidly construct semantic EA solutions and to produce other semantic-enabled business capabilities. TBS combines a very extensive and continually growing set of capabilities for importing information from many common data source (RSS, spreadsheets, databases, etc.), for integrating and processing information (through queries, rules, visual scripting of workflows using SPARQLMotion, etc.), and for exporting and/or displaying results in user applications (XML, html, forms, maps, calendars, trees, interactive graphs, BIRT charts, etc.).

TopBraid Suite™ Capabilities: TopBraid Suite is an integrated, complete lifecycle semantic application development product suite that allows users to design, assemble, deploy, use and collaborate within a new generation of dynamic business applications. Building on the capabilities and benefits that come from Semantic Web standards, it provides the following:

- **TopBraid Composer™** is a semantic modeling and application development tool. It allows enterprise architects to harvest schemas and data from any data source - including spreadsheets, XML, and UML - allowing them to integrate silos of information into global, actionable enterprise architecture.
- **TopBraid Composer Maestro Edition™** is an enhanced version of TopBraid Composer. It enables enterprise architects to prototype web-based applications leveraging SPARQLMotion™ visual scripting language to create data processing chains and built-in personal editions of TopBraid Live and TopBraid Ensemble.
- **TopBraid Ensemble™** is a semantic web application assembly toolkit. It provides a wide range of ready to use UI components to configure and assemble customized functionality for users of all types, including casual business users and power users. Different stakeholders may use TopBraid Ensemble to customize the information display according to their own needs. Customization ranges from simple changes in columns and forms displaying information, to more elaborate assembly of information layouts and interactions.

- **TopBraid Live™** is enterprise platform for the Semantic Web applications. It provides service oriented access to live enterprise information sources like databases and spreadsheets, allowing the enterprise architecture to respond to live information in the real enterprise systems.

More detailed information for each of the TBS products is available at: <http://www.topquadrant.com/topbraid> .

A TopBraid Suite Application to support Technology Policy Management at GSA

Building on Semantic Models of the Federal Enterprise Architecture Models

In November 2004, TopQuadrant helped to a build proof-of-concept for “Semantic EA” in conjunction with the General Services Administration’s (GSA) initiative to develop ontology models for the FEA based on the respective models described in natural language documents. The resulting models, FEA-RMO (FEA Reference Model Ontologies) were updated in 2008 to reflect new developments in the FEA such as FTF (Federal Transition Framework) and DRM (Data Reference Model). FEA-RMO is available as open source OWL files and a report on this work is available for download.

A prototype of an EA Registry was built, powered by the FEA ontologies. Using this environment, agencies can express their IT initiatives in the terms of reference models. They can also extend and modify the models while preserving the ability to relate to the core framework. This is achieved by expressing relationship between the additions and the core FEA elements. OWL is well suited for this work because it builds on RDF, which has inherent support for the aggregation of models.

Service-Oriented Architectures can benefit from ‘active’ reference models such as FEA-RMO for discovery and composition of capabilities. It is highly unlikely that all agencies will ever standardize on a single system. In fact, even within individual agencies there are multiple tools for describing and managing architectures, performing IT planning processes, measuring IT portfolios and other related tasks. Semantic Technology holds the key to achieving this interoperability and integration.

GSA Bricks: A Case Study of Semantic Technology and TopBraid Suite in Use for EA

The GSA is responsible for tracking the expenditures and procurements of a variety of agencies in the US government. Like any government agency, they utilize a wide variety of software in their everyday business operations. Like any business organization, the management of data and technology on an ongoing basis presents an organizational challenge. What systems are used for what business processes? What information can be found in which system? How is this information maintained? What functions will be impacted by a change in a particular system? The overall maintenance of information pertaining to this sort of question is the goal of an organized Enterprise Architecture initiative.

As part of an effort to produce an actionable, executable enterprise architecture solution, the GSA is developing a solution to some particular enterprise architecture problems. The first step is to solve a quite modest problem, which nevertheless causes some pain for everyday business processes in the GSA. This is the maintenance of a data set called the *Technology Bricks*.

A *Brick* is a technology policy roadmap for the next five years, for a certain technology requirement. A Brick specifies what products are approved for use within the GSA, what products are planned to be approved in the near term (2 years) and long-term (5 years). It includes policy statement about products whose use is discouraged or forbidden for GSA work.

There is a small committee that is responsible for the maintenance of the Bricks, and a larger group of IT managers and system maintainers who need to consult them from time to time. As is the case in many organizations, the management of the Bricks data is done by means of a solution that satisfies the basic requirements, but is not extensible in a number of important ways. This solution is to maintain a single file, using Microsoft PowerPoint, which is kept in a known, central repository. Modifications to the Bricks are made

by sharing this file; consultations are done by downloading this file, and viewing it in PowerPoint. A sample brick in PowerPoint is shown in Figure 2.

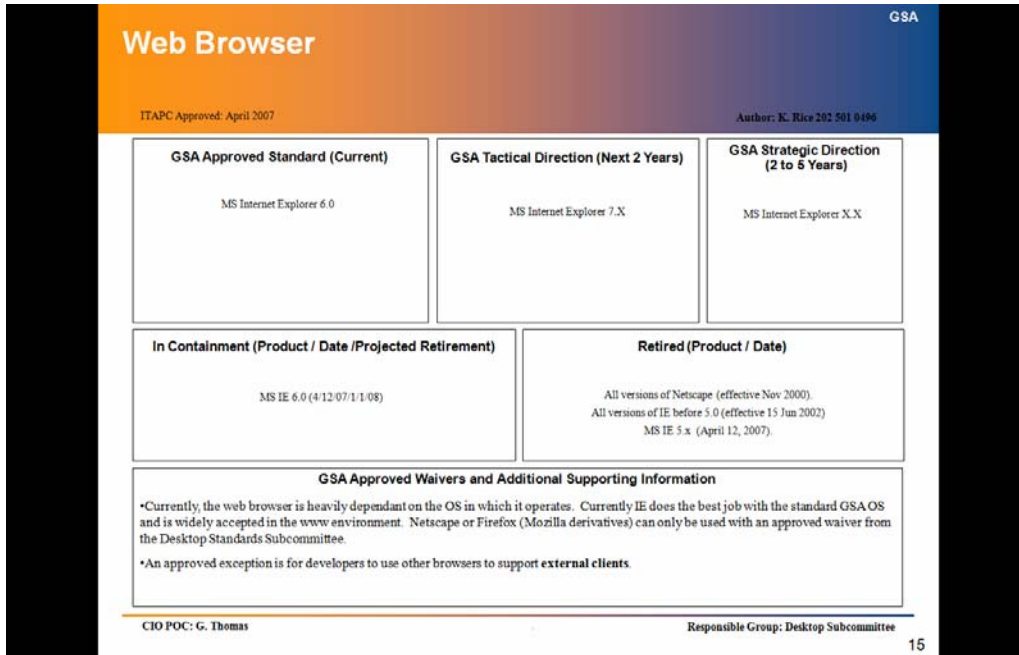


Figure 2: Current Solution for Managing Technology Policy Bricks; Modify a Power Point Slide Set.

The proposed solution utilizes semantic web technology to represent the Bricks in a structured form within an RDF repository. The Bricks are maintained using a web application (available only to the committee members) for updating the data. Access to the data is accomplished through another web interface for display of the information. Table 2 contrasts the features of the ‘as-is’ and ‘to-be’ solutions.

Challenge	“As-Is” Solution	“To-Be” solution
Distributed authorship	Master PowerPoint file, centrally managed, changes are merged	Data-backed web pages
Rich cross-referenced data	Search the PowerPoint for text, use manually built cross-reference index	Semantic Web linked data
Reference to external sources (FEA)	Names of FEA entities pasted into PowerPoint, often with errors	Semantic links to URIs for FEA entities
Input to the EA committee from the broader IT community	Verbal and unsystematic as part of meetings	Linked information about standards, vendors, systems and their use of technologies is available for analysis and decisions

Table 2: Features of the As-Is and To-Be processes for updating and consulting Bricks information

A proof of concept for the to-be solution has been developed and tested with a select set of potential users using the TopBraid™ Suite and the W3C Semantic Web standards. The system includes a Semantic Model, or *Ontology*, that describes the Bricks; the five possible dispositions for a technology, information about responsible parties (points of contact and authors), cross-references to vendors and products, and references into the Technical Reference Model (TRM) of the Federal Enterprise Architecture (FEA) as appropriate.

This information is displayed in two applications: for Bricks maintenance personnel, an application that allows the Bricks to be edited; for the larger class of Bricks consumers, an application that displays the Bricks. These

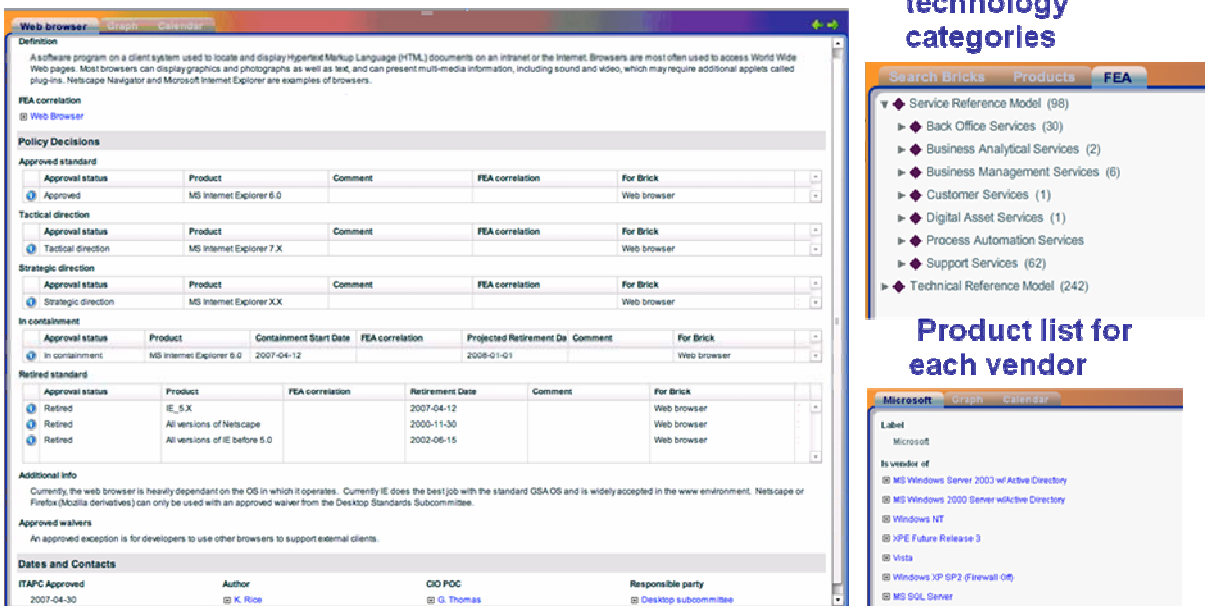
applications were built using the TopBraid Ensemble™ application assembly toolkit for constructing Semantic Web applications. The components communicate with a TopBraid Live™ server for the deployment of the application and management of the data.

Figure 3 shows some screenshots of the new system. The policies are described in a form (shown on the left) that includes selected information about each decision. Information about other entities (e.g., products, vendors, and GSA personnel) is available through hyperlinks to their own pages. Every entity in the system is ‘first-class’, and can be displayed in its own way, either as a web page or a grid. Even CIO Points of Contact are displayed with a list of the Bricks they are responsible for. Connections to outside sources (e.g., the FEA) can be done easily as well.

Managing technology standards for software and hardware

Capturing for each technology category approved, in containment & retired products as well as strategic direction

Navigating standard information using technology categories



The figure consists of two screenshots from the TopBraid Suite interface. The left screenshot shows a detailed view of a 'Web browser' brick. It includes a definition, FEA correlation, and several policy decision tables. The 'Approved standard' table lists 'MS Internet Explorer 6.0' as approved. The 'Tactical direction' table lists 'MS Internet Explorer 7.X' as a tactical direction. The 'Strategic direction' table lists 'MS Internet Explorer XX' as a strategic direction. Below these are tables for 'In containment' and 'Retired standard' products, such as 'IE_5_X' and 'All versions of Netscape'. The right screenshot shows a 'Product list for each vendor' for Microsoft, listing various operating systems and server products, including 'MS Windows Server 2003 w/Active Directory', 'Windows NT', 'XP Future Release 3', 'Vista', 'Windows XP SP2 (Firewall Off)', and 'MS SQL Server'.

Figure 3: Screenshots of Proof-of-Concept GSA Bricks Management Interface using TopBraid Suite

Interface customization is of utmost importance in Enterprise applications; each stakeholder has their own requirements when it comes to viewing and understanding enterprise architecture information. The TopBraid Suite is particularly well-suited for this sort of application, since the user interface can be customized by non-programmers. In this example, all customization for the user interface was done with the TopBraid Composer modeling interface, with no intervention by a UI programmer.

This application supports a number of important use cases that go beyond the current capabilities of Bricks management, paving the way for further enterprise architecture enablement:

- Policy Consistency Checking. Having an explicit, structured representation of the Bricks makes it possible to analyze them for patterns of inconsistency (e.g., a product that is both approved and retired for the same service)
- Lifecycle management. E.g., assign all Bricks from one POC to another when the former leaves the GSA.
- Executable Compliance Testing. Is a complex system in compliance with all relevant Bricks?
- Bricks exploration and reporting. The TopBraid Suite provides a number of tools for exploring information. These can be used to discover interesting patterns of data, which can be converted into SPARQL queries to drive reports (e.g., by pasting into JSP pages).

The Bricks application is quite modest in terms of the problem it solves, but it demonstrates many of the advantages of a Semantic Web solution in general, and the applicability of the TopBraid Suite in particular. The Semantic Web allows for a uniform representation of information so that every entity is treated as linked data. Connecting to external sources is done as it is on the web. Using TopBraid Suite, enterprise users from all walks of life can customize the user interface to their own needs. Even though the application is simple, this proof-of-concept sets the bar that any enterprise architecture solution must meet.

Summary of Benefits and Future Directions

Future Directions for Enterprise Architecture Solutions

An immediate requirement in the opportunities ahead is to enhance usability by providing better visualization of EA models. With this in place, a collaborative EA workspace can be built that enables multiple viewpoints to be supported for accessing the work and capabilities of the enterprise. On this platform, we anticipate several applications with substantial value for enterprises such as federated portfolio management, budget lifecycle management and integration with an Enterprise Service Bus.

Beyond, we envision the use of semantics to instrument IT systems so that models have fidelity with the real-time workings of the enterprise. In this future, the real-time EA infrastructure, by providing a “mirror world” of the enterprise, allows you to do many things critical to an agile enterprise, including: know how every IT component is serving some purpose in the enterprise; predict the impact of down-time; know the ripple effects of any technology upgrade. Key benefits of such an infrastructure include improved capabilities to govern, manage, sense and respond by bringing together and analyzing diverse models and enterprise information sources. Semantic Enterprise Architectures have the potential to deliver on this vision, motivated by the promise (and necessity) of a new generation of agile enterprises.

Benefits of Semantic Web Technology and TopBraid Suite for Building EA Solutions

In this whitepaper, we presented an overview of the need for and value of dynamic and executable EA models for enterprises, and made a case that semantic web technologies and TopBraid Suite are a promising way to accomplish this. The benefits of using Semantic Web technologies for EA solutions include:

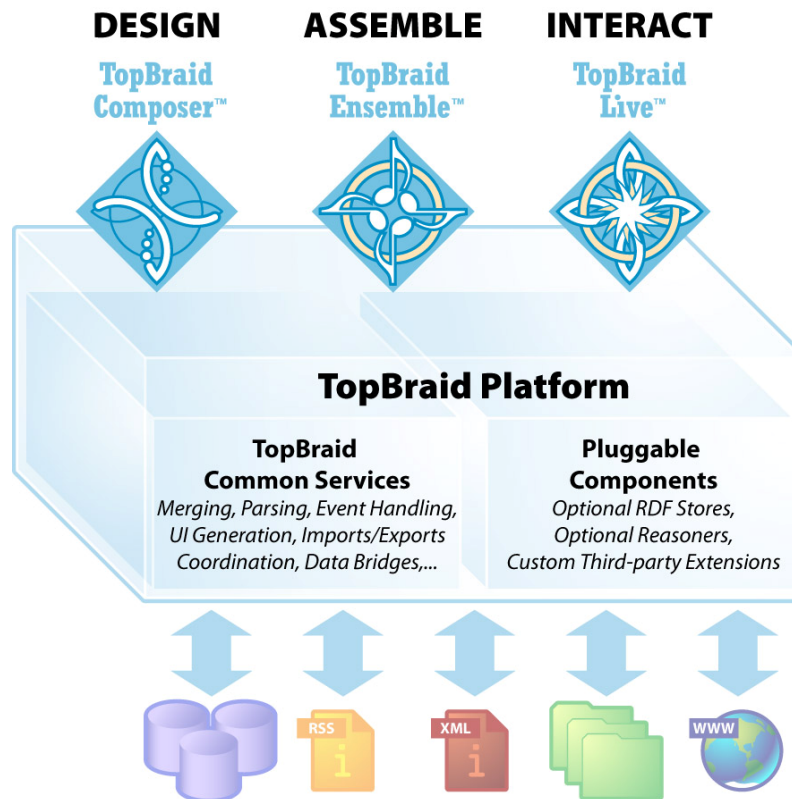
- Every entity is ‘first class’ – no re-engineering data to promote entities as requirements change
- Flexible schemas – add new kinds of data (metadata) as systems change
- It is easy to link external information – refer to reference models, standards, any external information as a ‘web’ connection (URI)

TopBraid Suite encompasses the full spectrum of Semantic Web tools and technologies necessary to build and deploy Semantic Enterprise Architecture solutions. Benefits include:

- Standards’ based capture and management of enterprise information models and metadata –based natively on RDF, RDFS and OWL
- Information aggregation across diverse enterprise data sources using TopBraid Composer’s multiple import modes – information from other EA systems, spreadsheets, databases, etc.
- Support for workflows and alerts
- Fully customizable and extendable taxonomies for organizing IT standards across the enterprise
- Support and compliance with the Federal Enterprise Architecture (FEA) including Federal Transition Framework (FTF) and the Data Reference Model (DRM)

- Integrated development/deployment environment. What you see in TopBraid Composer is what you get in TopBraid Live
- Integrated Forms and Grid editors – end users can customize displays using Composer editors
- Multiple display widgets – forms, grids, calendar, map, graph, etc.
- Business reports, compliance audits and other analytics
- Model-driven interface – user interface is specified just like any other data.
- SPARQLMotion™ - graphic dataflow language for specifying complex information filters and transformations
- Integration with JSP and other means for generating web interactions

In conclusion, TopQuadrant's TopBraid Suite of integrated products exploit the W3C Semantic Web standards to provide an open, flexible, configurable and standards-based platform to build and deploy solutions for a large class of future enterprise architecture solutions.



Interested in learning more? We invite you to visit TopQuadrant website www.topquadrant.com for more information and to obtain a free download of TopBraid Composer, our enterprise modeling tool.