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ONE GSA ENTERPRISE ARCHITECTURE

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ONE GSA WHITE PAPER

APPROACH TO DYNAMIC ENTERPRISE ARCHITECTURE CHANGE AND CONFIGURATION MANAGEMENT

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Overview

Governance, planning, architecture and analytics at the enterprise and segment levels require a wide variety of information from multiple sources be brought together, managed, published and analyzed with accuracy and efficiency. In this white paper such information is collectively called Enterprise Information Assets (EIA). GSA has instituted an initiative to get more value from Enterprise Information Assets and manage these assets more effectively for the good of the agency, citizens and our government and industry partners.

Dynamic Enterprise Architecture Change and Configuration Management means the ability to manage Enterprise Information Assets. Dynamic EA change and configuration management recognizes both internally and externally prompted change and provides for continuous capture of all artifacts including change proposals and provides for informed decision making about whether to make changes.

The focus of this paper is an initiative and software system prototype in support of dynamic change and configuration management of enterprise information assets and the GSA EA configuration management plan.

GSA Business Challenges

GSA is facing numerous challenges to its core businesses; especially its IT Services business. As a result, the agency has instituted a series of measures, including discretionary spending cuts, personnel cost reductions, and a hiring freeze to meet its legal obligation to 'break even'. With the continuing proliferation of Government Wide Acquisition Contracts (GWACs) across Government, GSA faces increasingly stiffer competition for its acquisition services from a growing Government competitor base.

The capability to supply acquisition service across the government – services based on a cost-effective, efficient and timely infrastructure – are goals of GSA.

In addition to the marketplace, GSA faces a number of internal challenges that have impact on the current state:

- GSA continues to undergo a major transformation with the establishment of the Federal Acquisition Service (FAS). This transformation is a key component of the One GSA vision, but as with any major change, it adds to the uncertainty and discomfort within the organization.
- Change is the norm and GSA must position its self as an agile organization ready to respond to internally and externally prompted change. Responding to change must be accomplished within the tight budget and time constraints that the organization is operating under.
- GSA has numerous processes related to its IT asset base (SDLC, PMP, EA, CPIC, etc.) that require constant management and update. Although related, these are not yet available to appropriate personnel in an easily accessible, configurable, and updateable environment.

- OMB and GAO are continually (and rightly) “raising the bar” in their assessment of Agencies Enterprise Architecture and overall IT maturity. GSA must keep pace with meeting the higher bar.
- The GSA OCIO has numerous stakeholders who want to be able to “view” the IT information, architectural and governance asset base in ways appropriate for their business goals. Currently, each IT information asset has only a single “view” – and frequently not a view that resonates with their needs.
- Much of GSA’s process, data and information assets are currently siloed. GSA could achieve better use and management of these assets if they were appropriately disseminated across the agency.
- Architectural information is frequently developed in forms appropriate to architects, but not business stakeholders. Information gets “trapped” into a single format that doesn’t work for everyone.
- While GSA has embraced the FEA, EA is not meeting its potential to provide value to the enterprise in support of internally and externally prompted change and management based on good information and solid analytics..
- Information is frequently locked into static documents that are difficult to revise, interrelate and actualize.

To deal with these challenges, challenges that were clearly identified in the Integrated Portfolio Management project (IPM), is the need for better management of information in support of enterprise knowledge, decision making and execution. Information that is accessible and cross-linked across stakeholders is a key ingredient to cost-effectively responding to internally and externally prompted change.

The GSA Architectural Team has developed an approach with these challenges in mind.

GSA Knowledge Management Challenges

GSA is typical of most government organizations in that it has acquired and accumulated a great deal of information, architectures and plans that are not well organized, integrated or maintained. Much information, some of it costly, is lost, forgotten or simply not applied at the right time. Plans and architectures are done and redone due to changes in contractors, tools, methodologies, technologies and management.

The information that is retained is frequently not “linked” or consistent. The key drivers in an IT plan are not the same key drivers in a human capital plan, funding is not consistently applied to enterprise needs and architectures don’t match reality. Decisions are made on inconclusive data after millions have been spent on analysis. *What information we have is not effectively transformed into knowledge.*

The standard practice in government is to deliver information in static and unstructured *documents*. While documents are a crucial part of the knowledge management landscape this approach has severe limitations. Information in documents tends to be unstructured and stove piped. If, for example, an enterprise architecture is delivered as a document it is nearly impossible to reuse, reference or revise information in that document. Initiatives that should use, extend and revise this information don’t, because it is locked

up in this document. Best practices in information and knowledge management are moving to various kinds of more structured and well defined information, such that it can be used, managed, referenced and extended for multiple purposes. Technologies such as XML, Semantic Web, Ontologies, Models, Metadata Repositories and DBMS systems store and manage information in a more flexible way. In bridging from the culture of documents to the culture of knowledge management we must recognize both and help them to work together more seamlessly while encouraging a transition to well defined and structured information.

While the technologies and methods for managing operational data in DBMS systems are well established, the same level of maturity has not emerged for management of governance and architectural information. This kind of information is less suited to the rigid structure of a DBMS, yet still needs some structure and management. It is this kind of information for which knowledge management is the right approach when applied to the dynamic requirements of EA.

While the cost of information loss is disturbing, even more troubling is that this is the kind of information that could help GSA achieve greater efficiency, transform to a more effective enterprise, improve its value to citizens, integrate with other agencies and achieve a more mature enterprise. There is, of course, also process and culture changes required – some of which have been identified in the IPM project. The Internet based technologies of the OSERA Portal (<http://www.osera.gov>) can help facilitate these cultural and process changes with easy access to and management of knowledge.

The OSERA Enterprise Knowledge Base (OsEra-EKB)

The OsEra-EKB is an open-source project sponsored by GSA-OICO to address knowledge management challenges in support of dynamic EA configuration and change management. The OsEra-EKB will provide the ability to search and retrieve information assets for any given concept; administer information, and create articles about information assets. Through semantic metadata capture, information assets will be categorized and contextualized to ease search and retrieval. This affords information suppliers and consumers the capability to easily determine what information is available, the subject of the information, and how to obtain the information. Additionally, when information components are visible, managed, and accessible within the GSA community, information suppliers and consumers will be more inclined to share and reuse common information rather than re-inventing it.

A goal of the OsEra-EKB is to integrate both the traditional “document centric” information and semantically enabled structured information (such as XML and Models), making it available, accessible and manageable in this knowledge management platform.

A great deal of information is developed inside and outside of GSA in the form of documents, spreadsheets, presentations, models and other forms of files. These artifacts typically go through multiple revisions with the contribution of multiple authors. Some information is official while other artifacts are temporary or simply informative. As this information is collected and developed it is generally put on local or networked disk drives under some directory structure relating to the source of the information (such as a project). While this serves the few who are directly involved with the artifact, it is not

effective as a “corporate memory” because such artifacts are hard to find and manage. Furthermore, as artifacts are developed they go through multiple revisions– and the progression of these revisions and the ability to retrieve past versions can be critically important for the maintenance of a reliable record of changes, who made them and why.

The basis of the OsEra-EKB knowledge management vision is that it is a place for all enterprise knowledge to be stored, managed, published and located. Any information that is worth developing is worth placing in the OsEra-EKB for the full lifecycle of that information. Placing information in the OsEra-EKB does not give it “Status” or “Approval”, it simply provides management and versioning of that artifact with the “hooks” for such approvals and status as we shall see, below.

Utilities and Features

The OsEra-EKB is an operational, open source prototype using ontologies, semantic web standards, OMG modeling and metadata standards to integrate, transform and repurpose GSA information. The knowledge base supports various kinds of information in a variety of tools and formats. The OsEra-EKB provides a means for defining and shared concepts that are used for the categorization of information assets. The OsEra-EKB platform includes a set of utilities that leverage “shared concepts” and provide the following “ontology model driven” capabilities:

- 1) User Interface: The user interface consists of a simple web based forms interface, allowing information to be entered, categorized and related.
- 2) Query: The query interface provides a user friendly layer over the underlying technologies (SPARQL) to query the knowledge base, locating information for browsing, editing or analysis. Query will also be able to export into standard XML files for further processing with widely available tools.
- 3) Upload/Download: The upload/download utility will accept data in any format to provide configuration management and categorization of that data in the repository – essentially enhanced document management. Data in supported artifact formats (e.g., EDOC, DRM, BPMN) will be able to be mapped to the knowledge repository directly. Artifacts linked to the knowledge repository will automatically update that repository when checked in and reflect any changes to the repository when checked out. This simple “check in/check out” paradigm for linked artifacts presents a very simple interface to the leading-edge capability underneath that maps between the data and file formats using shared concepts.
- 4) Check-in/Check-out using off-the-shelf configuration management tools based on “Subversion” – a popular open source configuration management system.
- 5) Mapping Facility: The mapping facility implements the generic infrastructure for mapping between ontologies and for import/export of external artifacts in the OMG standard XML Metadata Interchange (XMI) format. The mapping facility is be component oriented and will map import export components to source and target requirements.
- 6) Ontology of Architecture: Information that is relevant at the enterprise level comes from and is used by a variety of sources that use a variety of tools,

standards, methodologies and formats. The problem is that this information is inter-related, there are concepts shared between them. A business case should reference an enterprise initiative and effect the budget. A business process should be connected to both goals and the underlying systems that help automate that process. System data structures are reflections of business requirements. The OsEra-EKB implements “shared concepts¹”, a way to normalize and connect the same information expressed in different ways and using different terminology. The ontology of architecture is a set of shared concepts used in enterprise and systems architecture, so we can better integrate information from these many sources – and repurpose that information for other usages.

- 7) Adapting information: Once shared concepts are defined for a language, an “adapter” can be developed to map between the XMI representations of each artifact to instances of the shared concept ontology.

Key Benefits of the OsEra-EKB

The OsEra-EKB can increase the GSA’s core capabilities, support the development enterprise-level information services and mission critical applications and serve as a basis for information modeling standards. Some of the key benefits include:

- Complete and current information and metadata about that information will be captured and stored for use by the entire agency.
- Supports an information sharing environment because information is made generally available and accessible to any interested party through a simple, user-friendly interface; and provides a platform to migrate internal agency information assets from internal resources to cross-agency information assets where appropriate.
- Provides efficient discovery features so that information consumers can obtain information, formulate answers to business questions and exploit knowledge for better business decisions.
- Reduces the need for labor intensive collection and reconciliation activities to satisfy requests for information.
- Increases stakeholder collaboration by providing a central store for information assets; enhances the ability to implement standards and best practices by providing insight into existing resources.
- Provides for document management and versioning enhanced with the capability to categorize, group and approve information assets in multiple ways, across multiple dimensions, using an ontology.

¹ Shared Concept. An abstract identifier that links two or more terms in order to define their meaning. For example, the “morning star” and the “evening star” both refer to the planet Venus. See <http://www.w3.org/2000/10/swap/Primer>

- Provides for structured knowledge management using semantic web technologies and a common “ontology of architecture” so that models, architectures and governance information can be connected and managed as a dynamic configuration of knowledge.
- Provides for moving information between documents, models and other “static” artifacts to the ontology of architecture.
- Supports dynamic EA change and configuration management by providing the repository for all relevant information as well as internally and externally prompted change.

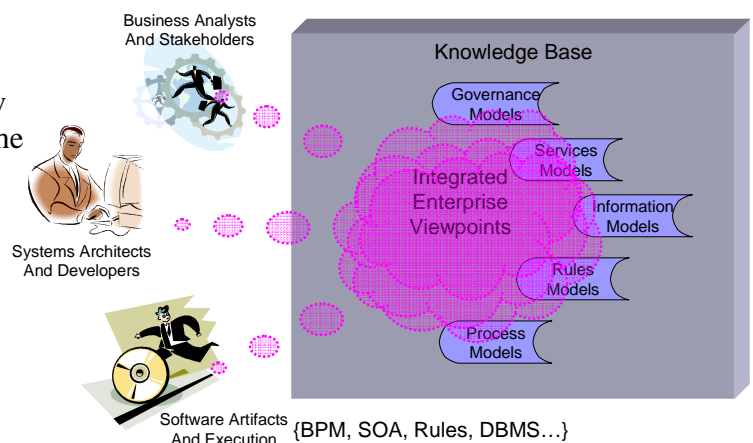
The combination of the Information Model, OsEra-EKB platform and supporting governance structure results in the GSA’s vision for its dynamic configuration management of EA related knowledge. This vision is intended to enhance knowledge throughout the GSA and achieve the following goals:

- Support collaboration, sharing and reuse: By enabling and supporting a culture of shared information assets, services, and processes across GSA.
- Enable strategic thinking and information driven decision making: By providing a flexible, model driven tool to manage information assets and developing an integrated information model that aligns to GSA’s business architecture.
- Improve the value and quality of information: By facilitating agency level comprehension of information and providing the capability to communicate within GSA and/or with partnering agencies about information with a clear understanding of its meaning and confidence in its quality.
- Reducing duplicative efforts: Redundancy in information and processes in GSA is not only time consuming and expensive, it is a source of inconsistent and sometimes contradictory information.
- Reduce costs by avoiding redundancy and providing for better integration of initiatives across GSA and by reducing the cost of re-developing and re-purposing information.

By providing a means to explore the opportunities for the integration of business processes and information, GSA will become more adept at consistent planning and execution of strategic initiatives.

Stakeholder appropriate knowledge

The diagram to the right illustrates how information in the knowledge base in the form of governance models, SOA models, Information models, Rules Models and Process models is integrated and “projected” as a view



appropriate to different stakeholders such as business analysis, systems architects and developers.

Approach

The target EA Data Architecture is expressed as a set of shared metadata concepts using Web Ontology Language (OWL) and Resource Description Framework (RDF) in the ontology of architecture. These concepts will be synthesized from the current GSA data architecture, as expressed in previously developed EA artifacts, as well as the Federal Enterprise Architecture (FEA) and Data Reference Model (DRM) 2.0. These concepts will be made available for use via the OsEra-EKB.

Model Integration

The target EA Data Architecture combines the original One GSA models with new information from the Financial Management Enterprise Architecture (FMEA) segment, Financial Management Enterprise Architecture Continuation (FMEA-C) segment, Contract Writing System segment and Information Technology Portfolio Management initiative. This integrated set of models utilizes both Enterprise Distributed Object Computing (EDOC) and Unified Modeling Language (UML) to represent the GSA's enterprise and segment architectures. A two-way mapping is defined and implemented from EDOC to instances of these shared concepts in the OsEra-EKB; and a one-way mapping is defined and implemented from these shared concepts to the FEA DRM 2.0. This model integration allows for a cross-project view of architectures that has not previously been available.

Aligning to the Federal Enterprise Architecture (FEA) Data Reference Model (DRM) 2.0

Unifying data architecture is essential in providing a foundation for consistent information. The FEA DRM 2.0 establishes a common data model for the purposes of streamlining information exchange processes within the Federal government and between government and external stakeholders.. To that end, GSA, as per the agency's EA goals, is committed to adhere to the standards and guidelines expressed in the FEA DRM 2.0.

Transforming the Enterprise-Wide Repository to the OsEra-EKB

Many of the processes and artifacts to support the GSA's IT vision have already been defined as part of the Integrated Portfolio Management (IPM) project. The target EA Data Architecture enhances the utility of these essential products by providing automated support via the OsEra-EKB's change and configuration management capabilities, shared concepts, mapping components, views and user interfaces.

Integrating Architectural Views

Enterprise, business and systems architectures integrate a number of viewpoints, each applicable to different needs and stakeholders. The primary viewpoints to be integrated in the first revision of the EKB build on industry standards and best practices. These viewpoints are:

- **Information & Data:** To be useful, information must be understood and shared. Information architectures focus on both the information that is shared between parties and the information that is stored in repositories and DBMS systems. The information architecture describes the semantics, context and structure of information based on DRM 2.0.
- **Service Oriented Architecture:** SOA provides a capability for people, organizations, systems and communities to work more effectively together by providing and using services. SOA in this context is both a business and technology concept – a way to understand our organizations, supply chains and communities as service providers and consumers. It also provides a way for our systems to work together more effectively using technologies such as web services. SOA relies in the information architecture to describe the structured information that enables service interactions and services are directly tied to the business processes that both enable and are enabled by services.
- **Business Processes:** Business processes describe how our organizations meet their mission and service responsibilities with well defined processes and activities. Business processes span the range from high-level “value chains” to detailed processes within a group. Business processes depend on and help develop information and both implement and use services.
- **Governance:** Governance is an integral part of the architectural process and both informs and is informed by the other architectural aspects. Governance is agency wide and business focused.

Examples

Document Approval Example

Scenario

In this scenario a fictitious performance evaluation (PE-2008) is required for the OMB. The requirement for PE-2008 is managed by Sue and provided by a contractor – Sam.

Steps involving the OsEra-EKB

- Sue has previously set up a folder in the EKB for OMB deliverables, called GSA/OMB.
- Sue enters a new asset into the OsEra-EKB user interface called “PE-2008” and categorizes this asset as “required”.
- After many months of hard work, Sam checks in a document as “PE-2008”.
- Sue reviews this document and has some issues; these are entered as a “corrective action” in the document.
- Jane, the supervisor, runs an artifact status report and sees that PE-2008 is required but not yet approved and notes the corrective action. Jane checks with Sue on the status.

- Responding to the issues, Sam checks in another version of PE-2008.
- Sue reviews the new version and categorizes it as approved.
- As part of the next OMB deliverable, all approved and required OMB deliverables are packaged and sent to OMB.

Model Integration Example

Scenario

In this scenario the DRM based information model stored in the EKB is used to find commonality between a new requirement for an “account” entity and existing account entities.

Steps involving the OsEra-EKB

- Ralph, a systems architect, is developing a system that has a requirement for an “Account” in a vendor management application.
- Ralph searches the EKB and finds a “Vendor Account” that was defined in the “FMEA” project. This entity looks good but lacks some information Ralph needs.
- Ralph checks out the model that defines “Vendor Account” in UML and, in another UML file, makes a subtype of “Vendor Account” called “Vendor Management Account”. Ralph adds some attributes and relationships to this new entity.
- Ralph checks his UML model into the OsEra-EKB
- When anyone looks at “Vendor Account” they will now see that it has a subtype “Vendor Management Account” defined as part of the vendor management application. They also see that this was entered by Ralph on 4/22/09 as part of his UML model.

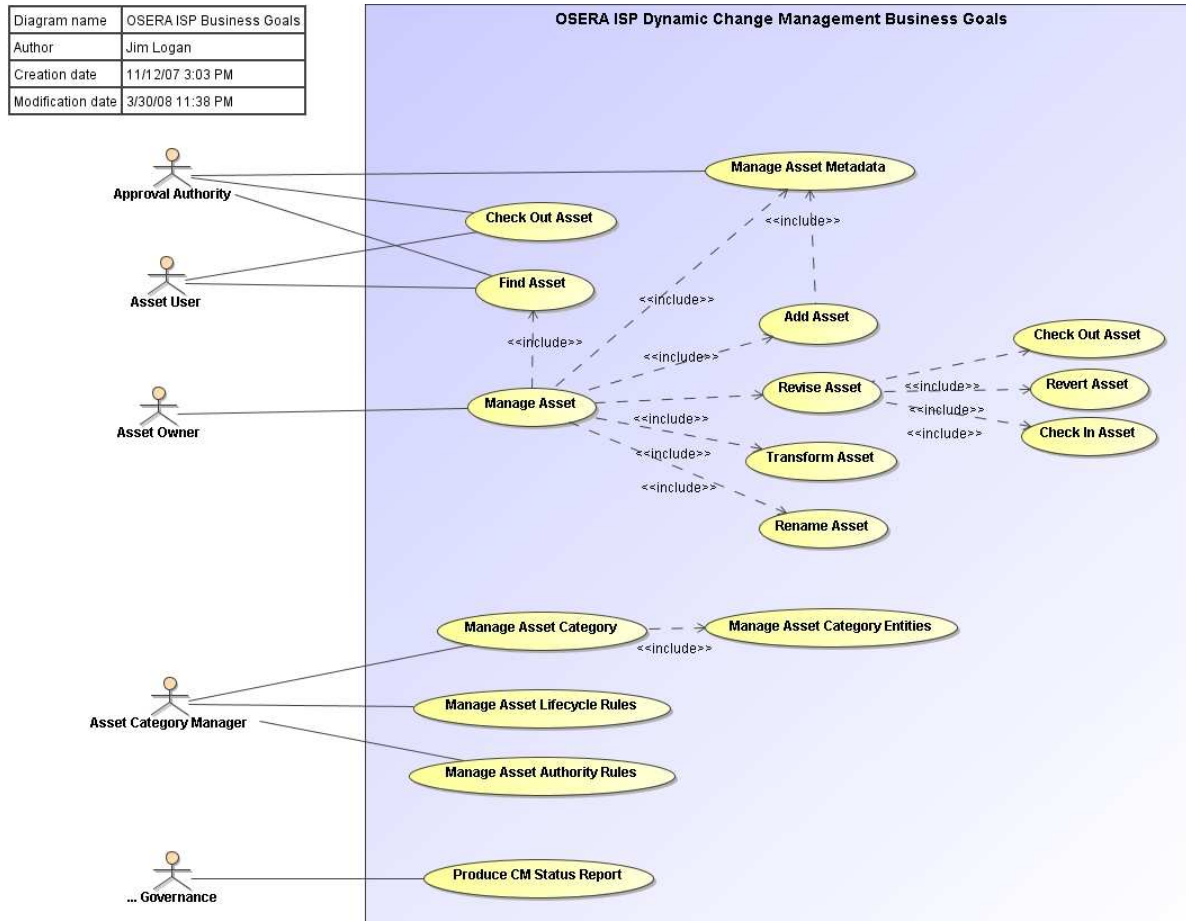
Licensing

The OsEra-EKB is licensed under the OSERA public license and is available all government users at no charge as an open source product.

Status

The above capabilities are in prototype development within GSA. Once capabilities are ready they will be made available to the entire federal community via the open source OSERA program.

Appendix 1- Roles of Actors using the OsEra-EKB



The diagram, above, illustrates the roles of people using the OsEra-EKB to manage information assets.

Asset User

The asset user is able to find and check out assets in the knowledge base. The asset user can narrow down the choice of assets based on category, approval and owner. Once located the assets can be downloaded to the users PC. An asset user may also subscribe to changes in an asset or asset category and be notified of changes by email.

Asset Owner

The asset owner is the primary “user” of the EKB asset management capability. The asset owners record assets in the knowledge base, revise them and can categorize them as well as provide other metadata. Asset owners are also able to search the knowledge base and retrieve assets.

The EKB keeps track of every version of an artifact and is able to provide a complete history of that artifact including who changed it, why and under what authority.

Recording why a change was made does require the asset owner to record the reason (the EKB is smart but not that intuitive).

Approval Authority

The approval authority can mark assets as being accepted and/or the official position of GSA or a GSA business unit. Categorizing assets as approved may require process and authorization in accordance with governance policy.

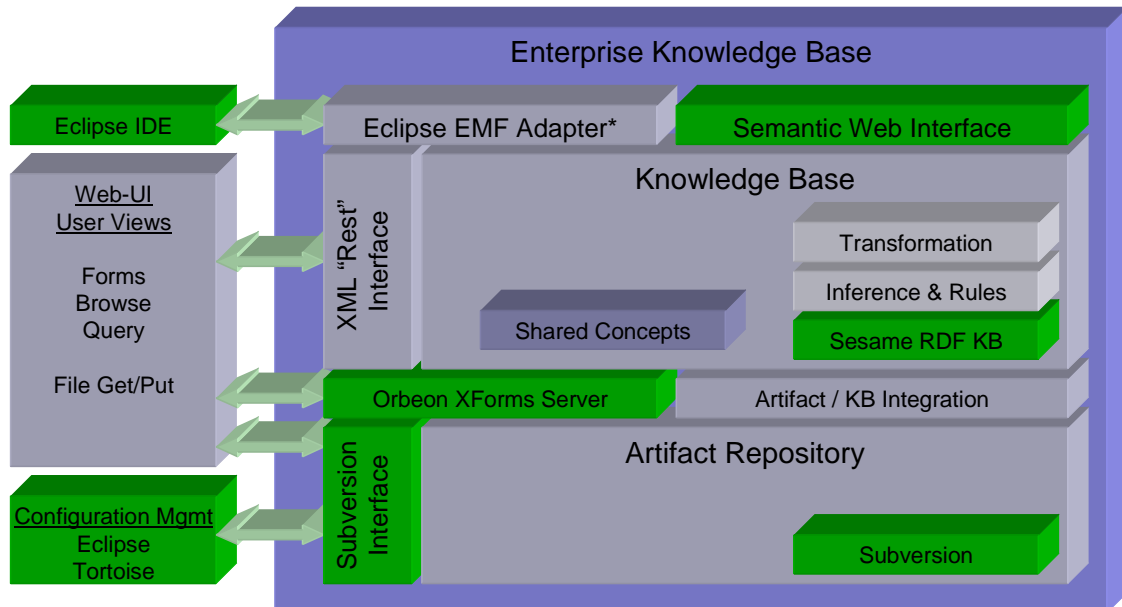
Asset Category Manager

The asset category manager “sets up” the knowledge base by adding new categories and approval rules – thus providing the basis for making the assts accessible as well as supporting the governance process as defined by the EA configuration management plan.

Governance

The governance role monitors the information in the knowledge base to make sure that the required information is in place and appropriate policies are being enforced.

Appendix 2 - Architectural Overview of the OsEra-EKB



The diagram above illustrates the high-level OsEra-EKB architecture which is composed of the following components:

- **Artifact Repository** – a Subversion based repository for files, such as documents, images and models. The artifact repository manages versioned files in a folder structure.
- **Subversion** – Subversion is an open source CM product from <http://subversion.tigris.org/> which includes the subversion interface.
- **Artifact / KB integration** – Synchronizes the metadata about all assets with the knowledge base and synchronizes model files with models in the knowledge base.
- **Oberon XForms Server** – an existing user interface component for managing information in the EKB using XML from <http://www.orbeon.com/>
- **Knowledge Base** – the knowledge management part of the EKB which stores and manages all asset metadata and models.
- **Transformation** – the generic capability to transform between different model formats and languages.
- **Inference and rules** – RDFS (semantic web) inference with added support for EKB rules and transformations.
- **Sesame RDF server** – Semantic web RDF database that stores and manages information in the knowledge base. Sesame is from <http://www.openrdf.org/>
- **Shared Concepts** – the “Ontology of Architecture” used as a “hub” to integrate different representations of architectural information.

- XML Rest Interface – XML based web interface for the EKB that allows standard XML tools to utilize the EKB.
- Semantic Web Interface – Part of the Sesame server which allows generic semantic web access to the knowledge base, including SPARQL queries.
- Eclipse EML adapter – future plans to support direct access to the EKB from eclipse via the “EMF” API.
- Web UI – User interface for the EKB which includes forms for managing instance metadata and for browsing the EKB based on the Data Reference Model.
- Enterprise Knowledge Base – The core open source technology of the EKB from www.modeldriven.org
- Eclipse IDE – Standard and open source IDE for developers.
- Configuration Management / Tortoise SVN – Client for SVN which allows users to check in and check out files using windows explorer. Tortoise is from: <http://tortoisesvn.tigris.org/>