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OPEN SOURCE E-GOVERNMENT REFERENCE ARCHITECTURE WITH AN OPEN SOURCE E-GOVERNMENT INFRASTRUCTURE SERVICES PLATFORM

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OSERA-ISP

A Change and Configuration Management Foundation for Data and Technical Architecture Execution

GSA

Architecture and Plan

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Section 1 Introduction

1.1 OISP Goals

GSA is undergoing a major business and technology transformation—a "sea change". GSA Chief Technology Officer (CTO) Chris Fornecker has identified the key indicators of this transformation to the GSA Business Systems Council (BSC) as: the "Get-It-Right" initiative; the Federal Supply Service and Federal Technology Service Merger into the Federal Acquisition Service (FAS); the transformation is to provide a unified face to the customer; OMB, GAO and Congressional mandates; and the integration and modernization of applications across the enterprise. He stated that "business as usual" will not facilitate GSA's efforts to modernize; One GSA is the architected approach that will.

While OISP is being developed by and for GSA, much of the results can be applied to other government and commercial needs. For this reason OISP is being developed as an open source project under OSERA (www.osera.gov).

GSA has made serious and successful strides to provide the infrastructure necessary to support this "Sea Change" in its initial Open Source E-government Reference Architecture (OSERA) efforts, Integrated Portfolio Management and the FMEA-C projects. This task builds on those efforts, linking them with subsequent developments in the Federal Government Enterprise Architecture Reference Models (FEA-RM), especially in the Data Reference Model (DRM) and the Technical Reference Model (TRM). OSERA-ISP (OISP) also provides for the ability to manage change and configuration of strategic information assets, management information and architectures.

OISP will provide GSA the key capability to manage and change both formal (i.e., structured) and unstructured enterprise-wide knowledge. The key to this capability is the development (to prototype level) of an enterprise-wide knowledge management repository that will contain, manage and provide access to GSA's strategic information assets: Architectures, plans, management information and metrics. This will enable GSA to become a more effective organization, make decisions on the basis of knowledge, align with administration policy and advance significantly in both OMB and GAO maturity assessments. *A key capability of this repository is the ability to integrate, transform and repurpose information using semantic web[1] standards and technologies.*

1.1.1 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 the goals of OSERA. This Task Order provides the next step in harnessing that "Sea Change" identified by GSA's CTO.

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

- 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.

- 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 asset base in ways appropriate for their business goals. Currently, each IT information asset has only a single "view".
- Much of GSA's data assets are currently siloed. GSA could achieve better use and management of these assets if they were appropriately available 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.
- Currently the GSA EA "Bricks" are not linked directly to the OMB Federal Transition Framework nor the FEA Technical Reference Model
- While GSA has embraced the FEA, EA is not currently providing sufficient value to the enterprise.
- The GSA EA, itself, is not visible agency wide in a usable, accessible environment

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.

The MDS Team has developed an approach with these challenges in mind. We will work with GSA to mitigate the risks associated with these challenges and support GSA to achieve the goals of the program. Our Technical Approach discusses, in considerable detail, how we will address many of these challenges.

1.1.2 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. <u>What information we have is not effectively transformed into knowledge.</u>

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 and architectural information. This kind of information is less suited to the ridged 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.

While the cost of this 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 and other agencies and achieve a more mature enterprise. OISP is the start of an initiative to address the core issues with knowledge management to help facilitate a more effective GSA. There is, of course, also process and culture changes required – some of which have been identified in the IPM project. OISP can help facilitate these cultural and process changes with easy access to and management of knowledge.

1.1.3 Vision of ubiquitous knowledge

Consider that there will be a knowledge management platform available to everyone in GSA and, as appropriate, to external stakeholders and contractors. This platform has all the information that people need to do their job and plan for the future. This platform is not limited to a few structured databases, but allows virtually any kind of information to be used, analyzed and managed by anyone with the authority to do so. It is the easy way to find out what you need to know, what others have produced and the trusted place to store, manage and integrate the vast body of information people work with today. This platform leverages and is part of the internet.

This platform is also able to work with any kind of information in a variety of tools and formats. For example, the information in a spread sheet that is part of a human capital study can be used in a business case that is directly related to the systems architecture of an application being funded and then implemented. There is a vocabulary of common terms, accepted across GSA, that help more clearly define business goals and metrics – and these terms are used consistently across various information artifacts.

There is a direct link and continuity from business goals to enterprise architectures to systems architectures, acquisition and implementations. While different tools and diagrams are used for different stakeholders, the underlying information is consistent, traceable and “linked”. Analysis can be done that crosses the “walls” between business and technical information.

As information and assets are developed within GSA and externally there is a culture of retention, extension and reuse. New information assets are stored in the repository and categorized according to their purpose, content and context. This allows new information to be found and reused easily, as well as managed reliably. New versions are saved and tracked so that the change over time can be better understood.

With this ability to manage, analyze and repurpose information GSA could be more effective at achieving its goals, of better serving its customers and of being a more mature enterprise. Without a handle on its knowledge resources it is hard to imagine much improvement at all.

This kind of environment is not science fiction, it is possible now, and OISP is part of the initiative to provide it. OISP envisions two classes of information and will have different capabilities for each. Virtually any information artifact that can be rendered as a “file” will be able to stored, managed, versioned and located. Each such asset will be categorized and contextualized such that it is easy to browse or query for the information you need. Once found it can deliver that information to any browser or desktop and keep track of any changes to it so that teams can work together effectively, even distributed teams.

A deeper level of integration and analysis can be provided for “structured” information, where the structure of that information has been modeled in and adapted to the knowledge base. This integrated and structured information will initially include information assets such as business cases, PMP, information models, business processes and business collaboration models. This same information will be integrated with and directly support the Federal Enterprise Architecture (PRM, BRM, SRM, TRM, DRM) and the federal transition framework (FTF) – this makes the FEA an integral part of the GSA architectural framework, not an afterthought.

Significant architectural focus areas such as data, process and services modeling will be a key aspect of the initial “integrated” capabilities. Besides the basic capabilities there will be contextual information in the form of policies and white papers on how GSA does architecture.

Various design tools will be able to “check in” and “check out” information in the format that is appropriate for that tool. The information in the repository will be able to be restructured in the format of specific tools and standards so that knowledge can be shared between organizations that use different tools, there is no more locking to a tool suite and information can be easily reused from project to project.

When stakeholders are viewing or even entering information they are doing so from their perspective, with a view that is appropriate for their needs, roles and authority. The underlying platform is responsible for repurposing information instead of making each user responsible for digging information out of alien formats and complex reports or diagrams.

The process of integrating all of these forms of information is a long one. What OISP does is lay the foundation with a platform and architecture that is sufficiently flexible to deal with this diversity of information, based on established standards and technologies known as the semantic web. OISP then starts the process of integrating information with some of the current information structures most crucial to GSA. As this capability evolves over time, and it becomes more integrated into the fabric of the enterprise, it will increase in value by being used as the repository for more and more information which is incrementally more integrated, linked and accessible.

What this task puts in place is an operational prototype for this knowledge platform as well as integrates key assets such as the FEA, OneGSA and Business cases supporting better decision making. Since the core of OISP will be open source, this opens the door for collaborative efforts with other agencies and for a pervasive intellectual capital platform across the government.

1.1.4 OSERA-ISP (OISP)

GSA's Open Source eGovernment Reference Architecture (OSERA) is an ongoing investment within GSA's Office of the Chief Information Officer (OCIO). OSERA I provided high-level business and technical architectures. OSERA II provided an open source technical implementation of "model to integrate" for business and technical architectures. This task, developing the OSERA Infrastructure Services Platform (OSERA-ISP), is designed to deliver a set of open source capabilities that better enable The "One GSA" Enterprise Architecture and support GSA's mission to help Federal agencies better serve the public with integrated knowledge management.

1.1.4.1 GSA Strategic Information Asset Enterprise-Wide Knowledge Repository (OSERA-EKB)

This task specifically addresses the creation of an enterprise-wide knowledge repository for GSA's strategic information asset base that we have called the "OSERA Enterprise Knowledge Base" (OSERA-EKB). This repository will be populated with many of the existing strategic information assets including the One GSA EA, the OMB FEA Reference Models, the OMB Federal Transition Framework, the GSA ITAPC "Bricks", etc. Additional capability will be provided to include other strategic information asset types such as the PMP and the GSA Executive Business Case within and accessible through the repository. These assets represent the initial information assts to be integrated, OISP is architected to be extensible for almost any kind of architectural or management information.

In addition, for increased usability, particularly by GSA "business" personnel, the One GSA EA, currently available only in the OMG specification EDOC will be available in Business Process Modeling Notation (BPMN). Appropriate individuals will be able to add or modify the One GSA EA in either BPMN or EDOC, depending on the "language" with which they are most familiar and comfortable and to take advantage of the unique capabilities of each language. In addition this task will deliver a One GSA EA Artifact Publication and Display Service which will be able to manage information artifacts in any format.

Beyond the significant benefits of the repository, the tasking also calls for some very specific advances in the One GSA EA in the areas of Data and Technology Architectures. These specific tasks will foster significant advancements in both OMB and GAO maturity assessments.

1.1.4.2 Data Architecture

This portion of the tasking provides for the alignment of the GSA Target Data Architecture with the OMB FEA Data Reference Model (DRM) 2.0 through the development of a specific Target Data Architecture and Gap Analysis. In addition, OISP provides for the development of the One GSA EA Data standards and quality guidelines. The information modeling standards will be supported by the OSERA-EKB implementation.

1.1.4.3 Technology Architecture

This portion of OISP provides for the alignment of the GSA EA ITAPC Bricks with both the OMB FEA Technology Reference Model (TRM) and the OMB Federal Transition Framework (FTF). These standards, as well as OneGSA will serve as a major revision of the “FEA-RMO” ontology and will also provide a user friendly implementation of that ontology in the OSERA-EKB

Section 2 Technical Approach

2.1 Technical Approach Description

OISP is a strategic initiative to address endemic issues within GSA and the government at large with respect to managing, integrating and using architectural and management information that is the foundation for achieving an effective enterprise. OISP combines a set of overall themes, capabilities and high level goals as well as specific tasks and deliverables. Many of the specific tasks and deliverables are an application of these overall themes and capabilities to specific needs. The MDS team's approach to this pattern is to define and/or develop a general solution and then apply that solution to the specific needs and deliverables. The reasoning behind this approach is reflected in the nature of the overall goals, that the processes, information and capabilities should be flexible, interoperable and strategic – not "stovepiped" as a point solution. The stovepipe mentality has caused many of the issues that OISP is attempting to address and repeating the same pattern would not produce a substantially different result.

Another challenge of this task is the integration of operational requirements and current or future capabilities that are on the edge of viability as mainstream enterprise capabilities. This includes the leading edge of MDA, semantic web, knowledge management and formal methods. The strategic approach to this has already been developed in the OSERA "Roadmap for Semantics in Netcentric Enterprise Architecture[2]" as an integral part of our approach.

The MDS team's technical approach to these challenges is layered, where proven capabilities are the foundation for more leading edge approaches that have a way to "plug in" to that foundation and provide additional value. This approach provides a base capability that is advanced by today's standards yet proven in the enterprise environment while supporting a roadmap that encompasses advanced approaches such as category theory and information flow.

In that we are taking an integrated approach that leverages work between tasks, the following sections detail the approach to specific requirements that are referenced in multiple tasks.

2.1.1 Architecture and design

Building and prototyping an operational capability that supports the SOW requirements while embracing and enabling the strategic vision requires that some intelligent design choices be made up-front. MDS has assembled a world-class team to address these design choices and provided for meetings and work products from that design team. This design team will include the technical leads from each of the partners.

Questions to be reviewed by this team include:

- Representation of information in XML, RDF and formal methods.
- Granularity of artifacts, ontologies and Articles
- Definition of the "meta ontology" that will be used to define other concepts
- Representation of context and scope of reasoning
- Structure and approach to shared concepts
- Bi-directional mapping of information between views, ontologies and artifacts
- Version and configuration management of information
- Relationship between artifact repositories (Subversion) and the RDF triple store
- Categorization and search capabilities for shared concepts guided by phase II of the roadmap which includes "Progressive mapping".

- Integration of formal methods in later phases of the initiative (Based on the OSERA strategy and roadmap)

The high level architecture and design will be developed in a combination of face-face meetings, virtual sessions and work product development.

2.1.2 OMB and GAO maturity at level five

OISP can provide capabilities that facilitate GSA's transition to a more mature organization in three ways;

1. By providing the information management infrastructure required for a mature organization to function.
2. By making our own behavior and deliverables compatible with and supportive of a mature enterprise.
3. By providing knowledge management and analysis capabilities in support of decision making.

Many of the processes and artifacts to support organizational maturity have already been defined in the Integrated Portfolio Management (IPM) project. The MDS team will be relying on this existing work and expand on it by providing automated support that will assist GSA in adopting these methods more easily. IPM provides an excellent set of requirements for information in the GSA enterprise-wide repository of knowledge.

Key elements and artifacts of IPM will be formalized as part of the knowledge repository, thus supporting the management of GSA's program planning. Achieving enterprise maturity will require the use of these capabilities as well as a transformation of the behavior and processes of the enterprise in concert with leadership as is described in the IPM deliverables. No technical capability or deliverable can, alone, advance the maturity of the enterprise. The capabilities and information provided by OISP will be designed to help facilitate such a transformation.

2.1.3 Extending GSA's "enterprise-wide knowledge" with the OSERA knowledge base

The "enterprise-wide knowledge base" is a theme throughout OISP. The current OSERA portal and Subversion repository is positioned to provide enterprise-wide information as a web repository and will provide the entry point for the broader knowledge base required for OISP. This task expands on those capabilities. The OISP tasks and deliverables are integral with this knowledge base capability and depend on providing a sound foundation.

While the current portal and Subversion provide some information management and dissemination it is not sufficient for the purposes of OISP, a much more capable knowledge management infrastructure is required. This more capable infrastructure will then be integrated with and made accessible using the OSERA portal.

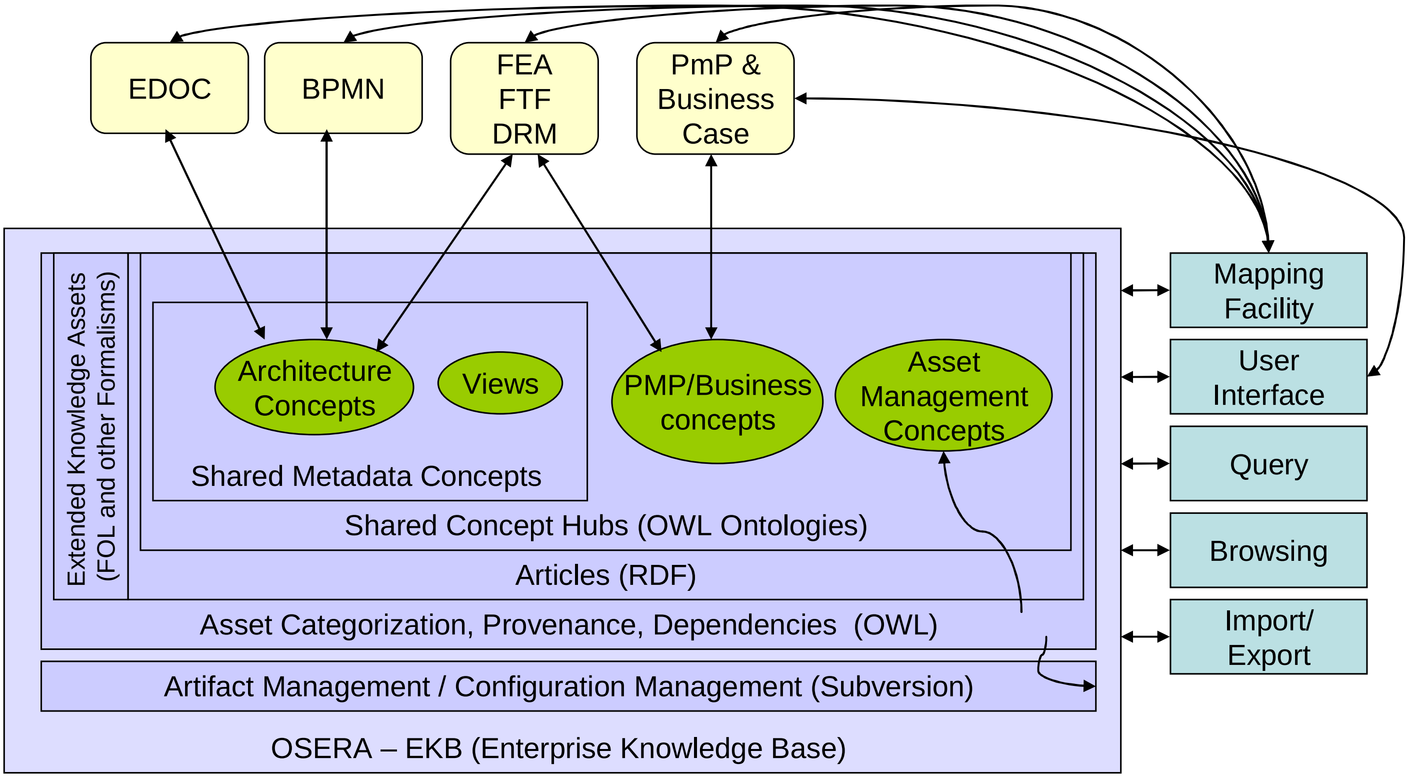
The knowledge management and repurposing capabilities required for OISP are at the leading edge of existing capabilities and do not exist as a ready-to-use package, particularly in open source. Therefore a major part of the project plan is the integration of existing open source capabilities and development of new capabilities to provide this knowledge base. The OISP knowledge assets are then managed within this infrastructure, which we will call the **OSERA Enterprise Knowledge Base (OSERA-EKB)**. The OSERA-EKB infrastructure will become an open source resource under the OSERA license.

Many of the components of the OSERA-EKB are part of the OISP-SOW, what we are doing in the project plan is pulling these together into a coherent effort to provide this capability as an open source product. Those components of the OSERA-EKB include the configuration management capability, shared concepts, mapping between different tools, views and user interfaces into the knowledge base. These components of the OSERA-EKB are further defined in section 2.1.4, below. The project plan also provides for the architecture of the solution, encompassing tactical and strategic concerns.

While there has been research on and products relating to knowledge management for years, the "enterprise" and open source nature of the OSERA-EKB places new requirements on the knowledge base. The result will be a capability that has unique value, due to this enterprise focus. An enterprise knowledge base has to consider scalability, reliability, standards, federation, versioning, security, incompatible architectures and a spectrum of information from highly structured and ontologically grounded to unstructured and informal in the face of an evolving technology landscape. A balance has to be achieved between managing commonality and supporting diversity. The enterprise repository has to be accessible and valuable to a broad base of users – some with specific expertise and others as casual participants.

2.1.4 OSERA Enterprise Knowledge Base

Information asset (IA) is a general term to encompass the broad base of intellectual capital relating to the management, design, architecture, processes, rules and information about the enterprise and enterprise systems. This can include everything from an RFQ (Like the OISP RFQ) to a detailed technical architecture of an accounting system to a time Ontology to an individual business rule. These information assets could potentially include everything except operational transactional data, such as is found in the typical DBMS (However such operational data many be linked to the knowledge repository). It is the responsibility of the knowledge management system to manage these information assets and provide easy access to them for the appropriate stakeholders.



The OSERA-EKB will be layered as shown above and described below:

2.1.4.1 OSERA-EKB Layer 1 – Artifact management

The "bottom" layer, the one in which all information artifacts ultimately reside, will be based on the Subversion configuration management system. Information assets will be "artifacts" managed by SVN. Each of these managed information asset artifacts will have a URL assigned by OSERA-EKB and will therefore be accessible as a web resource to anyone with permission to do so. Having a URL (and managing the meaning of that URL) is the core requirement for a web resource and shared concept. This is a proven and scalable capability that makes no assumptions about the resources being managed. What it does provide is a versioned, distributed, federated and reliable data storage "back end".

2.1.4.2 OSERA-EKB Layer 2 – Information Asset Ontology

The next "layer" describes these information assets with an ontology. The description will augment the simple "metadata" provided by subversion with an OWL/RDF[3] ontology that categorizes these assets, records their dependencies, their context, their provenance and the syntax in which they are expressed. This ontology for managing information assets will be part of the shared concept system and will integrate concepts from existing standards, such as SKOS[4] and RAS[5]. We will call this the "**Information Asset Ontology**".

What the OSERA-EKB user will see, at a minimum, is the subversion configuration management system augmented with the capability to categorize, contextualize and locate information more flexibly, based on the ontology. One of the difficulties in using a system like Subversion (or a shared directory) for managing large bodies of information is that assets can get "lost" in directory structures that do not always work for every need and are sometimes "refactored" to try and adjust to the latest view of that information. The ontology based categorization and naming of information assets will not assume any single or fixed categorization or naming scheme and will allow the same assets to be categorized and named multiple ways and for multiple purposes. The "concepts" used to categorize information can be user defined and evolve over time and be utilized in different contexts with different terms. To manage information in this way OSERA-EKB will place some conventions and restrictions on the physical directory structure of the repository. However, any information asset, of any kind, will be able to be checked into and out of the repository and managed in a controlled and reliable environment.

The Information Asset Ontology will be kept dynamically synchronized with the SVN repository by the use of "hooks" into SVN that allow any change to be recognized and the results processed as updates to the RDF store. Correspondingly, changes to the RDF store can result in changes to the assets (or the asset metadata in SVN). As information is managed in the repository the RDF store for the OWL ontology will be available to provide SPARQL queries to locate and analyze information in the repository. The RDF/SPARQL repository choice will be made as part of the OSERA-EKB development process. Technologies such as RDF and SPARQL will, however, not be visible to the average user – the capability will be accessible through a user friendly web interface.

2.1.4.3 OSERA-EKB Layer 3 – Articles

Categorizing and managing artifacts provides value, but it does not satisfy the OISP requirements for integrating, transforming and "understanding" that information at a semantic level. To do this we have to understand the structure and semantics of the information assets. Articles and shared concepts provide this next level of functionality.

Structured information will be represented in an "**Article**". *Articles are a set of statements from a particular authority in a particular language on a particular aspect of a particular concept*. This combination of factors helps define the context of each fact in the knowledge base. An article can be compared to a page in Wikipedia[6] or a synset Wordnet.

The challenge at this level is that even structured information comes in a plethora of formats, languages and formalisms. Structured information is also "packaged" in various ways, from very fine-grain elements to huge model files. Some conventions and normalization is required to make this information manageable and able to be repurposed or managed in different views. OSERA-EKB Articles may be defined based on "Ontology of Architecture" (See 2.1.4.5) that describes the concepts, terms, relationships and structure of concepts.

Structured concepts do not, however, assume that all concepts are shared or logically grounded, but allow that they may be. The Ontology of Architecture plays a role similar to the OMG-MOF[7] meta model in that it describes the information in and about the concepts in a technology (and logic) independent way.

Articles are a way to **modularize ontologies**, as is becoming best practice. What an Article does is establish the identity of a concept and allow a variety of statements about concepts in a "lattice of theories". The OSERA-EKB puts some structure on a set of related Articles using the Information Asset Ontology.

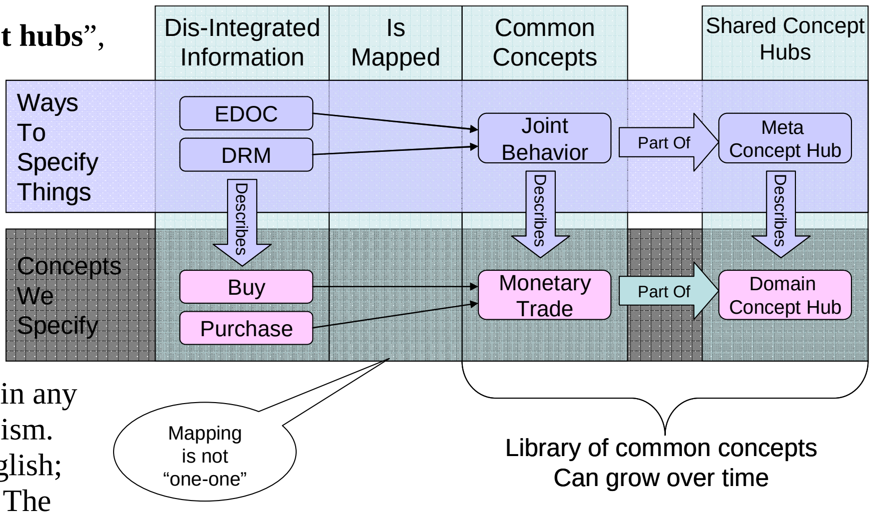
There are design decisions to be made about the granularity and physical representation of Articles, these decisions will be made as part of the early design sessions with the design team.

Once knowledge is represented in the OSERA-EKB as Articles we need to be able to extract, view and analyze that information from multiple viewpoints. When using the information we don't want to be concerned with just one (or a few) Articles, but the integrated set of information. As Articles are based on RDF, the same information can be linked to the information in other repositories for federation (a natural capability of RDF). Thus the RDF "view" of the OSERA-EKB will allow for queries and reasoning across arbitrary regions of the knowledge base, as defined in the Information Asset Ontology. The RDF store "view" of the knowledge base provides for the flexible query, analysis and mapping requirements in the OISP RFQ. In that articles may reference any URL, structured and unstructured information may be seamlessly integrated.

While the set of Articles, Facts and Ontologies in the world is open, a particular analysis, reasoning process or mapping will be done in the context of a particular set of Articles as defined by the Information Asset Ontology. Therefore while there is an "open world[8]" of information all computations can be performed with a more convenient and efficient closed world assumption where this is supported by a particular query or logic. Defining a context for an operation closes the world for that operation (and only that operation).

2.1.4.4 OSERA-EKB Layer 4 – Shared Concept Hubs

Representing concepts as Articles provides us with better management of information but it does not, by itself, provide for integration of that information or being able to derive additional benefits by "semantic processing", "model driven transformation" or other technologies that leverage the semantics of the knowledge. There are multiple ways to connect information and to describe it: from informal dictionaries to elaborate ontologies. What all of these techniques have in common is that they are ways of distinguishing and defining concepts – what something "means" in a given context.



OSERA-EKB will define "Shared **Concept hubs**", sets of concepts that are defined by an ontology within some domain and for which there has been an effort to define & normalize those concepts, removing redundancy. Concept hubs contain a set of **shared concepts**; each shared concept is an Article and as such has a global identity. Any number of Articles may serve to define and refine the concept from any number of perspectives, in any number of languages and using any formalism. One primary form of definition will be English; another will be a specific subset of OWL. The

OSERA-EKB will be designed such that other forms of definition (E.G. FOL or MetaSlang) can also describe the same concepts. It should also be noted that we are specific about the use of concept, not term. Concepts are disambiguated terms and their synonyms (i.e.,. also known as a "synset" in Wordnet).

Shared concepts are then used as a "grounding point" for other models, schema, architectures, ontologies or information sets. By grounding elements in shared concepts there is a "pivot point" for understanding where various information assets do and do not relate to the same concept. This grounding in shared concepts is supported by the core ontology (which is itself a set of shared concepts). The core definition of a concept will be minimally axiomatized, but will allow additional definitions (some formal) to be attached. Even with minimal inference support, a great deal of value can be achieved by simply having common grounding concepts. The next level of leverage is achieved by relatively simple inference across these shared concepts, where the relationships between them is well understood. Additional capabilities can be provided by "extended knowledge assets" (See below).

There are multiple sources of concept hubs; Wordnet[9] is an example of a concept hub that is very broad, but not deeply augmented with logic. However Wordnet makes an excellent hub for domain models and ontologies – a way to "drag and drop" common concepts into our architectures. Other hubs could be Cyc[10] or Dolce[11] at one end and existing enterprise lexicons at the other end (note that Wordnet, Cyc and Dolce are examples and are not being integrated as part of this project). There will also be the OSERA-EKB metadata hubs (see layer 5, below). What makes the concept hubs work is that hubs can be "grounded" in each other, thus forming a lattice of hubs. Core inference support in OSERA-EKB will understand, at least, equivalence and refinement of concepts and related terms.

While shared concepts bring together information from diverse viewpoints, particular ways to look at that information with respect to one of those viewpoints is required. To support these viewpoints the shared concepts will be visible through "views" of the knowledge base. Views are ontologies that define domain specific terms for shared concepts as well as particular ways to organize, structure and present that information to users. Views will be supported through an ontology particular to creating views.

In summary, OSERA-EKB will implement a core capability for the definition and maintenance of concept hubs containing shared concepts that are not deeply axiomatized but allow for deep axioms to be attached based on context. It will allow these concepts to be axiomatized by multiple forms of definitions or ontologies. Models, ontologies and other forms of knowledge will be "grounded" in these shared concepts which will provide the bases for the integration of information across systems, domains and communities – free of ambiguities such that they can be resolved by machine.

2.1.4.5 OSERA-EKB Layer 5 – Ontology of Architecture

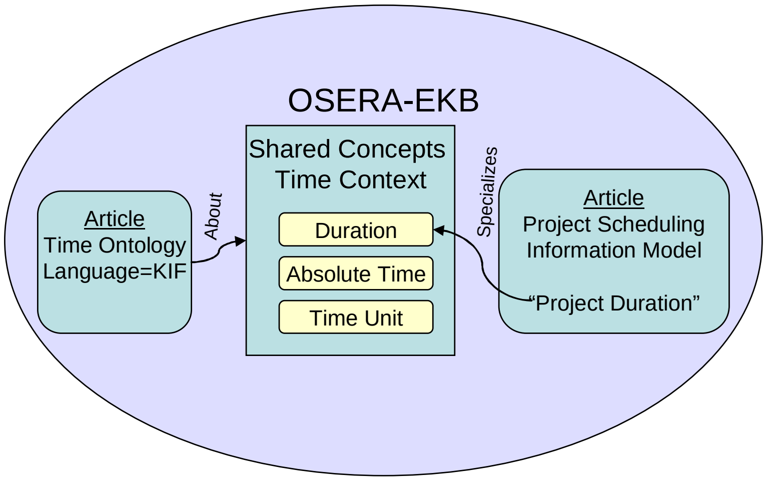
Shared metadata concepts are a distinguished set of concept hubs that normalize the shared concepts relative to architecture as are found in the FEA, FTF, DRM, EDOC, BPMN and current OneGSA architectures. These are concepts used to define other concepts and are typical of those found in modeling languages and ontology languages. The focus will be the definition of those shared concepts that are found in 2 or more of the reference languages and be called the "**Ontology of Architecture**".

The set of architectural shared concepts will be those synthesized from FEA, FTF, DRM, EDOC and BPMN These will build on the "semantic core" work already done as part of OSERA – but will focus on those concepts required for the enumerated set of languages. This will then make the GSA architectural assets and the FEA *a part of the same conceptual framework*. Adapters and transforms will then be used to project these shared concepts onto external artifacts in the native syntax of FEA, FTF, DRM, EDOC or BPMN.

Shared metadata concepts are the basis for the integration of information in different tools, standards and methodologies. Shared concepts represent the "local normal form" for those concepts and therefore the hub to which the tools-specific models are grounded. The transformation tools are then able to automate extracting common concepts from external formats and reflect changes back into those external formats.

2.1.4.6 OSERA-EKB Layer 6 – Extended Knowledge Assets

There are valuable logical systems that go well beyond the semantic web in expressivity; these include logics such as CL, KIF and PSL. Trying to semantically integrate these logical systems is difficult research. What we can do is *provide for each of them being able to make statements about the same concepts* – those defined in the EKB. *This provides the opportunity to leverage the capabilities of these extended knowledge systems, and even have them analyze and populate portions of the knowledge base*, without having to integrate the logics. However, the population of such diverse logical expressions, in particular those that represent the same assertion but represented via distinct formalisms, will grow over time to become a basis for integrating these extended formalisms via the methods of the roadmap's first stage (Automated Interoperation of Heterogeneous Languages and Ontologies). The cornerstone is then the strong identity of each concept, as provided by OSERA-EKB and the ability to augment the definition of a concept with different languages. The only extended logic being included at this time is OWL-DL. Extended first order logics are not being developed in this project, but are being provided for in the architecture of Layer 6 such that additional extended logics may be subsequently added, and integrated, in future projects, and this capability extended to all languages employed or managed by OsEra-EKB.



As an example of extended knowledge assets, a Time Ontology in KIF further describes shared time concepts with detailed axioms. A project scheduling model may want to use the concept of "duration" but may or may not want to commit to that particular time ontology.

2.1.5 OSERA-EKB Utilities

The OsEra-EKB platform will include a set of utilities implemented to the level of an operational prototype that will provide the following capabilities. Other utilities (such as a wiki and analysis tools) are anticipated as part of follow-on work. All of the tools will leverage shared concepts so that the capability can be "ontology model driven".

2.1.5.1 Browsing

The browser provides the ability to explore and retrieve information in the OSERA-EKB with a simple web browser. The browser interface will provide login through the OSERA portal and presents views of the knowledge base that are sensitive to the users roles, thus providing a more tailored user experience for interaction with the knowledge base. This component is expected to be based on TopBraid runtime libraries.

2.1.5.2 User interface

Information at the level of Articles will have a simple web based forms interface, allowing information to be entered, categorized and related. This component is expected to be based on TopBraid runtime libraries.

2.1.5.3 Query

The query interface will provide a user friendly layer over 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. This component is expected to be based on TopBraid runtime libraries.

2.1.5.4 Upload/Download

The upload/download utility will accept data in any format to provide configuration management and categorization of that data in the repository. Data in supported artifact formats (e.g., EDOC, DRM, BPMN) will be able to be mapped to the knowledge repository Articles 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.

2.1.5.5 Mapping Facility

The mapping facility will implement the generic infrastructure for mapping between ontologies and for import/export of external artifacts in XMI. Note that it is not the intent of this task to define new languages, ontologies or methods for mapping but to provide a framework where multiple ways to define or implement mappings may be used together in support of the OSERA-EKB. The mapping facility will be component oriented and will map import export components to source and target requirements.

Once shared concepts are defined for a language an "adapter" will be developed to map between the XMI representations of each artifact to instances of the shared concept ontology. These adapters will use a "change" approach such that the entire artifact is not mapped each time it is checked into the repository. Only changes to the artifacts will be used. The change based approach serves to keep the external artifacts intact and not require that every model element in the external element need be mapped to an instance of a shared concept (since many concepts are not shared). A change-based integration utilities for diff/merge will be created for XMI and RDF. These resulting changes will be the medium of exchange between shared concepts and artifacts. This will also allow a change in an artifact to propagate to instances of shared concepts which will then propagate to other external artifacts (which are linked to those shared concepts).

A mapping ontology and engine based on shared concepts is a potential follow-on effort.

2.1.6 FEA DRM 2.0, FEA Reference Model Version 2.2, FTF and ITAPC Bricks rendered in OWL

All of the source resources are available in a variety of forms, including human-readable PDFs (in all cases), and various versions of XML in others. In the cases where the information is available only in text (PDF) form, a good deal of the work will involve scraping that information from the text pages and creating an OWL model from it. In all cases, we will work (depending on availability) with the responsible parties for these works to determine the actual intent of the models.

We will make use of any machine-readable artifacts (e.g., XML files) describing these models. In the case of FTF, an XML artifact describing the catalog is available. In this case, much of the information is not model information per se, but data content for the model. We are hopeful that this data will provide a good starting point for a demonstration of the organizational power of an ontology for organizing information for effective browsing and retrieval. For FTF, since the material is already in XML, to the extent possible we will make use of existing TopBraid Composer XML import / transform capabilities to semi-automate the initial construction and population of the associated models.

The FEA will follow a model similar to the one used for the current FEA-RMO ontology, including the use of modeling design patterns to represent constraints among the model parts. A special focus for the FEA modeling will be to do a comparative analysis of difference of the existing FEA-RMO with the current FEA, and decide what needs to be carried over or changed from that version.

Since the DRM includes a meta-description of data, it could be possible to describe this pattern in terms of the shared concepts derived from the DRM, making the FEA model itself compliant with the DRM standards. The DRM also includes notions of controlled vocabulary and thesaurus, so we expect some overlap between the DRM ontology and systems like SKOS expressed using shared concepts. It is our intent to re-use ontologies of this sort whenever possible. We will keep track of these usages to be published as a mapping report between the FEA/DRM/FTF/Bricks models and shared concept ontologies based on the Information Asset Ontology. For DRM, a special focus of the modeling work will be to find out if there are any machine-readable artifacts (XML files, EA files, etc.) for the figures we see in the PDF. We will investigate ways in which they may possibly be mined more systematically.

For ITAPC bricks, the only source appears to be in PPT format, so the bulk of the work will be mining that. Since it is a natural language document, there may be some issues that we will need to address in figuring out the right mapping to TRM and SRM based on what is in there. The ITAPC bricks will require a model of their own to capture things like strategic standard, exception allowed, major system, minor system, and so on. But we anticipate that a large amount of content will be either an extension to or specific data to be mapped to TRM/SRM.

Analysis of the concepts in the FEA/DRM/FTF/Bricks against the requirements for precise and executable architectures and integration of shared concepts will, invariably, result in issues and inconsistencies in these and other specifications. The shared concept ontologies will make a best-effort attempt to resolve those issues and provide a unified, normalized and consistent view of architecture. This synthesized and consistent view will then be mapped to the as-is artifacts. Resolving these issues and providing a consistent and executable view of architecture may suggest changes to the source artifacts (such as the DRM) but this task does not include any of the technical or political process for suggesting such changes.

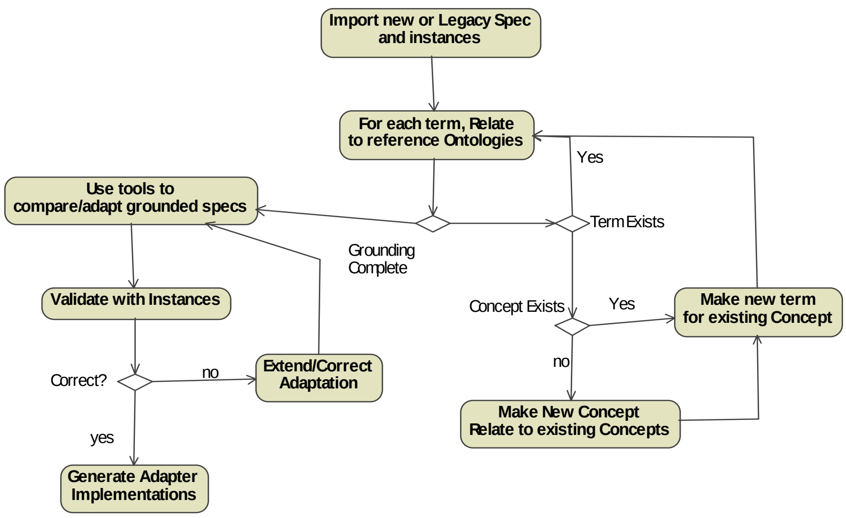
The first part of the FEA/DRM/FTF/Bricks modeling will focus on the specific artifacts while the second phase will focus on integration as shared concepts, below.

2.1.7 Creating shared concepts

Once the concepts of these artifacts have been mined the concepts will be compared with each other and with those in the shared concept hubs from other ontologies. Concepts in the FEA/DRM/FTF/Bricks/EDOC/BPMN and IPM will then be merged with existing shared concepts or will form the basis for new shared concepts in the ontology of architecture. The following is the process for shared concept synthesis:

For each named element in the source ontology or artifact:

- See if the same concept exists in a shared concept hub
- If so, and it is by the same name – use the shared concept
- If so, and it is by another name – make a synonym and use the shared concept



- If not, make a design decision: Is this a candidate shared concept?
- If it is, add the concept and relate it, as appropriate, to existing shared concepts

Domain specific ontologies will then either include or reference concepts from the shared concept hubs, which provides for a better "grounding" of the domain ontologies in these shared concepts and provides the basis for transformation and integration of information.

The diagram on the right shows the workflow of creating and adapting ontologies using shared concepts.

2.1.8 EDOC and BPMN Shared concepts and integration

EDOC and BPMN represent standards based views of architecture that are applicable to GSA. These views each have current specifications that will be used as the basis for creating shared concepts for the ontology of architecture. These concepts will also include input from the FEA/DRM/FTF/Bricks, above. The result will be an ontology, expressed as shared concepts, that defines the common elements of these views such that information can be mapped between them or with other views, such as the FEA or UML (however a UML mapping is not included in this task). Since MDS was involved in both standards and has already created candidate shared concepts in the earlier OSERA work (the Semantic core ontology) we are in an excellent position to define this common core.

These tasks involve creating a synthesis of these views to represent the common underlying model more than creating new concepts or modeling paradigms. However, in creating such a common model, abstractions of these concepts are created to provide the "join point" between them. It is not the intent of this task to create models representing everything in both EDOC and BPMN, but to focus on those concepts that are in the intersection.

2.1.9 Creating the Target Data Architecture

The target data architecture will be created based on input from stakeholders, the DRM and the data architecture methodology used for the OneGSA tasks: Financial Management Enterprise Architecture, Contract Writing as well as the Integrated Portfolio Management (IPM) and Asset Accounting (FMEA-C). The data architecture used in the FMEA tasks is based on UML and has been refined to combine CIM, PIM and PSM views of data. While UML will not be mapped into shared concepts (as per the task order questions), the approach to data architecture used by OCIO will be integrated.

Data architecture as defined in the FEA and the task order includes data "context" and exchange and is thus integrated with SOA concepts as expressed in EDOC and associated UML profiles. For this reason the "data architecture" is, in fact, part of the overall architectural approach used by GSA and the process and collaborations used by GSA contextualize the DRM information assets. The information model of this architectural approach will be defined as the shared concept hub for architecture, the ontology of architecture.

The part of the general ontology of architecture that is data centric will combine three aspects of information:

1. The domain ontology – which defines the general concepts without concern for structure or use
2. The persistence model – defining which concepts will be persisted to support processes, components, services and responsibilities
3. The messaging model – which defines the "interaction" schema, the information that passes between parties to effect business processes, services and collaborations

The domain ontology is the "grounding point" for both the persistence and messaging model where as collaborations and processes define the context for communications and roles define the context for persisted data. The target data architecture will show how these three views are defined and integrated.

2.1.10 Approach, Design and Implementation Guided by the "Roadmap for Semantics in Netcentric Enterprise Architecture"

During the previous phase of OsEra the MDS team researched and prepared a roadmap to guide the development and implementation of advanced concepts for OSERA, titled "Roadmap for Semantics in Netcentric Enterprise Architecture". The roadmap articulates prescriptions and proscriptions directly relevant to concepts advanced by the current proposal, including Articles; the multi-layer OSERA-EKB; the definition, derivation and execution of transformations; the *disciplined* use of an ontology language, e.g., RDF(S) or OWL-DL for representing and managing in a decidable fashion not only domain semantics but importantly *schema and language semantics*, e.g., the semantics of FEA, DRM, EDOC, and BPMN; ontology modularization; browser-based applications for managing deeply heterogeneous artifacts that cross community boundaries and meta-levels, shared concepts; concept lattices; and the productive application to real-world enterprise architecture of formal methods (including Information Flow and IFF, Formal Concept Analysis, and Category Theory). Above and beyond these specific prescriptions and proscriptions the roadmap lays a course by which information systems such as OSERA may grow, change and evolve *on any and all layers* yet achieve interoperability, and remain interoperable with other systems that *evolve independently*. The MDS team's design, development and implementation of the proposed effort will be guided by the roadmap and its developers, helping to insure satisfaction of requirements and laying a foundation for future enhancements.

2.1.11 Demonstration

The MDS team’s approach to OISP emphasizes the integration of information on a common platform. As such the demonstrations of each capability will, in fact, be the same demonstration. This demonstration will show:

- The fundamental capability of OISP to manage information artifacts and knowledge
- Check in/check out of an EDOC model with the integration of that model with shared concepts
- Check in/check out of a BPMN model with integration of that model to shared concepts
- Browsing of architectures in terms of shared concepts
- The user interface for business cases and PMP
- Production of DRM, FEA and FTF artifacts (as defined by existing schema) from the information derived from EDOC, BPMN, Business Cases and the PMP and represented as instances of shared concepts
- Configuration management artifact browsing and display
- A configuration management status report

2.1.12 Base Technologies

OISP will build on and utilize a broad base of open source software which already provides much of the foundational capabilities but need to be extended, configured and integrated to provide a part of the OISP solution. Purpose-specific capabilities will then utilize these base technologies. In addition, TopBriad™[1] Composer will be used for some Ontology editing and user interface requirements.

Technologies we will be building on include:

- RDS triple store and SPARQL Query (specific product TBD after assess/select)
- Reasoning engine(s) (specific product TBD after assess/select)
- Subversion
- Eclipse (IDE, EMF, Web tools, Ant, jUnit, Etc)
- Topbraid Composer and library for ontology editing and user interaction

As part of the process, an assess/select will be done to determine the core semantic web technologies to use. This will include the RDF triple store, SPARQL query and rule/reasoning engines. The primary candidates are Sesame and Jena with consideration given (based on GSA direction) to non-open source alternatives that implement standard interfaces. Semantic Mediawiki will also be considered. The scope of this assess/select will be limited to the purpose of this task and the production of prototype level of functionality. It is not intended as an enterprise or strategic technology commitment.

The OISP project will both build on and contribute to open source projects using the OSERA license.

2.2 The "OneGSA" EA Data Architecture (Information Management)

The data architecture is designed as a view on a set of shared concepts for data modeling implemented in the OSERA-EKB. These shared concepts and view will be derived from the DRM, EDOC, OneGSA, FEA, FTF and common data modeling techniques.

The OneGSA target data architecture will be expressed as a set of shared metadata concepts using RDF & OWL in the ontology of architecture. These concepts will be synthesized from the GSA data architecture as expressed in the current EA artifacts as well as the DRM (Please see 2.1.6 for a description of the DRM mapping process). A two-way mapping will be defined and implemented from EDOC to instances of these shared concepts in the OSERA-EKB and a one-way mapping defined and implemented from these shared concepts to DRM 2.0.

[1] TopBraid is a trademark of TopQuadrant, Inc.

Note that much of the generic work in support of task 2 is defined in task 4.

2.2.1 Task 2 Subtasks and Deliverables

Table 1 – Task 2 Subtasks and deliverables

Task Area	ID	Project Sub Task	Value Delivered	Revs
Architecture	2.1.1	Data Architecture analysis and design	Current state/future state analysis of data architecture with gap analysis and recommendations See also: 2.1.9, 2.1.6	30 60 120
Shared concept hubs and support	2.2.1	Information management shared concept ontology – integration of DRM and GSA data architecture assets	Integrates the DRM concepts into the GSA architectural shared concepts. See also: 2.1.9	90 180
External adapters and shared concept integration	2.3.1	Shared data management concepts mapped and published to the DRM XML structure	Provides link from GSA architectures to DRM See also: 2.1.9, 2.1.5.5	210 240
Deliverables	2.5.1	Target Data Architecture	The target data architecture will be described as an ontology of shared concepts for business entities and properties including data description, sharing and context. See also: 2.1.9, 2.1.4.5	90 210
	2.5.2	Demonstration	By defining the target architecture as part of the OSERA shared concept system and using the OSERA-EKB utilities, definition and use of the data architecture implementation will be demonstrated. See also: 2.1.9, 2.1.10	300
	2.5.3	Shared Concept Implementation	By defining the target architecture as part of the OSERA shared concept system and using the OSERA-EKB utilities, definition and use of the data architecture implementation will be implemented. See also: 2.1.9, 2.1.7, 2.1.4.5	180
	2.5.4	Gap Analysis	The gap analysis will document the difference between the current data architecture used by OCIO and the target data architecture. See also: 2.1.9	150
	2.5.5	EDOC to FEA DRM 2.0 Mapping	The EDOC to FEA DRM mapping is a combination of: 1. The OSERA-EKB (From task 4)	210 270

			2. The EDOC to shared concept mapping (From task 3) 3. The shared concept to DRM Mapping See also: 2.1.9, 2.1.8, 2.1.5.5	
	2.5.6	The "One GSA" EA Data Architecture Whitepaper and Information Model	The white paper will explain the concept of the knowledge repository and the application to data architecture See also: 2.1.9	180
	2.5.7	The "One GSA" EA Data Standards	The data standards and information quality guidelines will show how information should be modeled, documented and related as well as how data schema should be recorded in the repository. See also: 2.1.9	210
	2.5.8	Information Quality Guidelines	The data standards and information quality guidelines will show how information should be modeled, documented and related as well as how data schema should be recorded in the repository. See also: 2.1.9	210
	2.5.9	Transition Strategy Update	The transition strategy update will describe the transition to a federated data architecture based on the standards and guidelines. See also: 2.1.9	240

2.3 The "OneGSA" EA Technology Architecture

There EA technology architecture is designed as view of a set of shared concepts for technology modeling implemented in the OSERA-EKB and expressed in the ontology of architecture. These shared concepts and view will be derived from the "bricks", the FEA and common modeling techniques.

The OneGSA target EA technology architecture will be expressed as a set of shared metadata concepts using RDF & OWL. These concepts will be synthesized from GSA's ITAPC Bricks ("The Bricks"), the Federal Transition Framework (FTF) and the current version of the FEA reference models in W3C's Web Ontology Language (OWL).

The generic OSERA-EKB query and UI utilities will then be used on all EA Technology models.

2.3.1 Subtasks and deliverables

Table 2 – Task 3 Subtasks and Deliverables

Task Area	ID	Project Task	Value Delivered	Revs[2]
Shared concept hubs and support	3.2.02	EA technology architecture ontology of shared concepts integrating GSA's ITAPC Bricks ("The Bricks"), the Federal Transition Framework (FTF) and the current version of the FEA reference models	The GSA architectural framework will integrate the FTF and FEA as first-class concepts See also: 2.1.6, 2.1.7	90 150 210
	3.2.03	Information and EA technology design (with use cases) and implementation for user interface and query	Provides the user-friendly interface to the knowledge base for the FEA & FTF. See also: 2.1.5.2, 2.1.6	180
External adapters and shared concept integration	3.3.01	FEA & FTF mapping to physical artifacts	Provides compliance with OMB requirements and direct integration with standard artifacts for exchange with OMB See also: 2.1.5.4, 2.1.5.5, 2.1.6	210 270
Deliverables	3.5.01	ITAPC Bricks in OWL	The initial version of the bricks in OWL will be as stand-alone concepts while the second version will be integrated with shared concepts. See also: 2.1.6	**30** 120
	3.5.02	FY09 FEA Reference Model	The initial version of the FEA in OWL	60

[2] "Revs" indicates deliverable revisions

		Ontology in OWL	will be as stand-alone concepts while the second version will be integrated with shared concepts. See also: 2.1.6	120
	3.5.03	FTF in OWL	The initial version of the FTF in OWL will be as stand-alone concepts while the second version will be integrated with shared concepts. See also: 2.1.6	60 120
	3.5.04	Ontology Mapping Whitepaper	The whitepaper will provide the fundamental information that someone will need to map to or from one of these models includes two things: • Rationale and interpretation of the constructs in the model. This is primarily an English-language gloss of the concepts in the model • Design patterns used in the models. In order to understand how to map to a model, it is useful to understand how the models were built, and how these patterns allow the models to be extended. Much of this material was learned during the modeling exercise of creating the first version of FEA-RMO. See also: 2.1.6	180
	3.5.05	2 Suitable User Interfaces	The user interfaces will be provided by a custom treatment of the generic OSERA-EKB user interface. The details of these user interfaces will depend on the details of the use cases for the business case, which will be co-developed as part of the work. One candidate is a browser/semantic search engine based on some combination of the models developed as part of this project, e.g., FEA, DRM or FTF. The development of the use cases will involve interviewing ITAPC stakeholders to determine business needs.	210 270

			See also: 2.1.6, 2.1.5.2, 2.1.5.1, 2.1.5.3, 2.1.10	
	3.5.06	Add and Update Use Case Descriptions	The UML models and use cases will describe the add and update operations based on the generic OSERA-EKB capability See also: 2.1.6	120
	3.5.07	Add and Update UML Use Case Model and Diagram	The details of these user interfaces will depend on the details of the use cases for the business case, which will be co-developed as part of the work. One candidate is a browser/semantic search engine based on some combination of the models developed as part of this project, e.g., FEA, DRM or FTF. The development of the use cases will involve interviewing ITAPC stakeholders to determine business needs. See also: 2.1.6	120
	3.5.08	Demonstration	The demonstration will rely on the prototype implementation of the OSERA-EKB as well as the specific EA technology View. See also: 2.1.10	300
	3.5.09	Shared Concept Implementation	The shared concept implementation is derived from the (second stage) integration of the bricks, FEA and FTF as grounded in shared concepts and their implementation in the OSERA-EKB See also: 2.1.6, 2.1.7, 2.1.4.5	120 180

2.4 EA Change and Configuration Management

Change and configuration management is the foundation of the OSERA-EKB and the capability on which tasks 2 and 3 implementations and demonstrations are dependent. As such much of the "generic" work for the project is under task 4. The generic infrastructure and shared concept ontologies are all listed under task 4, but will be used by tasks 2 and 3.

Change and configuration management is provided for as a fundamental capability of the OSERA-EKB. The OSERA-EKB utilities provide the "self-service EA artifact inventory publication and display service" as well as the knowledge repository based on shared concepts describing architecture.

2.4.1 Subtasks and deliverables

Table 3 – Task 4 Subtasks and Deliverables

Task Area	ID	Project Task	Value provided	Revisions
OSERA-EKB and generic capabilities	4.1.00	Architecture, approach and resolution of design decisions by expert design team. (Three face-face meetings plus interim virtual meetings)	Create a balanced approach between tactical and operational capabilities and strategic intent by considering some fundamental design questions with an expert group. In a series of face-face and virtual sessions resolve these issues to provide guidance for the project implementation. See also: 2.1.1	30 90 150
	4.1.01	Systems architecture and component model. Design and model the systems architecture of the OSERA-EKB down to the component model level with use of MDA automation where practical.	Provides an implementation design for use in implementation, automation and communications within the team. Provides as-built documentation for follow-on efforts. See also: 2.1.1, **Error! Reference source not found.**	30 90
	4.1.02	OSERA-EKB Layer one and 2 design & software development & link with RDF triple store	Provides the ability to manage information assets augmented as well as the basis for the "self-service EA artifact inventory publication and display service". This task will define and implement the software for configuration management and its link to the ontologies. See also: 2.1.4.1, 2.1.4.2	90
	4.1.03	Semantic web infrastructure assess/select and integration	As the OSERA-EKB and domain level capabilities are built on a semantic web infrastructure, the choice of standards base infrastructure components is important. Primary selection criteria will be performance and fit to the capabilities defined for these components. This task will select the infrastructure. See also: 2.1.1, 2.1.12	60
	4.1.04	Layer 2 Asset categorization, Context, provenance, dependencies and location shared concept ontology	Layer two is an ontology focused on the management of knowledge assets. This ontology helps to categorize those assets, define their context, dependencies, provenance, history and location. The result is an ability to capture, manage and analyze artifacts and knowledge.	60 90

			The layer two ontology describes the artifact or Article – it is know the knowledge it's self. This task will define and implement this ontology. See also: 2.1.4.2	
	4.1.05	Layer 3 Article management and infrastructure	While layer one and two focus on "artifacts", layer three focuses on more granular "bits of information" that may come from and effect many artifacts and views. This information is organized into "Articles" – each focusing on a particular topic from a particular perspective. Articles are modular ontologies that contain instances of shared concepts. This task will define and implement layer 3. See also: 2.1.4.3	60 120 180
	4.1.06	Layer 4 concept hub system and supporting shared concept ontology and support for Views	This task will define and implement shared concept hubs and the support for views on those hubs (as artifacts or user interfaces). See also: 2.1.4.4	90 150
	4.1.07	Layer 5 - Shared metadata concept hub, ontology of shared concepts for defining shared concepts	This task will bring together the concepts of FEA/DRM/FTF/Bricks/BPMN and EDOC into a set of shared concepts representing an ontology of architecture. This ontology will represent the "grounding point" for these external views. See also: 2.1.4.5	90 120 150
	4.1.08	RDF-RDF mapping, transformation and import/export – generic capability	This task will define and implement the generic infrastructure for mapping between ontologies and for import/export of external artifacts in XMI.	90 150 210
	4.1.09	Extended Knowledge Asset Support & OWL-DL	OSERA-EKB will provide a framework where logics other than that used for the shared concepts may augment shared concept definitions. This task will provide the "hooks" for these other logics as well as demonstrate that hook for OWL-DL. See also: 2.1.4.6	240
	4.1.10	OSERA-EKB Browser, UI and Query Utilities	These end-user based utilities will provide the casual user with no ontology background with the capability to publish and query information in the knowledge base as well as use purpose-specific user interfaces (such as the 2 provided in OISP).	150 210 300

			See also: 2.1.5	
	4.1.11	XMI & RDF Diff/Merge	Provides the ability to integrate the EKB with external artifacts based on changes rather than full replacement. See also: 2.1.5.4, 2.1.5.5	90 150
Shared concept hubs and support	4.2.01	Shared concepts and View for architecture (EDOC and BPMN)	This task will develop the shared concept ontologies based on EDOC and BPMN. See also:2.1.8, 2.1.7, 2.1.4.5	90 150
External adapters and shared concept integration	4.3.01	Two way integration with EDOC	This task will develop the adapter to and from EDOC as represented in XMI. See also: 2.1.8, 2.1.5.4	180 240
	4.3.02	Shared concept from and two way integration with BPMN	This task will develop the adapter to and from BPMN as represented in XMI. See also: 2.1.8, 2.1.5.4	180 240
Deliverables	4.5.01	Dynamic Change Management PIM-level UML Component Model	This task produces the component model of the OSERA-EKB produced from the design effort. See also: 2.1.4.1, 2.1.4.2	30 60
	4.5.02	Dynamic Change Management CIM-level BPMN Process Model	The process models describe the business processes that will be utilizing OSERA-EKB. Many of these process models are in or will be derived from the IPM project. See also: 2.1.4.1, 2.1.4.2	60
	4.5.03	Dynamic Change and Configuration Management Whitepaper	This paper will describe the business case for and use of the OSERA-EKB See also: 2.1.4.2	240
	4.5.04	Dynamic Integration and Round Trip Translation of a PMP Strategic Assessment and a GSA Executive Business Case	This capability will be realized as a user interface and View of the OSERA-EKB for the purpose of PMP and business case management. See also: 2.1.6, 2.1.5.2, 2.1.2	270
	4.5.05	Shared Concept Implementation	The artifacts of IPM (and others as supplied) will be utilized to create the shared concepts for a PMP Strategic Assessment and a GSA Executive Business Case. See also: 2.1.2, 2.1.7	210
	4.5.06	Demonstration	The demonstration will use the OSERA-EKB to demonstrate the implementation. See also: 2.1.10	300
	4.5.07	BPMN Realization in Formal Language	As BPDM is now adopted as the meta model for BPMN this will be used as the basis to produce an OWL representation as shared concepts. See also: 2.1.8	210
	4.5.08	Two-way mapping	The two-way mapping will be provided by	240

		between EDOC and BPMN	the basic capabilities of the OSERA-EKB combined with the BPMN and EDOC mappings. See also: 2.1.8, 2.1.5.5, 2.1.5.4	
	4.5.09	Configuration Management Status Report Service	Configuration management and status will be a report derived from a query on the layer 2 ontology, which describes all of the information assets in the OSERA-EKB. See also: 2.1.4.2, 2.1.5.3	270
	4.5.10	EA Artifact Publication and Display Service	This capability will be provided by the OSETRA-EKB utilities. See also: 2.1.4.2, 2.1.5.3, 2.1.5.1	270

2.5 Technical Assumptions

2.5.1 Sizing

Total size of triple store will be less than 10m Triples for prototype.

2.5.2 Completeness

All software is developed to the level of an operational prototype and demonstration. Completing such a prototype to the level of an operational capability will require a follow-on effort.

2.5.3 Open source

While the core capability will be open source, some of the utility functionality may utilize Topbraid composer and its runtime library as is allowed for based on the response to questions.

2.5.4 Scope of assess/select

The scope technology assess/select will be limited to the purpose of this task and the production of prototype level of functionality. It is not intended as an enterprise or strategic technology commitment.

2.5.5 Stakeholders

GSA will identify the stakeholders for each task requiring stakeholder analysis and coordinate access to those stakeholders.

2.5.6 Security

As a prototype capability, security is not a requirement.

[1] Semantic Web - http://www.w3.org/2001/sw/
[2] Roadmap - http://osera.modeldriven.org/documents/Roadmap%20for%20Semantics%20in%20Netcentric%20Enterprise%20Architecture.pdf
[3] RDF – Resource Description Framework (http://www.w3.org/RDF/)
4 Simple Knowledge Organization Systems (SKOS) - home page
[5] RAS – Reusable Asst Specification (http://www.omg.org/technology/documents/formal/ras.htm)
[6] Wikipedia - http://en.wikipedia.org/wiki/Wikipedia
[7] OMG MOF - http://www.omg.org/technology/documents/formal/MOF_Core.htm
[8] Open World Assumption - http://en.wikipedia.org/wiki/Open_World_Assumption
[9] Wordnet - http://wordnet.princeton.edu/
[10] Cyc – www.cyc.com
[11] Dolce - http://www.loa-cnr.it/DOLCE.html