OpenSG Enterprise Information Management

Requirements Specification

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# Introduction

The flow or exchange of energy in a physical system organizes that system.

The flow or exchange of information serves to organize social systems. An enterprise is a social system. The boundaries of an enterprise are flexible and permeable with respect to information. For the purposes of this document an enterprise is defined as a public, private or government corporation whose primary line of business is some or all of the following: generation, transmission and distribution of electric power. These enterprises design, build and operate physical systems to control the flow of energy. The requirements in this document may be applied to a major part of such an enterprise or the entire enterprise.

It is practically impossible to separate an enterprise from the information it creates and consumes. To manage the information from an enterprise perspective is to maximize the efficiency and effectiveness of the enterprise. While information is often referred to as an asset like people, money, facilities and equipment it is more multidimensional as it is the asset used to manage the other assets. Not only is information multidimensional it is abstract. Financial assets are also abstract but we have hundreds of years of experience with their management. Such experience is in a way experience with managing information of one type. “Wall Street” has shown more than once that there is still a long way to go in perfect management of those abstractions. We have only about 50 years of experience in managing automated information. Its abstract nature and multidimensionality makes information hard to understand and manage.

Management of an asset requires having information about the asset and in most cases a model of the asset; this model may be mental or physical. For instance we have information systems to manage people, facilities, equipment, power flow, etc. Each one of these systems is a model of the asset. Managing any asset requires modeling its behavior and applying abstractions to it, e.g. categories, rankings etc. This is no less true for managing the information asset.

The difficulty comes from the need to have a model of the asset which in the case of information means we must have an abstract representation (model) of what is already abstract.. This fact often leads accusations that such efforts are “pie in the sky”, “metaphysics”, “irrelevant academic exercises” or “hopelessly complicated”. Certainly some efforts in the past that have tried to address information management from a broad perspective have deserved those disparaging labels. However, experience with such efforts and those of more modest scope have led to a body of knowledge accompanied by increasingly sophisticated tools which make the success of an Enterprise Information Management effort much more likely to succeed.

So, if an enterprise cannot be differentiated from the information that is its lifeblood, the impulses of its nervous system, how can a large enterprise dependent and socially organized by information exchange be managed without tackling an enterprise wide approach to the management of its information? Without enterprise information management the social fabric is fragmented and at best the enterprise is not optimally organized and coordinated and at worst it is dysfunctional or schizophrenic.

## Purpose

The purpose of this document is to provide both the functional and technical requirements needed to serve as the framework for how to develop and support an Enterprise Information Management (EIM) approach within a Utility. The focus of the EIM task force is the information among systems and/or applications to enable Smart Grid business processes across the enterprise.

## Scope

The scope of this effort is to examine the current state of enterprise information management (EIM) within the utility industry. This includes best practices, …

 document intends to capture data from information sharing sessions and combine them to form an overall view of the nature of EIM across utilities that participate in the OpenSG Task Force. Once the current state of EIM is assessed, an expression of the desired future state will be constructed. Based on the delta between the current state and the future state, an industry gap analysis will be constructed to identify areas for work specifically along the lines of semantic management, information services, Big Data, and data movement. Once this gap analysis is constructed a generic road map and generic project success factors will be included in this document to help EIM Task Force members in identifying successful project and program candidates. Finally the issue of how the EIM strategy development and implementation exists cooperatively with a standard industry Waterfall SDLC will be addressed to demonstrate how the two concepts mutually support and reinforce each other.

This excludes the use of specific technologies, detailed process flows

## Acronyms and Abbreviations

This subsection provides a list of all acronyms and abbreviations required to properly interpret the Consumers AMI Grid-Apps System Requirements Specification.

|  |  |
| --- | --- |
| SRS | Requirements Specification |
| SOA | Service-Oriented Architecture |
| ESB | Enterprise Service Bus |
| SDO | Standards Development Organization |
| CIM | IEC TC57 Common Information Model  |
| TOGAF | The Open Group Architecture Framework  |
| UML | Unified Modeling Language |
| DDL | Data Definition Language |
| XSD | XML Schema |
| WSDL | Web Services Definition Language |
| ESM | Enterprise Semantic Model |
| ETL | Extra, Transform, Load |
| EDI | Enterprise Data Integration  |
| EII | Enterprise Information Integration  |
| CEP | Complex Event Processing  |
| BI | Business Intelligence |
|  |  |

## External Considerations and References

The work of EIM RS is dependent upon the best practices available from the following entities and standards organizations:

## Document Overview

The Enterprise Information Management (EIM) Requirements Specification is meant to be a general guide representing some level of consensus within the utility industry. The intent is to provide clarity of direction for a utility implementing an Enterprise Information Management strategy, especially in the following areas:

* Metadata selection and management
* Information management
* The relationship between information architecture and application architecture
* The relationship between information management and application management

In order to meet these goals, the document is structured based on the EIM framework below:



**Section 2** describes the vision and strategy and what issues can be resolved through the application of EIM.

**Section 3** describes requirements for EIM governance.

**Section 4** describes requirements for EIM core processes.

**Section 5** describes requirements for EIM organization.

**Section 6** describes requirements for EIM infrastructure.

**Appendix A** contains abstracted business processes that are intended to be facilitated by this EIM Framework.

# EIM Vision & Strategy

## Vision

There is an inventory of information that exists at multiple levels of abstraction from general topics to operational data elements.

This inventory is based on a semantic model of the enterprise, possibly multiple harmonized models.

This inventory details life cycle, quality, timeliness and volume characteristics.

The inventory specifies security and privacy characteristics.

This information inventory is related to business processes, business goals, business initiatives, applications and technology infrastructure. thus illustrating its behavior in support of the enterprise and in digital form.

Information ownership, stewardship and trusteeship is clearly delegated at the proper levels within the organization and such responsibilities are part of the cultural norm.

Each fact of interest to the enterprise has authorized source and system or record.

Type of source is not restricted to traditional application systems but includes embedded, sensor, mobile and emerging data sources.

Multiple representations of the same fact are standardized where possible and harmonized in definition, identification and values.

Multiple locations of the same fact are known and tracked.

With the above functionality in place the enterprise knows:

* Which data is the most trustworthy
* Which data is best for any given decision
* Who is responsible for each information object
* How to explore data to discover improvements in operations
* What data is supporting the most critical and valuable decisions
* The operational health of the enterprise in real time
* The level of dependency on data suppliers
* The impact of technology changes on information availability, quality and use
* The impact of changes in business goals, process and initiatives on information needs
* How to reduce and rationalize the number of application systems needed
* How to reduce and rationalize system interfaces
* How to effectively consolidate and integrate data for analysis and to support new uses

In other words the enterprise will have much more coherent self knowledge because the information about its information is visible and understandable. there will be many more “known knowns” and many less “unknown unknowns”..

## Mission

Implementing a “Smart Grid” is a complex matter that requires a holistic approach, chief among them is the ability for utilities core operational systems to interoperate both internally and externally in real time such that adverse events can be better managed to avoid catastrophic consequences. In an increasingly compliance-driven and competitive utility industry, information must be treated as a vital resource. Utilities must strive for information transparency, governance, quality, market compliance and fidelity. EIM frameworks and strategies provide a clear roadmap for utilities to establish the necessary governance and technology solutions. EIM is not only complementary to Service-Oriented Architecture, but also enable the convergence of operational technology (OT) and information technology (IT), which are key to the successful realization of a Smart Grid.

The mission of the EIM Task Force is to provide user group members with a jump start in addressing these challenges through their Enterprise Information Management (EIM) initiatives. Member companies will be incorporate EIM Task Force deliverables - requirements, use cases, a framework, guidelines, lessons learned, etc. - into their internal (SDLC) processes. Doing so will provide a context and mechansims for automomous projects to accomplish their mission while simultaneously contributing to enterprise information management objectives.

## Strategy

The strategy for this task force is to act as a clearing house and sharing environment for Enterprise Information Management. It is understood that every organization will develop different policies to support the EIM implementation. However there are some key themes and commonalities for which this task force can act as a common information exchange: semantic management, information services, Big Data, and data movement.

Semantic management as it applies to this task force concerns itself with working through the process to provide guidance to participating utilities and vendors on the construction of semantic models. As part of the semantic model construction each organization will need to determine the relevance of each information standard and apply it to internal data structures. Every organization is unique, and as such one semantic model will not necessarily work for the whole organization. The strategic goal of the task force in this instance is to outline general patterns for constructing a semantic model and implementing semantic management to support the implementation and continuance of an Enterprise Information Management strategy.

Information services refers to the processes to establish, maintain, and use reusable data services and aggregation services to provide consistent access to data elements throughout the organization. The EIM Task Force will act as a marketplace of ideas to assist in the development of patterns around the construction of data services and aggregation services. Topics that may be included in this would be the data services associated with sources of data vs. data services associated with authorized data copies. Every organization may have a unique architecture, and the intent is to express patterns that would work in a wide variety of architectural frameworks.

Big Data is a topic that has the potential to impact a number of data and information constructs within the organization. As stated before the intent is allow EIM Task Force members the ability to confer and discuss different strategies with each other and discuss how particular implementations of the Enterprise Information Management strategy enhance or detract from the implementation of Big Data implementations.

Finally data movement is concerned with moving data from one store to another through a variety of vehicles. Data movement has an impact on several components governed under an EIM strategy. The strategic intent of the EIM task force is to discuss the different data movement patterns and how they do or do not support an EIM strategy.

## Goals & Objectives

Enterprise Information Management has been described as a fusion of Business Intelligence (BI) and Content Management (ECM) from an enterprise perspective. In essence, it is a strategy to overcome information silos while simultaneously addressing the ever-increasing avalanche of data spreading through an organization.

EIM offers an enterprise several important, and valuable, business advantages:

1. Operational Efficiencies – it can minimize the “wheel reinvention” syndrome by allowing re-use of existing successful (and well-understood) data processes
2. Transparency – data can be more easily shared while retaining proper data access since all enterprise data is under a single EIM governance mechanism
3. Better Business Insights – information sources are vetted, decision risks are minimized by EIM data consistency and trustworthiness mechanisms, assets can be better managed, etc.

At a high level, the goals of EIM are to maximize:

1. Data Accuracy
2. Data Integrity
3. Accessibility
4. Security

These goals are typically pursued by attacking the following related objectives:

1. Information Reliability – grading information content and sourcing can promote the goals of Data Accuracy and Integrity
2. Safety – industrial and personnel safety are closely associated with asset management, business security, information accessibility, timeliness and reliability. Again, this objective can be used to improve the high-level EIM goals listed above.
3. Compliance – legal and political forces upon the enterprise require it to comply with a number of regulations and commitments. The EIM goals are important to all compliance objectives at any enterprise.
4. Energy Market Price Integrity – wholesale energy markets are becoming increasingly crucial to the well-being of all citizens, which means the basis for market pricing will receive greater scrutiny from local, state and federal regulators. Utilities therefore should expect to be pressured to justify their pricing models in detailed submittals to these agencies. The EIM goals can be advanced during efforts to meet this objective.

Finally, as the EIM goals may conflict with each other in a particular context, a primary EIM objective is to install enterprise governance mechanisms to resolve data definition, format, content, and security issues across applications and business processes. This mechanism can also be leveraged to advance the EIM goals themselves by thoroughly documenting these resolutions to allow them to be applied consistently in similar future situations.

An important strategy to pursue in support of the governance objective is to encourage decoupling important data from the source application(s) creating and using the data. This can often be very difficult as it requires application architects and designers to shift their thinking from programming-centric logic toward a more data-centric point of view.

## Value Proposition

## Information Management Challenges

Some of the challenges that utilities are seeking to address through the deployment of an Enterprise Information Management strategy are listed below.

* Large volumes of data are coming in from different sources.
* Utilities do not have strategies in place to manage the data volumes and make it actionable.
* Information management strategies are fragmented by application and by business unit.
* Multiple competing sources of record exist within many utility organizations.
* As processes become more real-time, they are negatively impacted by lack of data consistency.
* Utility IT is currently a cost center, and it needs to transition to an enabler of business transformation.
* IT is missing a holistic strategy and approach to manage data and information as assets across business silos.
* Business units struggle to get the right information at the right time.
* Need to coordinate with major vendors to bring vendor participation into EIM efforts
* Need to understand the EIM issues around large capital systems
* Very little unified view into security view of the organization
* The level of churn and change in the utility is unprecedented, and utility organizations may not be in a position to accommodate that change
* Organizations need to be taught the concept and value of compatible change
* Business models do change over time and IT architectures will need to adapt accordingly
* Projects will push back on the cost of integrating EIM activities
* Functions are duplicated with multiple applications
	+ BI
* In the current environment, best practices are often not shared or enforced within the organization
* Fragmented and outdated integration patterns increase costs
* Data is inconsistent within the organization

## Business Value

This is what EIM will give us as an output from the Task Force activities.

As with any investment, a utility employing an Enterprise Information Management strategy will engage in the effort with goals and objectives in mind. Some of the goals and objectives along with expected future value are listed below:

* Structure the data to create actionable information.
* Consistent data management across the entire IT infrastructure.
* Clear articulation of sources of data, authorized copies, and working copies.
* Processes supported and governed by accurate enterprise data.
* The deployment, governance, and status of financial resources, human resources, and material resources is made visible through data. Data is therefore treated as a vital business asset throughout the enterprise.
* Combining data from different contexts into a unified view creates useful and actionable information relevant to the business.
* Manage operational security
	+ Implement and enforce security policies
* Reduction in application dependency
* Provide a single version of the truth
* Provide integrated reporting and analytics based on the single version of the truth
	+ May also lead to a reduced number of reports needed
	+ Reduces the need for multiple BI systems
* The ability to take a larger view of data and manage it independent of applications
* Develop holistic Information Management capability
* Compliance with OpenADE recommendations and FERC regulations
* Understand which technologies to use in what situations
	+ Also manage the need for and deployment of exceptions
	+ Take advantage of new technologies and phase out old ones in a strategic manner

# EIM Governance

## Sponsorship

This establishes the business and IT executive sponsorships that are required to ensure proper support, buy-in, and success of EIM program. Sponsorship can include a steering committee with members from business and IT with specified decision-making roles and responsibilities.

## Stewardship

This establishes the data and information ownership (stewardship) structure, policies and procedures, and relationships to organization functional and process roles and responsibilities.

## Policies, Principles and Tenants

This provides the essential policies, principles and tenets for what EIM is and how EIM will be conducted and enforced with business/IT functions and programs.

NISTIR requirements that may have an impact in this space are the following:

* Access Control and Policy Procedures (SG.AC-1)
* Remote Access Policy and Procedures (SG.AC-2)
* Account Management (SG.AC-3)
* Information Flow Enforcement (SG.AC-5)
* Separation of Duties (SG.AC-6)
* Least Privilege (SG.AC-7)
* Use of External Information Control Systems (SG.AC-18)
* Publicly Accessible Content (SG.AC-20)

## Alignment

This provides the structure, relationship, policies and procedures necessary to align EIM vision and strategy with business vision and strategy as well as enterprise architecture goals and objectives. Alignment with major programs is a critical part of this component.

## Reference Model

This provides the overall governance reference model of the EIM program, and includes the reference architecture model showing the key components of EIM capabilities and services, which provides the foundation for alignment analysis and recommendations.

# EIM Core Processes

## Data Quality

Processes to identify, analyze, improve, and measure the data quality issues and improvement efforts.

Note: Many organizations tend to focus on data quality within an application. The EIM Framework focuses on data quality within the entire organization.

## Data Integrity

Processes to identify, analyze, improve, and measure the data integrity issues and improvement efforts.

Note: The EIM Framework seeks to optimize data integrity within the entire organization which may differ in focus from optimizing data integrity for a domain or even an application.

## Data Security and Protection

Processes to ensure the protection, security, and management of corporate data and information according to the corporate policies and regulatory mandates.

## Data Lifecycle Management

Processes to govern how to create, classify, update, use, distribute, and archive, and obsolete data and information, for new projects as well as ongoing maintenance.

Note: Many organizations manage the data lifecycle on an application by application basis. The EIM Framework works to ensure that the data lifecycle is managed both within an application but also across different applications in a unified manner.

## Data Movement

Processes to identify and guide how data should be managed when they are moved around the enterprise and Line of Business systems, applications, and data files.

## Semantic Management (Definitions, Metadata, Models)

Processes to establish, manage, and use the business and IT semantics (that is business terms and definitions, metadata management, enterprise semantic models management, semantic integration etc.)

## Database Management

Processes to manage the physical corporate databases and data files.

Note: Most organizations have processes to manage individual databases. The next level of database management is to implement processes that enable management across a database infrastructure and governs multiple instances.

## Master Data Management

Processes to manage the creation, maintenance, distribution, and usage of corporate master and/or reference data entities to support business processes and business transactions with the objectives of improving data quality and integrity, improving data and information accuracy, and reducing process inefficiencies.

## Information Services

Processes to establish, maintain, and use actual data and aggregation services in the form of reusable software components for business systems and processes to share and leverage data and information across both transactional and analytical needs.

## Services and Support

Processes for the EIM program and/or organization to provide functional services and support to the rest of enterprise IT and business organizations and projects.

# EIM Organization

## CSF & KPI’s

Critical Success Factors and Key Performance Indicators to be established for the EIM organization or program to be measured.

[Note: Need to tie the KPI back to the value prop.]

## Structure

The EIM organizational structure internally and externally, with focus on not only how it is organized internally but also how it interacts with external stakeholders and users of EIM services.

## EIM Competency Center

The following tasks are key execution steps that any Enterprise Information Management Competency Center must undertake in the process of laying out the EIM strategy.

1. Identify key existing information management architectures and technologies
2. Identifying key future information management architectures and technologies
3. Identifying information management architectural options and proposing architectural solutions

## EIM Implementation with Governance

While the EIM Governance process is critical in the business jointly identifying how the EIM should be constructed, what should be in it, and how it impacts the daily activities of the organization, the ability execute and implement the agreed upon EIM is also key.

The implementation and modifications to an EIM need to be managed very similarly to the way that an organization would manage a business process modification or a major software project. The impacts of the changes can be far reaching and will most likely be implemented as part of a strategic or capital project. The implementation of the EIM begins with the approval of a business case in which specific Enterprise Information Management enhancements are quantified as key goals of the project.

Key to implementing an organizational Enterprise Information Management competency is ensuring traceability from the strategy to the requirements to the implementation method. Without this traceability the organization may spend resources developing a strategy that is never implemented. EIM as asset that a utility thought it had created will not be developed as an asset. The resources used to create the strategy will represent a sunk cost with no opportunity to meet the stated objectives required to demonstrate a payback from the implementation of an Enterprise Information Management strategy.

## Roles & Responsibilities

Roles and responsibilities of every position within the organization.

## Key Responsibilities in the EIM Competency Center

Data and content architecture and management

Data development

Data quality management and auditing

Information planning and management

Master data management and reference data management

Metadata management

Integration services management

Data implementation management and support

Database operations and management

Document and content management

Data and information security management

Coordination with data warehouse and business intelligence planning

Coordination with data warehouse and business intelligence implementation

Coordination with data warehouse and business intelligence support

## Business Value & Relationship Managements

How will the EIM organization manage the relationship with business and IT to ensure that business value is delivered and measured in accordance with the CSFs and KPIs established?

# EIM Infrastructure

## Information Architecture Blue Print

This is to establish and maintain the enterprise information architecture blue print to ensure its viability and relevance to Enterprise Architecture and the rest of the IT core competencies.

## Knowledgebase and Repositories

A knowledgebase of EIM best practices, methodologies, architecture patterns, design models, implementation guidelines, IT lifecycle management related to data/information, etc. Also calls for a repository of metadata and enterprise semantic models.

## Technologies

A portfolio of technologies required to provide basic and advanced EIM services.

*(James to provide inputfor this sections in coordination with Henry, who will work on the other side of the coin by describing core processes for the previous section) Categories/IRM type of breakdown (abstract functionality and not products)*

*[Directory Services*

*Service Repository*

*ESB*

*CEP*

*EII*

*LDAP (Identity and role management)*

*Data Modeling*

*Content / Data Management (Structure & un-structured)*

*Mash-up services*

*Knowledge representation language (relationships, concepts)*

*Security services and key management*

*Master Data Management*

*Data Quality*

*Data Profiling]*

## Knowledgebase and Repositories

A knowledgebase of EIM best practices, methodologies, architecture patterns, design models, implementation guidelines, IT lifecycle management related to data/information, etc. Also calls for a repository of metadata and enterprise semantic models.

## Standards & Best Practices

(Jim to provide some initial content – include clarification of why a given standard is relevant to an EIM practice) Standards and best practices that an EIM program adopts or develops to ensure efficient and effective services of EIM functions.

## Standards

*[Multispeak*

*NIST Conceptual Model*

*SGIP CoS*

*IEC TC 57*

 *61850*

 *61968*

 *Part 100 (bp and standard)*

 *61970*

 *62325 (Markets)*

*IEC 11179 Metadata classification schemes*

*IEC SC65 IEC 62541*

*TOGAF (ADM) (BP)*

*OAG*

*OGC*

*SEP 2.0*

*ESPI Interface*

*UML*

*OWL]*

## Best Practices

Implement EIM on a project by project basis, not using a “Big Bang” approach.