

An Oracle White Paper in Enterprise Architecture  
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# Revitalizing Your Information Architecture Initiative

An Architect's guide to the National Information Exchange Model

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## Executive Overview

The U.S. Government is perhaps the single largest supplier of data in the world. However, despite over six hundred billion dollars in Federal information technology expenditure over the past decade (<http://www.itdashboard.gov/faq-public>), much of this data remains locked away in agency stovepipes with little in the way of discernable integration standards, common data governance processes, or common data management processes.

These information system stovepipes are largely the result of independent agencies operating for many years in silos, without centralized IT oversight and without adherence to common information architecture principles.

Enterprise Architecture programs such as the Federal Enterprise Architecture (FEA) Program defined by the Federal CIO Council help to address some of these issues but tend to be disconnected from the real world architectures that execute business processes and realize business goals.

Meanwhile, information exchange standards provide more direct business benefit but are typically implemented in a very tactical manner, generally focusing on compliance and doing little to advance longer-term goals.

Oracle believes that greater positive impact can be achieved with a more agile and iterative approach to Enterprise Architecture combined with a more strategic outlook on information exchange standards. Further, Oracle believes such an approach can help to achieve dramatic and enduring benefit for agency business performance and can ultimately serve to break down government information stovepipes.

## Introduction

According to the IDC in their latest annual study of the digital universe entitled *Extracting Value from Chaos*, the world will in 2011 create 1.8 zeta bytes of data (1.8 trillion gigabytes), nearly double what it was in 2009 and nine times greater than the number for 2006. This explosive growth presents huge IT challenges especially for corporations where information architecture is highly segmented, lacking standards, or dependent on aging components. As a result of these challenges, organizations spend billions of dollars in managing their Information Technology instead of focusing on their core business challenges.

In contrast, modern, standards-based information architecture provides readily accessible, secured, trusted information that enables business performance and dramatically lowers costs.

Proof of this can be found in numerous case studies of government organizations embracing IT modernization. For example, the Nationwide Suspicious Activity Reporting Initiative, created to ensure timely sharing of information that may be indicative of planned terrorist attacks, successfully implemented evaluation environments at 14 federal, state, and major city fusion center sites over a twelve month period. The initiative proved that the combination of standardized best practices, functional training, and technology can significantly improve the quality and timeliness of public safety and security information sharing programs. Refer to [http://www.ijis.org/docs/success/case\\_study\\_nsi\\_jun2010.pdf](http://www.ijis.org/docs/success/case_study_nsi_jun2010.pdf) for additional information.

This paper is intended to assist the reader in devising their own success story through improved information architecture. In particular, this paper will assist the reader in evaluating information exchange standards such as the National Information Exchange Model (NIEM) as a means to revitalize information architecture initiatives. Following are the key topics covered:

- The Business Challenge
- The Solution Framework
- Picking a Starting Point
- Applying Best Practices
- The Case Study

## The Business Challenge

If the case studies that come to mind for your organization don't stack up against the success story presented above, your information architecture may be a trouble spot. While pinpointing specifics can be tough, determining whether there is a basic need is really pretty easy using the below subjective measures.

- The degree to which data, application, and business process consumers have **trust in data**;
- The **efficiency of business processes** that are consuming your organization's data; and
- The **perception of data value** in your organization.

In all likelihood, if you feel data is not trusted, processes are inefficient, or data value is not realized, your Information Architecture needs help.

To go a bit deeper in your analysis, more detailed indicators are needed. Following are additional detailed indicators that Information Architecture needs a boost.

- Modern channels for *information sharing and delivery* (e.g. wikis, portlets, blogs, Enterprise Search, eDiscovery) either don't exist or are poorly used.
- A modern foundation for *analytics and reporting* either does not exist or conversely, there are numerous tools and it is unclear when to use which.
- Essential facets of *Data Management* such as common vocabularies, data stewardship, data quality tools and processes, data lineage tools and processes, master data management, records management, and content management are either missing or not used properly.
- *Data Integration* consists of point-to-point interfaces with significant duplication of data and little or no relation to a service-oriented-architecture.
- There is no consistent set of standards applied to *information modeling*, models are out of date, or models are not centrally located.
- There are operational incidents traced to physical and operational aspects of *Database Management* such as database administration, storage management, or data backup and recovery.
- Indicators of poor data *information governance and lifecycle management* such as significant duplication of data across databases, conflicting reports for same data, unmanaged metadata, and lacking archival schemes.
- Operational incidents or audit alerts related to poor or inconsistent *Information Security* practices or infrastructure.

## The Solution Framework

With the problem context established, a solution framework must now be adopted that can help to elaborate tangible, achievable business goals and align people, process, and IT to meet those goals.

Oracle provides an Enterprise Architecture (EA) Framework that is ideally suited to this purpose. An Oracle EA framework and architecture development process will ensure that a structured approach is used to evaluating potential solutions and that related architecture domains (e.g. business, application, information and technology) are considered in tandem to fully consider potential benefits and risks. The Oracle Enterprise Architecture Framework is illustrated in Figure 1 below.

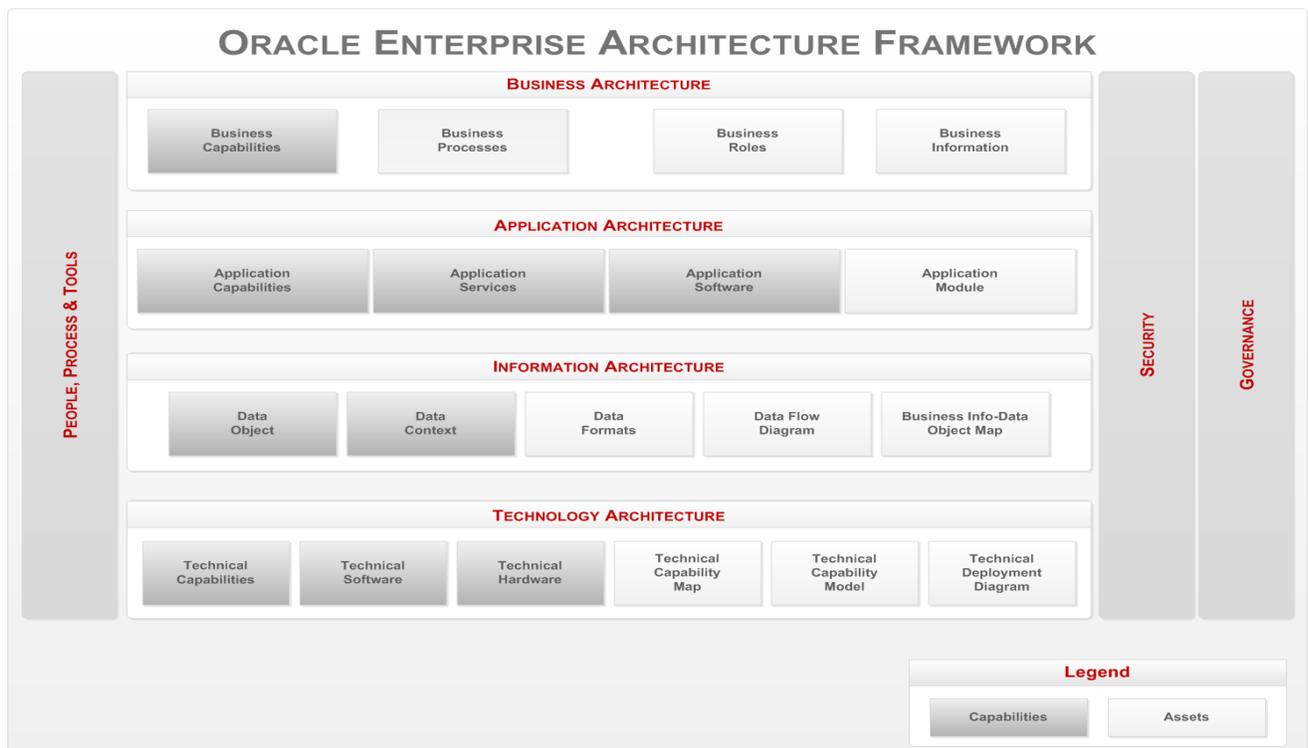


Figure 1: Oracle Enterprise Architecture Framework

Within the EA framework, Information Architecture is elaborated to ensure that all relevant subject areas are considered. This gives useful context to discuss various aspects of a revitalization effort and to evaluate products and standards and their potential impact. Oracle's Information Architecture Reference Model is illustrated in Figure 2 below with descriptions for each subject area following.

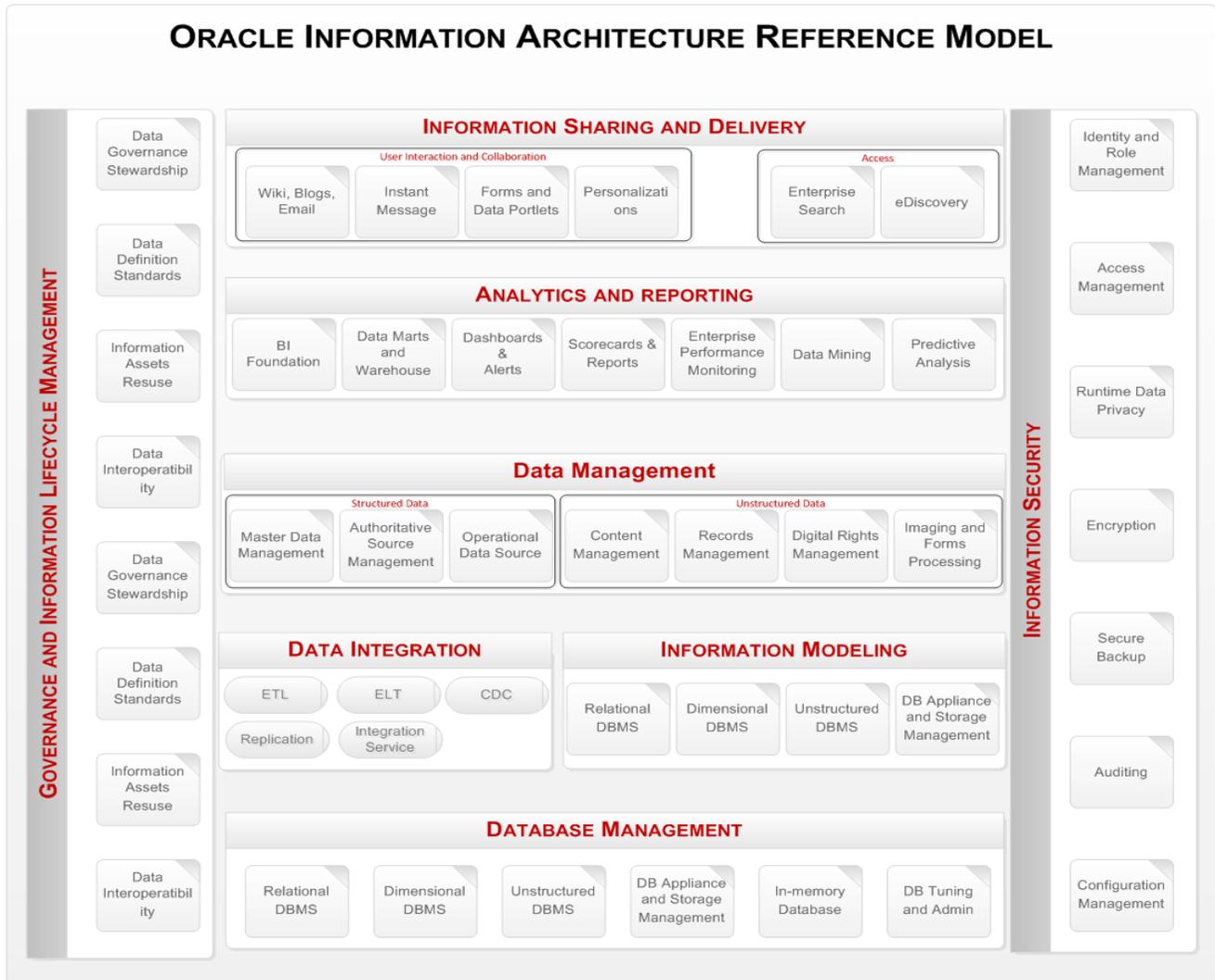


Figure 2: Oracle Information Architecture Reference Model

- *Information Sharing and Delivery* relates components that are needed to interface to data consumers in a practical and effective way.
- *Analytics and Reporting* relates components that are needed to create information from data enabling rational decision making and illustration of same.
- *Data Management* relates components that help manage plans, policies, programs, and practices that control, protect, deliver, and enhance data asset value.
- *Data Integration* relates components that assist movement of data through an enterprise using standard design patterns.

- *Information Modeling* relates components that enable representation of concepts, relationships, constraints, rules, and operations for data throughout the enterprise.
- *Database Management* relates components dealing with physical and operational aspects of data and database management systems.
- *Governance and Information Lifecycle Management* relates components used to formally and proactively manage data throughout the enterprise.
- *Information Security* relates components needed to protect information and information systems throughout the enterprise.

## Picking a Starting Point

Given the breadth of topics that comprise Information Architecture, finding a starting point with potential for tremendous impact yet without tremendous risk, can be challenging. While no single answer works for all organizations, integration architecture is a good bet.

Aging integration architectures offer excellent change potential because they are frequently characterized by a jumbled mess of point-to-point data exchange interfaces. Each interface is essentially a contract between two application owners that must be created and managed. When the same data is represented in multiple contracts, each one managed independently, there is massive duplication of effort in activities related to: design (endless discussions); development; testing; and data reconciliation (think operational incidents). This duplication of effort has a major impact on IT operations and results in a huge financial burden on organizations.

Implementing a modern, standards-based integration architecture that emphasizes strong publication standards has the obvious benefit of reducing point-to-point interfaces. This not only lowers costs but also enables faster release cycles making it easier to implement or update key business process and resulting in a direct impact on business performance. In addition, such architecture gives natural opportunity to incorporate: data sharing standards; data security standards; data quality standards; data lifecycle management; and data governance program elements. Finally, integration architecture can be implemented incrementally, targeting sets of interfaces grouped around common publication standards. This greatly reduces risk and greatly improves the odds of project success.

In seeking to achieve all of the benefits of modern integration architecture, organizations must, relative to a set of interfaces being considered, first establish publication standards. This can be a significant challenge as such efforts typically require participation from multiple departments and potentially multiple organizations. The answer to this challenge is to use external standards pre-defined by external committees or organizations. External standards have a way of cutting through the political morass that often oozes out of cross-departmental standards development efforts.

Thankfully, the Department of Homeland Security (DHS) and the Department of Justice (DOJ) have partnered to sponsor the National Information Exchange Model (NIEM), pronounced Nēm (<https://www.niem.gov>). NIEM is a collection of data exchange standards that are managed through a

central government-sponsored program and supported by a centrally managed framework and reference model.

The primary work product of NIEM is a set of actionable standards in the form of NIEM-conformant xml schemas. Schemas and related artifacts (examples and context) are packaged in *Information Exchange Package Documents* (IEPDs). As of the publication of this paper, there are 320+ IEPDs available for download in the DOJ-managed *IEPD Clearinghouse*, each representing a collaborative effort between multiple government organizations, often across multiple levels of government (Federal, State, Local, Tribal). The *amber alert IEPD*, for example, was the result of collaboration across all levels of government across multiple domains: Emergency Management Services; Juvenile Justice; Transportation; Law Enforcement; Public Works. Note that the amber alert IEPD like most IEPDs is focused on inter-agency data exchange related to a very specific business context; in this case, emergency response for missing children.

Additionally, NIEM has a reference model comprised of a well organized, federated meta-model and a data dictionary with more than 7,000 accepted terms commonly used in inter-agency data exchange. The entire NIEM model can be downloaded as a whole and/or domain-centric sub-models can be downloaded.

All of the work that goes into defining NIEM standards and related reference models represents significant savings for adopting organizations. Moreover, for many government agencies, NIEM adoption is mandatory per the Office of Management and Budget (OMB). Such mandated initiatives when viewed in a strategic context, offer excellent potential to modernize Information Architecture and begin to break down information silos.

## Applying Best Practices

When applying NIEM in a strategic context, it is important to recognize opportunities to advance information architecture beyond the obvious benefit of enabling business processes and reducing point-to-point interfaces. Such advancement opportunities include:

- Introduction of data quality standards and services
- Introduction of data security standards and services
- Introduction of a Data Governance Program initially focused on interfaces
- Introduction of Data Lifecycle Management
- Introduction of Service-Oriented-Architecture and data services
- Introduction of Operational Data Stores as core hubs in your information architecture

These opportunities are realized as you prosecute a specific data integration need (e.g. NIEM data exchange) within the strategic context of the Information Architecture Reference Model that was presented earlier. Recalling the reference model, illustrated again in Figure x below, note the subject areas that are relevant.

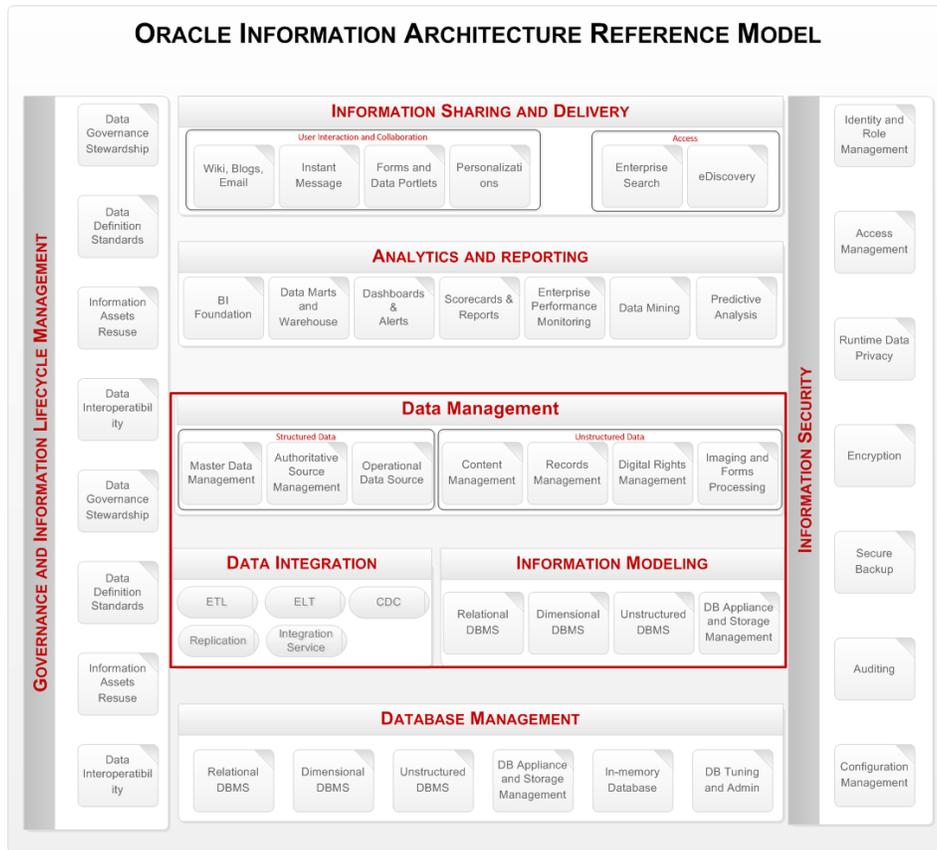


Figure 3: NIEM and Information Architecture

For each of the highlighted areas, technical best practices for implementation are elaborated below.

### Data Management

Data Management is particularly important relative to data integration and NIEM. When exchanging data between departments or between organizations, the presumption is that data to be shared is of high quality and comes from authoritative sources. Without sound Data Management practices, this is difficult to achieve.

To start, as data is identified for specific exchanges, authoritative sources for each data element should be identified. Additionally, NIEM reference models and related data dictionaries are an excellent tool to validate, complement, or kickoff efforts to establish common vocabularies at the department or agency level.

Finally, Master Data Management should be given particular attention. It is not unusual to have as many as fifty sources for commonly referenced data all competing to act as authoritative sources.

Master Data Management is specifically designed to solve these types of problems for particular sets of data such as customer, site, and financials. Though master data management projects require significant effort, an iterative approach starting with data needed for identified NIEM implementations, can result in staggering benefits.

## Data Integration

If even a single NIEM standard is implemented for an organization, it is necessary to integrate to the data sources that will be used to create xml documents to be exchanged. Thus data integration is central to information exchange and to NIEM.

As a best practice, data should be sourced through data services organized by key data entity. The data service should abstract from physical sources and additionally consolidate all operations that are allowable against the data entity. Finally, data services should interface with service consumers using a coarse-grained canonical model that reflects all data and operations.

NIEM reference models may assist in defining such data services. Alternately, multiple individual NIEM-conformant exchange standards may provide useful input for definition of such data services.

A Service-Oriented-Architecture (SOA) provides the foundation for such an approach. For certain types of data, tools are also available to incorporate off-the-shelf business processes, data canonicals, and commercial tool integrations.

## Information Modeling

Information models are needed in order to understand how to relate agency data to that needed for a particular exchange or for data services that will in turn be consumed by information exchange implementations. If models are out of date, difficult to find, or are not consistently represented, efforts to understand and capture data for specific exchanges will be slower than they would otherwise be.

NIEM reference models and related documentation may be useful to understand data relationships and assist modeling of canonicals.

## Governance and Information Lifecycle Management

Publication standards require a governance process to ensure solid design, high data quality, and adherence to standards. Likewise, data that is associated with publication standards must be managed relative to a defined information lifecycle in order to ensure proper source management, security-conscious data movement, and appropriate archival and disposal. Such governance concerns must fit into the broader governance framework of an organization.

To the extent that there are deficiencies related to existing governance and information lifecycle management, these deficiencies may be felt in managing exchange implementations. For example, if poor architecture governance has led to massive duplication of data across databases, it may be difficult to determine which sources are appropriate for a particular data exchange or canonical or to feel confident in the quality of the data.

## Information Security

Data exchanges between departments or between organizations often contain sensitive information. As such, security and privacy are paramount concerns. While NIEM itself is focused essentially on data payloads (i.e. xml files) and the means to validate them (i.e. xml schemas), physical exchange concerns must still be addressed. This includes security concerns related to exchange of data with an external party including authentication, authorization, and encryption.

Likewise, security for data at rest and for data movement related to NIEM exchange implementations must be addressed as part of data integration architecture.

## The Case Study

Increasingly, government organizations need to exchange data with other agencies and jurisdictions as a way to meet the growing demands for information exchange. This includes all levels of government, both horizontally (state to state) and vertically (local to state or state to federal). One of the government verticals where this is most urgent is in health and human services (HHS).

On March 23, 2010, President Obama signed the Patient Protection and Affordable Care Act (PPACA), which extends health care coverage to an estimated 32 million uninsured individuals and makes coverage more affordable for many others. As per this act, each state needs to build and administer healthcare Exchanges to operate in each state by 2014. The act also proposes several new health care programs including:

- Health Insurance Exchange
- Health Information Exchange
- Modernization and evolution of Medicaid and CHIP
- Integrated eligibility and enrollment

Oracle has been deeply involved in defining an efficient, business-driven framework for Health Insurance Exchange using the Oracle Enterprise Architecture Framework (OEAF) as an organizing construct (see the section entitled “Practical Enterprise Architecture” for more information). OEAF can easily adopt NIEM standards to exchange needed data between agencies and vendors.

## Business Architecture – Functional Model

Figure 4 below shows the high level functional model for Health Insurance Exchange. Red arrows indicate areas will NIEM-conformant exchanges will be used.

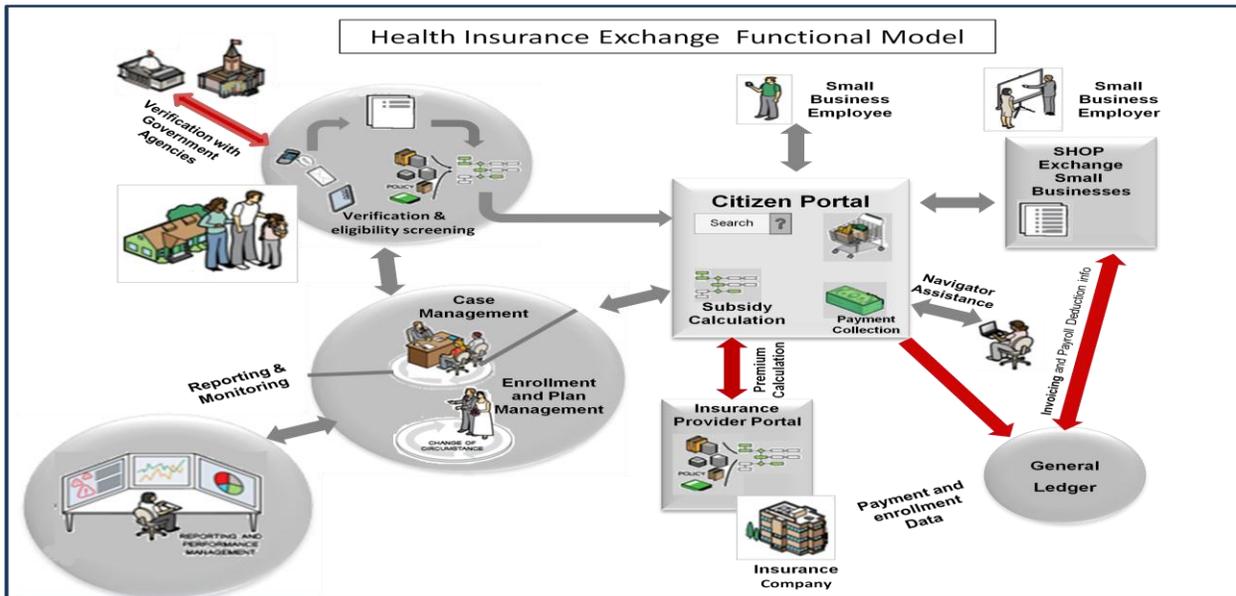


Figure 4: HIX Functional Model

HIX will help consumers and small businesses apply for public and private health insurance and other benefits. Individual Citizens and small business employees can access the site via the *Citizen Portal*. HIX will need to connect various systems to perform the eligibility determination and to verify individual's data. These systems may be internal to state government or may be external like CMS, Social Security Administration, Department of Homeland Security, IRS, State Insurance Agency and State DMV. HIX also needs to integrate with insurance carriers and provider networks.

Due to heavy integration requirements, it will save time and money to standardize processes, information objects, and data integrations. NIEM will help to do this as data are flowing across agencies and third party businesses.

## Business Architecture – Capability View

Figure 5 below shows a high level capability view of HIX based on OEAF.

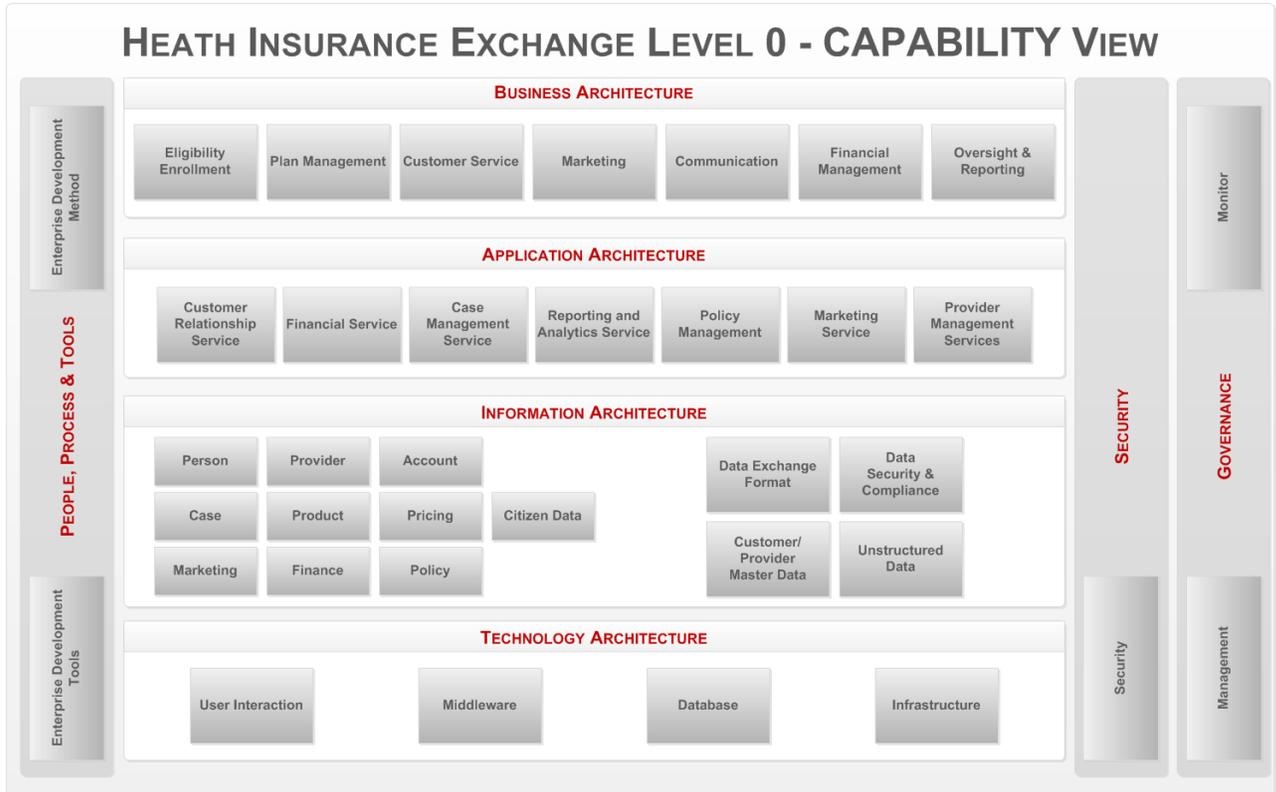


Figure 5: HIX High Level Capabilities

Overall design starts with defining the business architecture which includes the business capability models and business processes. After finalizing business process models, the next step is to define the business services and business information objects.

## Application Architecture

Following elaboration of Business Architecture, Application Architecture is defined. Application services and application data objects are defined and mapped to business services and business information objects. These application services then invoke other subordinate exchange functions and backend services. Examples are verification services, security services, and ERP services. Figure 6 below illustrates a sample application diagram for HIX.

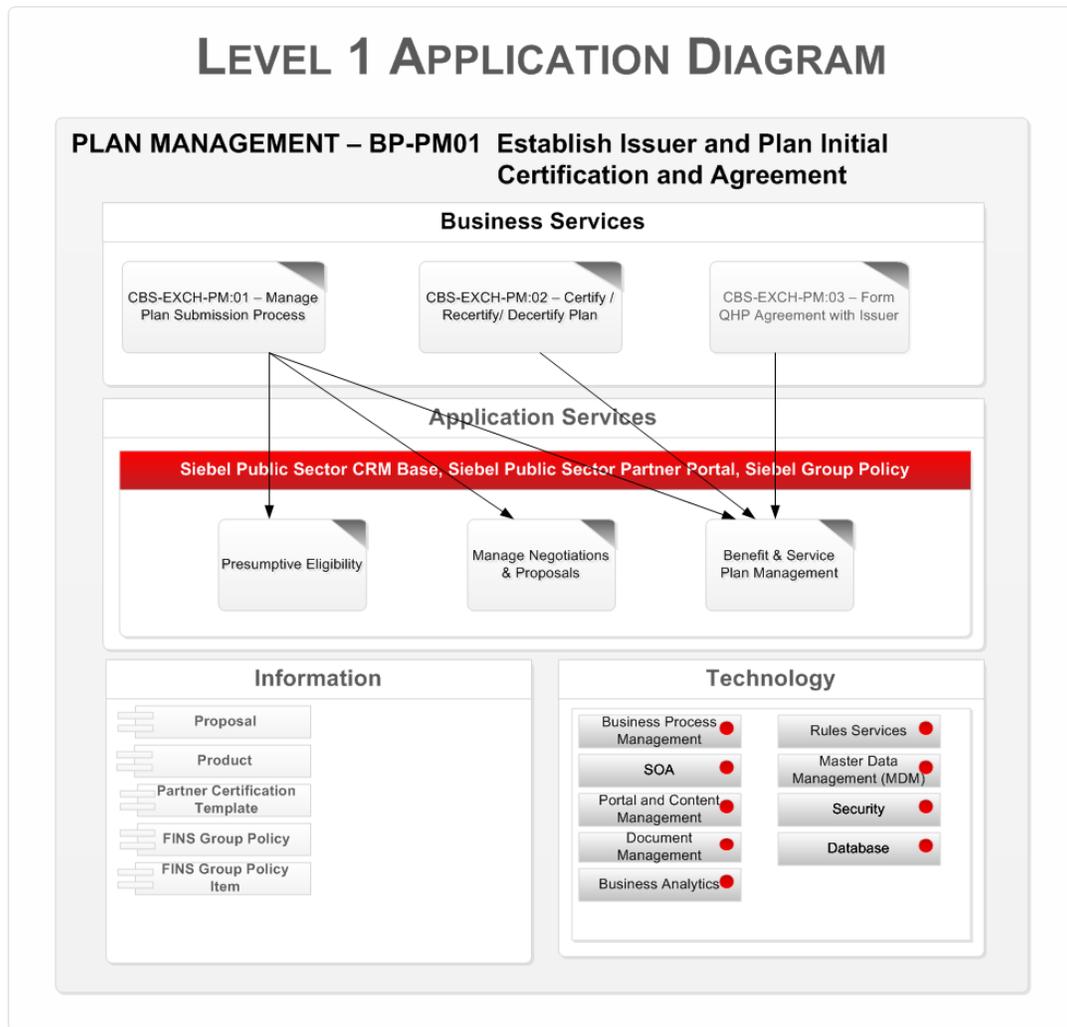


Figure 6: HIX Application Diagram

NIEM-conformant messages will be used whenever an insurance exchange needs to send or receive messages to an external service/application – as recommended by Federal HIT policy-makers. If a commercial software product is used to build an information exchange mapping to application name and module is also done at this point.

## Information Architecture

One of the goals of information architecture is to derive common data models and standardize data exchange formats across organizations and agencies. NIEM plays a major role in doing this for HIX. By standardizing data objects, architectural complexity will be much lower and time to deliver new services will be significantly reduced.

As per the latest OMB sponsored NIEM assessment report, HIX expects to save as much as 30% in development time and cost, from planning through design, by using existing NIEM standards. Additionally, by defining common canonical data objects, even greater reuse is possible.

When defining data architecture definitions, data objects are defined and detailed data flow diagrams are created to elaborate integration and to define the data context based on the type of data. Figure 7 below shows various data context regarding HIX information Architecture.

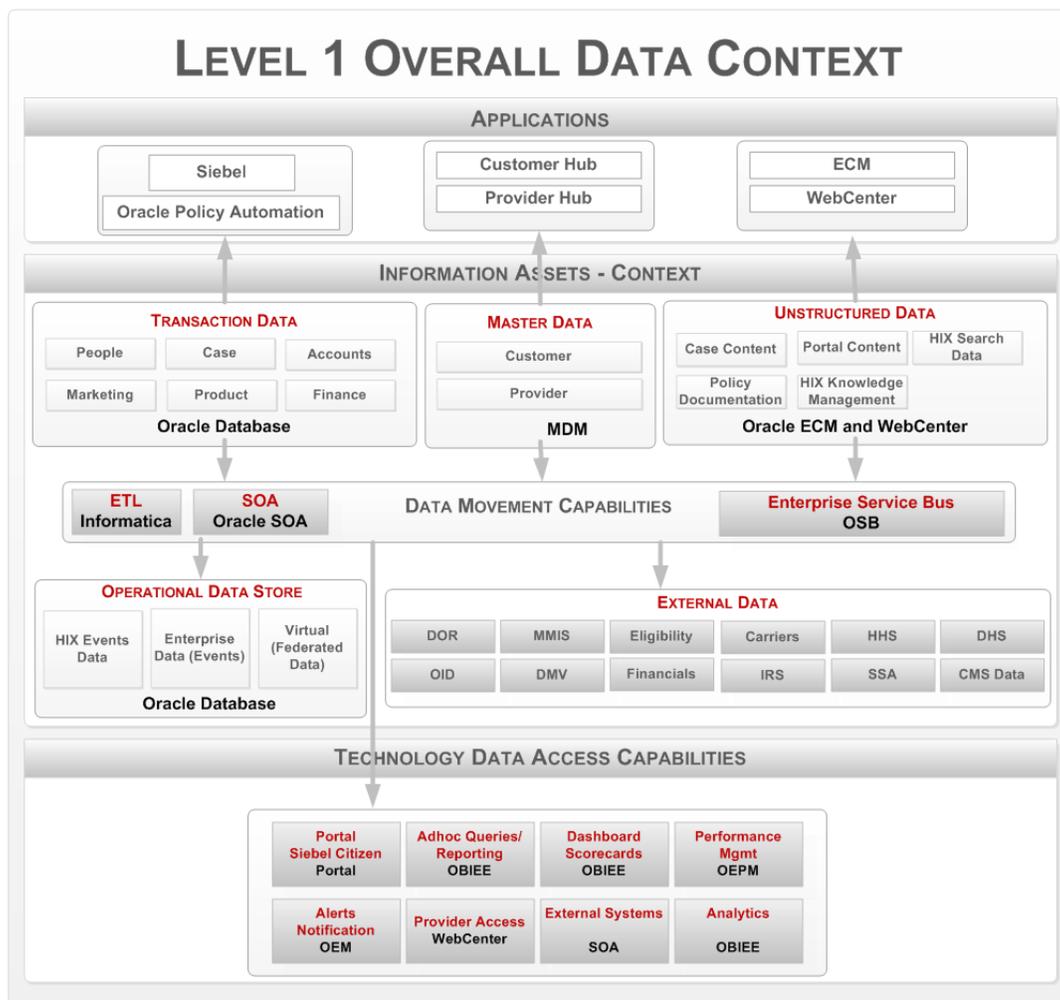


Figure 7: HIX Data Context

Following figure 8 shows overall Information Integration need for Health Insurance Exchange.

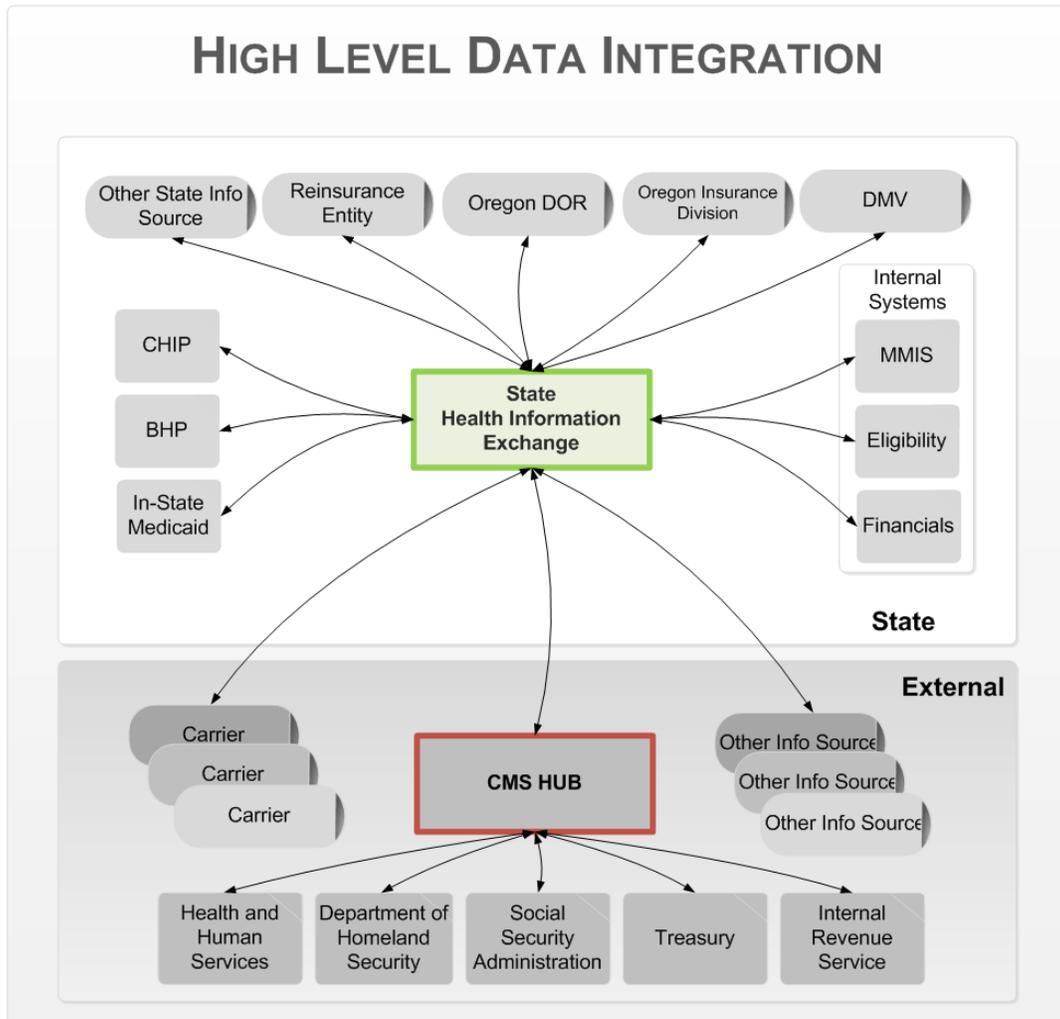


Figure 8 HIX Data Integration

## Technology Architecture

The last step is to define the Technology Architecture which can support the above Architecture requirements across business, application, and information domains. Technology Architecture will provide the overall software and hardware view to implement HIX. The process for hardware and software selection should ensure that support for open standards exists and that a loosely coupled process for integrations can be supported. Figure 12 below shows high level Technology capability view for HIX.

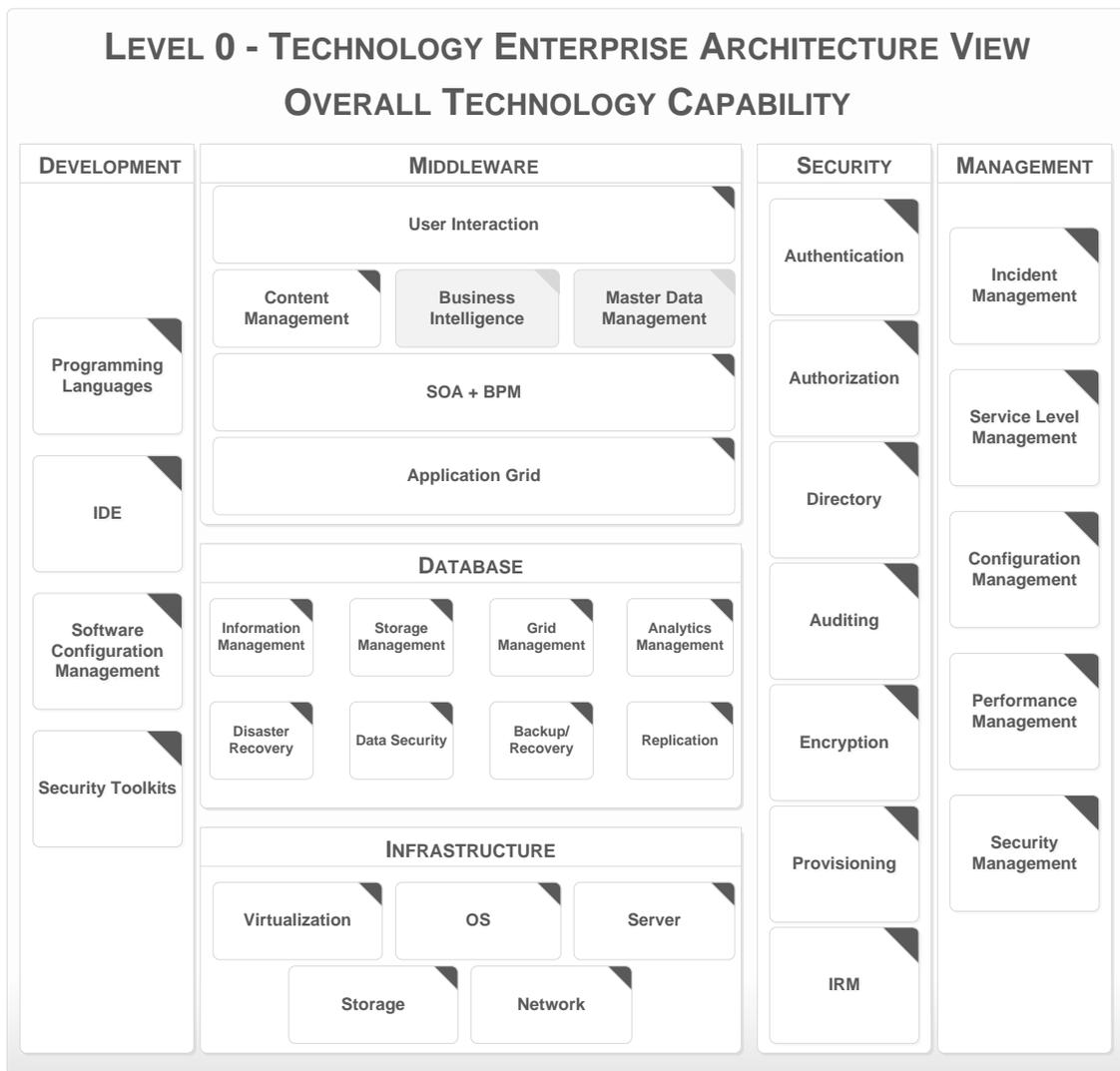


Figure 12: HIX Technology Capabilities

Oracle offers a comprehensive solution for implementing NIEM-based information exchanges. Our approach offers four key things:

- Robust, enterprise-grade infrastructure software
- Comprehensive approach addressing all your exchange needs
- Pre-integrated middleware products and state-of-the-art tools
- Knowledge and experience in designing NIEM-based exchanges

For detail information on supported technology to build NIEM based exchange, please refer white paper “[NIEM Solution Architecture using Oracle Fusion Middleware](#)”.

## Conclusion

If your organization is seeking sustained growth and reduced operating costs, revitalizing your information architecture efforts is a must. Further, if point-to-point data exchange interfaces are running rampant in your organization, modern integration architecture might be the place to start and NIEM might be just the catalyst needed to jump-start the effort.

For such efforts to have maximum impact and minimum risk, an Enterprise Architecture solution framework should be used. Considering integration architecture and NIEM in the context of Enterprise Architecture gives a strategic view that offers better potential to modernize Information Architecture and ultimately to break down data silos across government.

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