STATE OF MINNESOTA
MINNESOTA ENTERPRISE ARCHITECTURE
WHITEPAPER

Concept Level WHITE PAPER
Developed for the State of Minnesota Enterprise Architecture
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Credits

This paper is the result of work coordinated under the Minnesota Enterprise Architecture Development Committee (MEADC) of the Architecture Advisory Committee.

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Overview

"The leaders of the organization must have a clear vision of the **desired future state** of the **entire system**, including such dimensions as its business, its organization and its ways of working. This vision must be used as a **common context** both for diagnosing the needs for changes and for managing the process of change, so that it acts as an **integrating force** for the multitude of apparently disparate changes to be made. The plan for making changes must be an integrated one." (Beckhard and Pritchard, 1992))

In a large modern enterprise, a rigorously defined framework is necessary to be able to capture a vision of the "*entire system"* in all its dimensions and complexity. Enterprise Architecture (EA) is a process framework that is able to coordinate the many facets that make up the fundamental essence of an enterprise. It is the master plan which "*acts as an integrating force"* between aspects of business planning such as goals, visions, strategies and governance principles; aspects of business operations such as business terms, organization structures, processes and data; aspects of automation such as application systems and databases; and the enabling technological infrastructure of the business such as computers, operating systems and networks. To that end it is clear that the state of Minnesota is in need of Enterprise Architecture (EA).

The Economic Benefits of Enterprise Architecture

Most large organizations have difficulty defining and managing the economic benefits of Enterprise Architecture. Managers often ask what Enterprise Architecture can provide. At the same time several governmental organizations have adopted Enterprise Architecture as part of their change and E-Government initiatives.

A holistic Enterprise Architecture approach can deliver significant benefits to organizations. Enterprise Architecture delivers the foundation for the sharing of services, the ultimate business driver for Enterprise Architecture.

"There is a parallel between (Enterprise) Architecture design and city planning. City planners must design in the face of many unknowns, such as future transportation technologies, changing work, living, and commuting patterns, and so on. As a result of this level of planning, our major cities are able to accommodate new technologies for transportation and communication which remain viable for hundreds of years, and which

make a major contribution to each city's brand of urban culture." (Nolan and Mulryan, 1987)

A fundamental principle that can be applied to Enterprise Architecture is: "Always design a thing by considering it in its next larger context - a chair in a room, a room in a house, a house in an environment, an environment in a city plan." (Saarinen, 1956)

With these quotes in hand it is clear that the Enterprise Architect's task is not to foresee the future but to rather enable it. Enterprise Architecture maps the design of the larger context (i.e. the enterprise) within which organizational design, business process reengineering, systems design, technology infrastructure design and data analysis, should be considered. In Enterprise Architecture, as in city planning, it is futile to attempt to foresee every possible future change. The architecture must rather provide the capability to enable change to occur rapidly, without undue resource utilization, yet in a controlled manner and with minimal adverse impact.

Enterprise Architecture

Enterprise Architecture must be based upon an accepted set of business needs: the motivation factors and case for action. The following have been defined for the purposes of Enterprise Government Architecture:

1) Appropriate government information and services will be accessible regardless of location, time, and method of access and group (e.g. language, culture, age and ability).
2) Access to information and services will be authenticated to the degree required by specific information and services. Information will be protected to the level required both internally and externally.
3) Coherent and navigable access will be provided across multiple points of interaction for government information and services spanning departments and other levels of government (i.e., "no wrong door").
4) Government information and services will quickly respond to the client's changing expectations
5) Government service levels and functionality, focused on citizen values that are provided via technology improvements will be pursued providing there is no proportional impact relative to costs. Costs and quality will be considered as 'tradeoffs' to the citizen value equation.
6) Government will reduce the total cost of ownership of IT investments through the elimination of duplicate infrastructures or support services and the leveraging of economies of scale.
7) Government will increase attractiveness for business investment in the State to build stronger local economies.

Current state of the Architecture

Currently Minnesota has a technical architecture that has been a guide for technology purchases and development for several years. While the architecture has some over-all direction for technology structure, it is limited to a set of "best practices" and a list of currently acceptable technology. The architecture has some principles that relate to the business but the scope did not fully address the business architecture, the process of developing applications or the structure of information (data).

Desired state of the Architecture

Move the current technical architecture to an Enterprise Architecture. The current architecture will suffice as the Technical Architecture within an Enterprise Architecture, with its standards and revitalization processes. However, there is a need to combine certain domains. The results will be the following associations of the current technical domains to disciplines within new domains.

New Version	Current Version
Application Domain Architecture	Application Middleware Data Integration Presentation and Accessibility
Infrastructure Domain Architecture	Platform Network
Security Domain Architecture	Security System Management

Table 1

The Data and Records Management and the Data Integration domains will become part of an Information Architecture.

In summary, in order to take the current state of a Technical Architecture and move it to an Enterprise Architecture, the state needs to add the components of Enterprise Business Architecture, Enterprise Information Architecture and Enterprise Application Architecture. The Application Architecture will use Service Oriented Architecture (see the Application Architecture section for more information) as its guiding principle. Moving to a Service Oriented Architecture is an important and work intensive step that will require a significant investment in time and personnel.

Use the Federal Model

There are many ways to classify governmental functions and their lower level services. This paper proposes to adopt the federal government's Federal Enterprise Architecture (FEA) as the starting point for the Minnesota Enterprise Architecture (MEA). The FEA is a framework that can be described as a collection of interrelated "reference models" designed to facilitate cross-agency analysis and the identification of duplicative investments, gaps, and opportunities for collaboration within and across governmental agencies. Since these models were designed from the government point of view they will work as well for the State of Minnesota and local governmental jurisdictions within the state. The Federal government has spent several years working on these categories and continues to add improvements. Although there are a few functions which are not really core to Minnesota activities (space exploration), most of the functions map very well to Minnesota. Further, in the spirit of sharing of services, it makes sense to use the FEA tools and framework since government has already expended a large amount of resources on it. Further, the Federal Office of Management and Budget has approved, even promotes, Minnesota using the framework.

The following is an overview of the federal reference models.

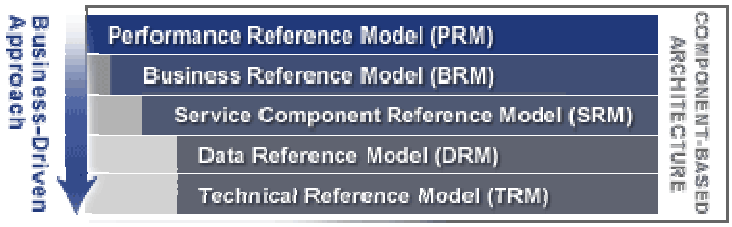

Figure 1

Starting from the Top (figure 1) of the framework and moving to the bottom.

Performance Reference Model (PRM)
The PRM is a "reference model" or standardized framework to measure the performance of major IT investments and their contribution to program performance.
Business Reference Model (BRM)
The Business Reference Model provides an organized, hierarchical construct for describing the day-to-day business operations of government. It provides a tool to identify common functions across agency boundaries. It provides a classification to four levels (line of business, function, sub-function and mode of delivery)
Service Reference Model (SRM)
The SRM looks at government as a collection of high level services independent of the business functions or purpose. For example, process automation services (workflow, scheduling, etc.) could be use by many different business functions. These services

provide a foundation to support the reuse of applications, application capabilities, components, and business services.

Data Reference Model (DRM)

The Data Reference Model (DRM) describes, at an aggregate level, the data and information that support government program and business line operations. This model enables agencies to describe the types of interaction and exchanges that occur between the Federal Government or all levels of government and citizens.

Technical Reference Model (TRM)

The TRM is a component-driven, technical framework used to categorize the standards, specifications, and technologies that support and enable the delivery of service components and capabilities.

There is a need to map the Federal Reference models to Enterprise Architecture. That mapping will be in this context:

Business Reference Model – Enterprise Business Architecture
Data Reference Model – Enterprise Information Architecture
Technical Reference Model – Enterprise Technical Architecture
Service Reference Model – Enterprise Application Architecture

Starting with the BRM

The new **Minnesota Enterprise Architecture (MEA)** is to be entirely business-driven. The foundation is the **Business Reference Model (BRM)**. The Federal government, in developing the Federal Enterprise Architecture, started with a Federal BRM and as a **Business Reference Model (BRM)** is developed for a large diverse organization, such as the State of Minnesota, it is used to identify where duplicated lines of business occur. Once those are identified, the next step will be to plan to reuse some of the service components utilized to perform those processes. This includes current service components and new ones. Further, the data exchanges will be identified and the sources of that data can be reduced in number. In other words, the same data will not be stored multiple times. Technology will be planned for and the number of platforms will be reduced; both driven by cost and interoperability. Therefore, this business-based foundation provides a common framework for improvement in a variety of key areas such as:

Budget Allocation
Information Sharing
Performance Measurement
Budget / Performance Integration
Cross-Agency Collaboration
E-Government
Service Oriented Architecture

Integration with other Enterprise Processes

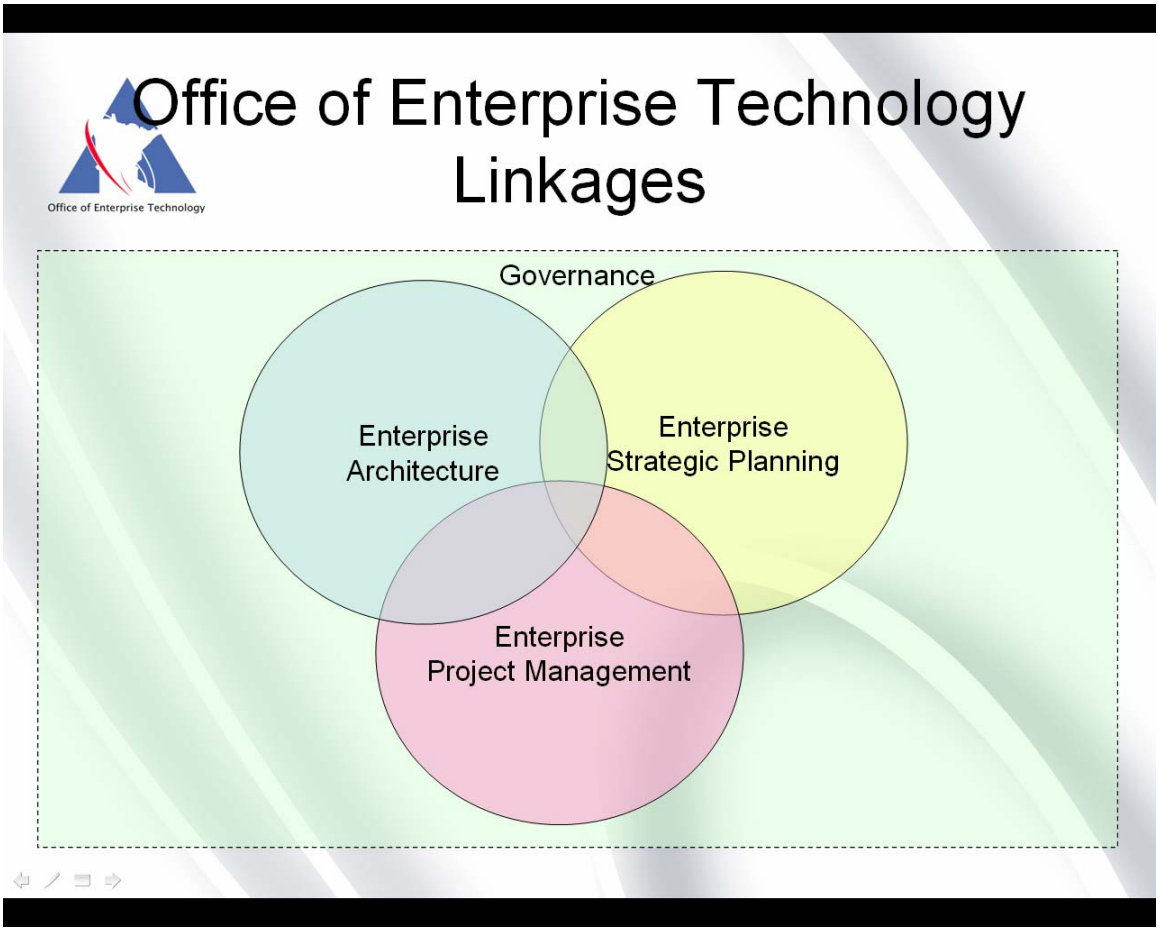

Figure 2

Since Enterprise Architecture is a guide for state IT investment, most IT projects in the state will be affected by it. However, Enterprise Architecture is designed to help the state achieve its strategic and tactical goals. As a result, there must be interplay between many strategic projects or initiatives and the Enterprise Architecture process. Here is a short list of Enterprise processes that have a strong linkage to the Enterprise Architecture effort:

1) **Enterprise Strategic Planning**
   A successful architecture must be aligned with the strategic plans of the organization. Architectural planning should closely follow strategic planning. Whatever this project comes up with could be important for the development of enterprise architecture.
2) **Enterprise Project Management**
   Agency projects will be mapped to the business function they are aimed to support. The functions and sub functions will be examined to determine where

sharing of services can take place. Further, if there is a sub function that can be exposed to other agencies that will be mandated at this point.

3) **Budget Process**
   Agencies will map investments to the Business Architecture based on the function of the investments; not the function of the program or agency. Though an IT investment will have more than one valid mapping to the Business Architecture, the primary mapping will be the business function and sub-function it most directly supports.
4) **Drive to Excellence**
   The Drive to Excellence expresses many of the state's strategic goals with respect to information technology. Its focus is on effectively delivering government services using information technology efficiently. Each of the identified projects will require flexible enterprise architecture to be successful.

5) **Federal Enterprise Architecture Initiative**
   Much of agency communication is not horizontal between state agencies, but vertical with federal agencies and local government units. Any architecture that the State adopts must facilitate the interaction with other levels of government and other states. An architecture that is consistent with the Federal Enterprise Architecture has the best chance of interoperating with other governments.

Architecture Program

Enterprise Architecture is an endeavor to maintain alignment between an organization's needs and the technology that supports these needs. Because both technology and business needs change over time, Enterprise Architecture must be established as a process with periodic deliverables. Enterprise Architecture is an iterative process and it should be noted that process is more important than the architectural standards (artifacts) that are left behind. However, the Enterprise Architecture Program includes both the process and the artifacts. There are expectations to be realized as a Architecture Program goes through iterations. The schedule for these iterations needs to be determined by the formalized governance process. The following is a list of the first 3 iterations and what results should be realized by those iterations.

1) **First Iteration**
   The Enterprise Architecture Program is integrated with Strategic Planning and the Budget processes. These touch-points need to be well-defined and process orientated so that by the third iteration it will be second nature.
2) **Second Iteration**
   Enterprise Architecture is used to guide development and acquisition. Enterprise Architecture will guide IT procurement rather than be the tool. The organization captures metrics to measure the savings in resources, including time and money. Costs and benefits, including benefits across agency boundaries, are considered in evaluating projects. Integration procedures are reviewed and the process is updated when problems or new functionality is identified.
3) **Third Iteration**
   The Enterprise Architecture process drives continual reinvention throughout the

enterprise. Business influences technology and technology influences business. Captured metrics are used to proactively identify improvements to the Enterprise Architecture framework or blueprint information and/or integration processes. The organization works with other jurisdictions to share ideas for improved integration, including procurement and project management practices.

Implementation Plans

Phased Process

The Enterprise Architecture Process will use a phased approach. This formalized plan will be the completion of the first step. It will be followed by the establishment of a governance process. A committee such as the former Architecture Review Board will need to be established. Some of the current Enterprise Architecture processes will require word changes but the structure is very sound. The Federal Enterprise Architecture (FEA) will become the framework which lends itself to Shared Services. The Technical Architecture will need to take that into consideration and Service Oriented Architecture (SOA) will be a principle. Following the execution of the plan a new iteration will be started by the governance process. Changes will be needed and implemented throughout the process.

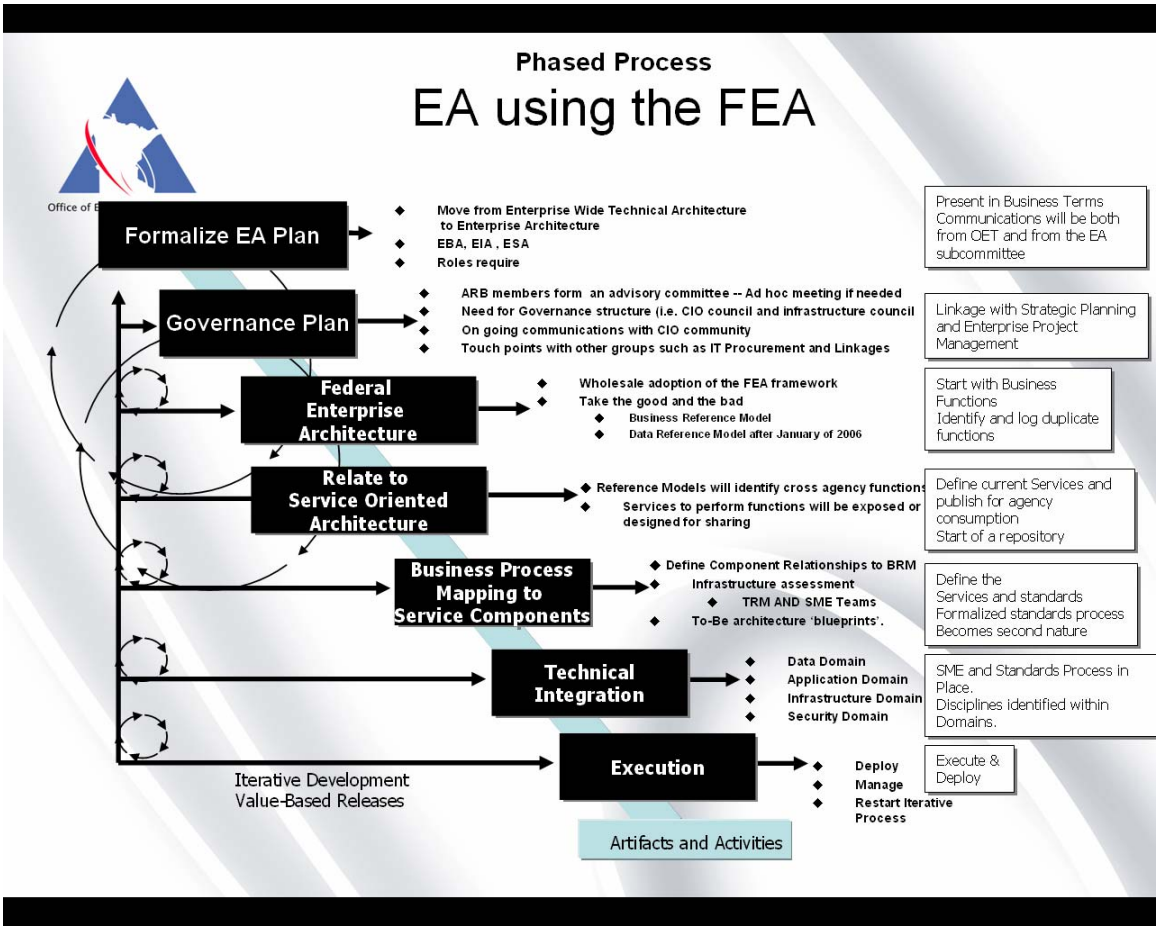

Figure 3.
The following is a more definitive description of the phased from figure 3.

Formalized Enterprise Architecture Plan (Figure 3)

This document is the formalization of the Enterprise Architecture Plan. The Minnesota Enterprise Architecture Development Committee (MEADC) was chartered to produce Enterprise Architecture for the State of Minnesota. Once again, the current Minnesota architecture is a Technical Architecture while the to-be state is an Enterprise Architecture (EA). This implies there will be additional components adopted. The following components will need to be added.

- Enterprise Business Architecture
- Enterprise Information Architecture
- Updated Enterprise Technical Architecture with a highlight on the Application Domain

There will be a need for additional roles in the future to update and preserve the Enterprise Architecture. Some roles can be jointly held by one person while others can not. Below is a list of the roles: (there is a much more extensive description of roles in the National Association of State Chief Information Officers Enterprise Architecture toolkit). The MEADC needs to make it clear that making any progress on this process will require resources. The roles marked with an asterisk (*) will need to be staffed.

- Business Architect*
- Information Architect*
- Application Architect*
- Communicator
- Documenter*
- Advisor
- Subject Matter Experts (SME)
- Services Teams
- Project Teams
- Procurement Manager
- Project/ Services Methodology Communicator*
- Special Interest Groups

The Project/Service Methodology Communicator's role may be able to be combined with some of the others.
There will also be a need for infrastructure. There will be a need for bandwidth (which we may have), servers, repositories and an office to manage those repositories. This process will be very complicated and there may be some certification process that will be needed as well.

Governance Plan (Figure 3)

Minnesota's architecture governance process was disbanded. The Minnesota Enterprise Architecture Development Committee (MEADC) proposes to use a membership subset of the former Architecture Review Board. This subset will serve as a small ad hoc governance team that the MEADC can submit the Enterprise Architecture plan. Further, this temporary governance team will guide the MEADC and other OET teams as well.

Here is the current break down of the Minnesota Enterprise Architecture Development Committee.

The original members are
Steve Ring -- Department of Health
Tim Willson -- Department of Finance
Neil Beltt -- Department of Human Services
Mike Ryan -- Office of Enterprise Architecture

New additions are
Janet Cain -- Department of Public Safety
Robert Horton -- Minnesota Historical Society
There will be further additions in the near future.

The Federal Enterprise Architecture (FEA) (Figure 3)

While the MEADC is aware that the Federal Enterprise Architecture (FEA) is not a perfect framework it does meet the 80 – 20 rule for mapping business functional areas for governments. This includes the state of Minnesota. The federal government has spent substantial time and resources to issue the FEA and it makes sense to the MEADC to avoid reinventing that wheel. Therefore, the FEA models will be accepted in whole and used as the framework for the Minnesota Enterprise Architecture. Here are some of the high points for adopting the FEA:
Developed for government -- organized by business functions
The FEA does promote sharing of services and therefore is a good model for the Office of Enterprise Technology's sharing services strategy
The FEA is driven from the business
Design across functional areas -- analysis of the basic functions of an organization (services). By dissecting the functions into their constituent parts, a framework can be constructed for developing applications that use independent modules, called services. Then common, well tested security services (log-in, authentication, authorization) that can be used by all applications can be developed. This will increase the security of systems over the collection of independently derived security features which now exist. Also, many existing applications can be converted to services by what is called "wrapping."

Relate to Service Oriented Architecture (Figure 3)

Clearly from the previous bullets, the Federal EA model promotes Service Oriented Architecture. This will be clarified further in the Application Architecture Domain section on Page 16.

This process step will result in the following business benefits:

- Reduce integration expense
- Increase asset reuse
- Increase business agility
- Reduce business risk
- Decreased cost of software maintenance
- Decreased cost of software development
- Increased revenue
- Improved data integrity
- Improved decision making.

Business Process Mapping to Service Components (Figure 3)

The Federal BRM will be analyzed with targeted agencies in the first step. This may be due to a new IT project within the agency or with another agency with some of the same business functions. This will ascertain where business functional areas cross multiple agencies and, thereby, where sharing of services can take place. Further, the technology will be standardized through the Technical Reference Model (TRM) process to promote the service sharing through web services. This will necessitate that applications are designed for a Service Oriented Architecture.
The results will be that the State of Minnesota will be strategically planned across business functional areas and not agencies. When this result is achieved, Version 1 of the Minnesota BRM will exist. However, the process to attain this BRM will take a very collaborative effort involving many agency business experts' time and commitment.

Technical Integration Plan (Figure 3)

The definition of this step needs to be fleshed out further. However, at the high level the purpose is to redesign our Technical Architecture to a Technical Reference Model (TRM). The current Technical Architecture Domains will become disciplines within a TRM in these three areas, as mapped in Table 1:

Security Domain
Infrastructure Domain
Application Domain

Further, an Information Architecture will be needed. That will be adopted from the Federal Enterprise Architecture as well and be called the Data Reference Model. The FEA is predicting the issuance of such in early 2006.

Version 1.0 will be issued (Figure 3)

Communication Strategy

The MEADC knows there is a great need for a communication strategy. This is a brief overview of the strategy but it does depend on the OET Office of Communications.

Current View

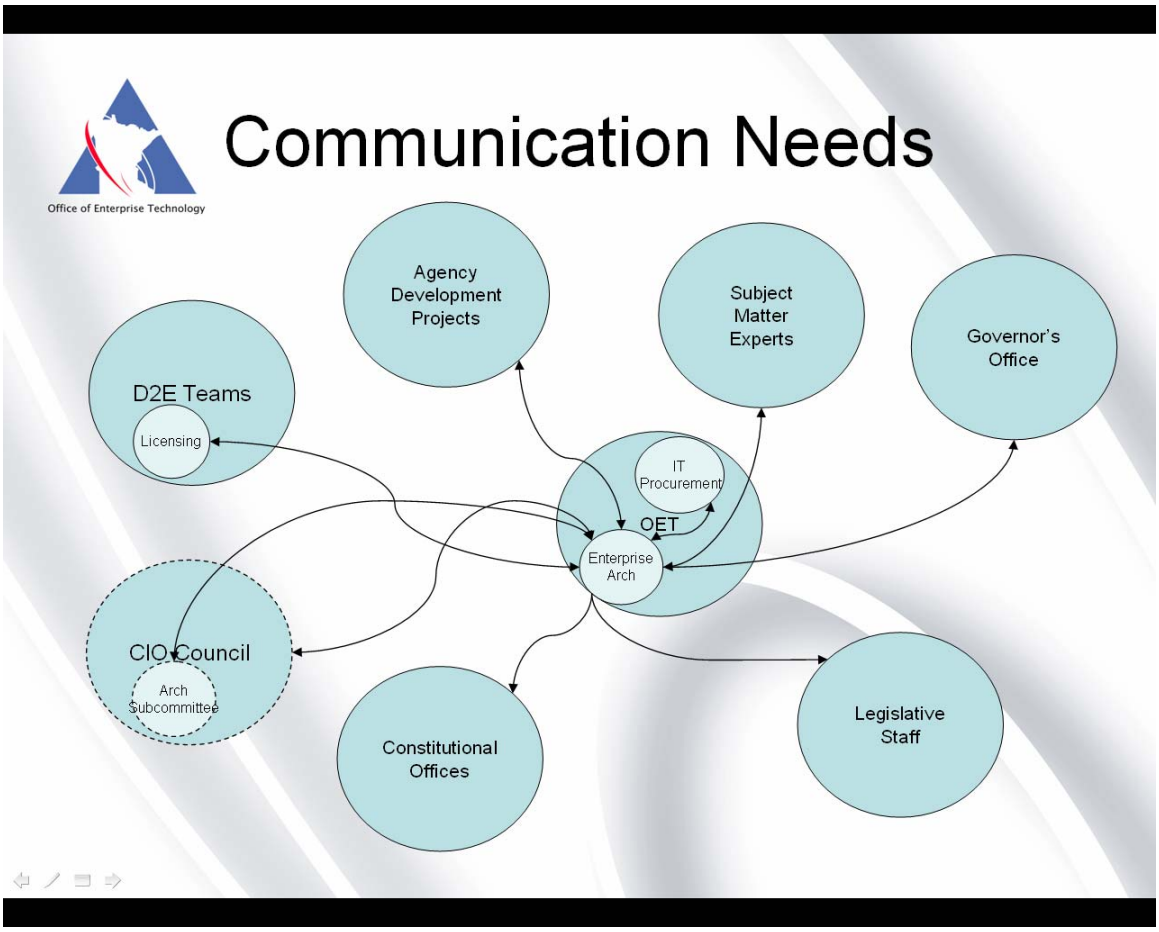

Figure 4

Communications currently takes place in an ad hoc way to many different external and internal processes. The need for clear and concise communication makes ad hoc communication a formula for failure. The bottom line is that work in this area can not be communicated too often and so there is a great need for a communicator role and process.

Proposed View

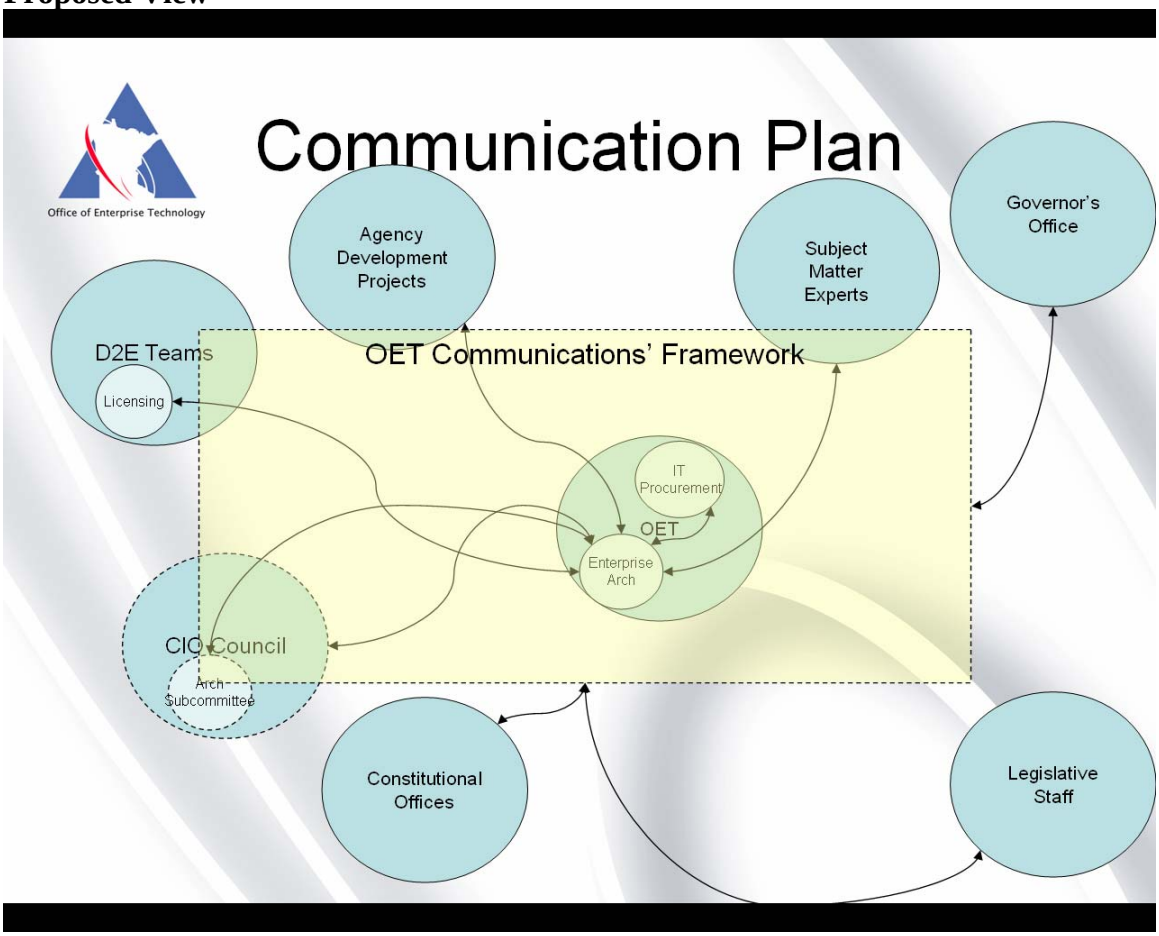

Figure 5

Communications will take place through the Office of Enterprise Technology's (OET) Communications Office. There will still be some mandated one-to-one communications between subject matter experts and the Agency Chief Information Officers. However, most of the external communications will be handled through the OET communications process, especially to the elected officeholders.

Next 12 months

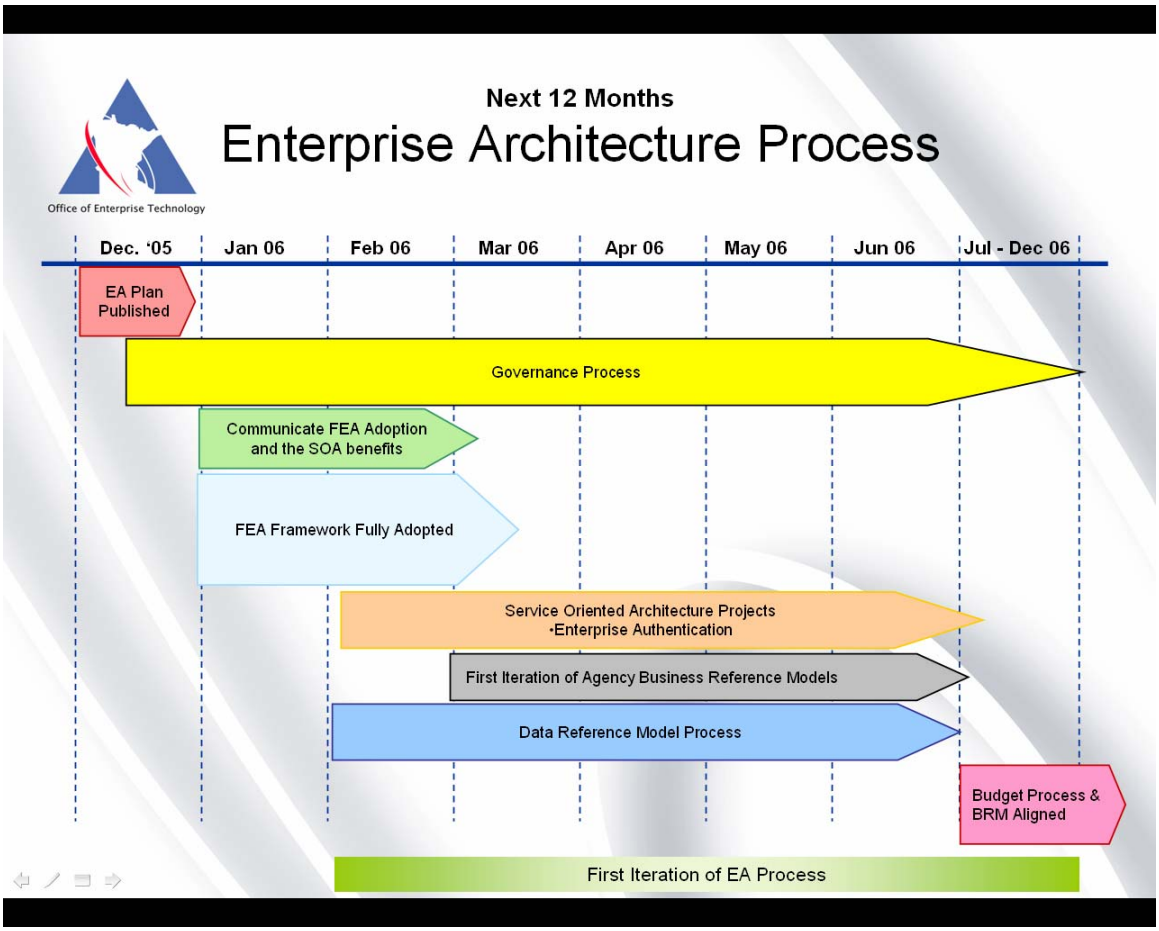

Figure 6

Application Domain Architecture

Minnesota is moving, by virtue of this architectural process, to a Service Oriented Architecture. This type of architecture is really an application design strategy and therefore will affect the Application Domain of the Enterprise Architecture.

The goals of the Drive to Excellence initiatives and the pressures for change that the state is facing require efficient delivery of government services. The strategic direction is toward services that provide more flexibility, less duplication, and fewer silos of information. As a result, Service Oriented Architecture (SOA) is proposed as the unifying conceptual approach for application development. The emphasis is in on the construction and deployment of flexible applications that are aligned with the organization's processes (services).

An SOA is based on an analysis of the basic functions of an organization. By dissecting these functions into constituent parts, a framework for developing applications that use

independent modules, called services is constructed. Common functions (services) that can be reused are identified.

In an SOA, because many services are derived from direct analysis of the organization's functions there is a close correspondence between applications and the processes that are used to perform the function. If applications are built as a composite of service modules, a change in business rules or processes can be accomplished by changing individual services, not the whole application. As an example, consider the development of a common, well tested security services (log-in, authentication, authorization) that can be used by all applications. The security of the state's systems will be increased over the current collection of independently derived security features. Many existing applications can be converted to services as well.

In order to implement a service oriented architecture at least four things will be needed:
The decomposition of business functions into constituent services
The identification and development of some core common services (e.g. security)
The technical infrastructure to support building and using applications based on services
Policies and processes to encourage and support SOA.

The use of the federal enterprise architecture will provide a quick start for addressing the first item. The business reference model (BRM) and the service reference model (SRM) will be very useful in analyzing the state's processes. The SRM, in particular, identifies common services used in governmental organizations. New application development efforts could compare their needs to the services identified in the SRM. Additional services could be identified by extending the decomposition of the business functions from the BRM. Those service components can be provided by development, purchasing from a vendor, or calling the service from a state repository.

The second item will require the implementation and support of some core common services that are used by most applications. A few of the services will be critical to provide while others will be needed as service orientation develops. An authentication and authorization structure service will be essential. This will compel the adoption of an identity management solution and the technical infrastructure to support it.

How the state repository is governed is another essential service. A very strict data standard or the need for data translation services will emerge.

The third item has implications for the Infrastructure Domain as well as the Application Domain. Sharing Services requires certain architectural building blocks. For instance, network standards and bandwidth must satisfy the necessary communication between services. There are others.

Specifications of products and processes for all of the stages of application development: analysis, design, coding, testing, and deployment. Perhaps a there will be a demand for a business process execution language processor (BPEL),

The fourth item is the need to develop processes and policies that maintain the quality of the developed services, manage change (versions), and provide incentives for developers to use the service oriented infrastructure and approach. This will probably mean the deployment of a "proof of concept" project, and a vastly greater communications effort with the state's application developers.

Suggested Projects for Enterprise Architecture

The following E-Government projects will need to be processed through the Enterprise Architecture

E-Authentication
Uniform Business ID
Web Services Security
Web Services Management
Infrastructure

Business Processes that need decomposition

Licensing
E-Records Management
Disaster Management
Geospatial One-Stop
Recreation One-Stop