EA Framework

Research and Analysis

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Contents

This document is a response to requested research and analysis of Enterprise Architecture (EA) Framework alternatives for the State of Utah. It has been designed as a component for consensus building for the selection of an EA framework for the State. All of the major frameworks (12-15) that had potential applicability were reviewed in detail. There were some limitations on publicly available information from proprietary frameworks, but generally enough was known and published by users to be able to draw conclusions.

EA frameworks are generally adapted to meet the unique needs of customers. No evidence was found of any user that applied an EA framework without adaptation. EA frameworks need to produce useful strategic and operational alignments with business needs. Technical reference models are a valuable components of frameworks for deploying and building infrastructure. EA frameworks must have a method for dealing with architectural styles such as Service Oriented Architecture (SOA) and new and emerging Web 2.0 technologies. The framework also needs to provide a basis for understanding and integrating the defacto architecture of the State.

This review recommends adoption of The Open Group Architecture Framework (TOGAF) as providing the most easily adaptable EA framework with a broad user base, information and tool base, and many other relevant supporting materials. The TOGAF framework can be readily mapped to other frameworks such as NASCIO and ITIL, and offers a cost effective way to implement an EA framework that aligns with agency business and will provide useful results from a practical perspective. TOGAFR offers opportunities for the State to train and certify architects using TOGAF methodologies and standards for a consistent EA approach across State government. The TOGAF EA framework license may be used internally by the State at no cost.

Introduction

Dramatic changes in business and technology have created a plethora of overlapping and sometimes confusing solutions, products, and standards that can increase complexity and impose much higher levels of risk for State and agency executive management and the Chief Information Officer (CIO). Exaggerated claims for products and solutions can be mind numbing. EA process, and the EA framework, must align business with IT resources and the processes they are designed to enable. Choosing an EA framework also requires choosing supporting methods and techniques that facilitate alignment and communication with the business.

The enterprise architecture framework is widely used as a mechanism to manage the development and evolution of architectures. An Enterprise Architecture (EA) framework is a structure in which major components of the architecture and the relationships between the components are defined.

An EA framework provides:

- a structure to organize thinking about the architecture;
- a description of the architecture documentation or artifacts;
- a common set of semantics, used with stakeholders interested in the contents of the architecture;
- a way to communicate the architecture by establishing a baseline for stakeholders about the contents of the architecture using common definitions and concepts; and,
- a method for getting buy-in for technology investments that align with business.

Gartner suggests that EA frameworks comply with the following criteria[1, 2] to be effective within an organization:

- A framework must be consistent and structured.
- The framework must use a top-down approach to architecture development that encourages architecture driven out of business strategy.
- The framework should incorporate a variety of constructs at different levels of abstraction and allow removal of needlessly complicating factors.
- The framework should define and enable a process for developing the architecture.
- The framework should describe the deliverables that will be produced during the work of architecture development.
- The framework should provide advice on architecture governance.

Strategic Direction for Enterprise Architecture

The State IT Strategic Plan has defined the criteria for EA to "provide a roadmap for moving the State of Utah IT infrastructure (i.e., processes, information and data, applications, and technology) from the current state to the future state."[3] The plan identifies an objective future state for EA as follows:

> "We maintain a master architecture that clearly links system and technology choices and investments to desired business or State service capabilities. Our architecture captures both the current state (inventories, standards, process models, etc.) and the future state, with the level of detail and the areas of focus being commensurate with current business and service priorities of the State. We also maintain localized versions of this master architecture to be more responsive and relevant to the specific needs of State offices and agencies."[4]

"Always design a thing by considering it in its overall context."
—*Eero Saarinen*

An EA framework needs to support and enable the realization of this overall strategy and direction for the State. The enterprise architecture for the State is business-driven. Its foundation is based upon understanding agency business objectives, what services they need to provide, and how they prefer to provide those services to meet the needs of their customers. A business-based foundation provides a common framework for improvement in a variety of key areas:

- Information Sharing
- Development of Shared Services
- Cross-Agency Collaboration
- Shared Technical Expertise
- Improved Efficiency and Effectiveness

Enterprise Architecture operates on fundamental principles, such as consideration of context. An EA maps the design of the larger context, the State enterprise, and considers how the information systems and technology infrastructure are considered as part of the overall environment. EA has often been likened to the processes and common sense benefits of city planning.

"As for the future, your task is not to foresee, but to enable it."
—*Antoine de Saint–Exupery*

In EA, as in city planning, it is not reasonable to foresee all future changes. The EA must provide the capability to enable change to occur as rapidly as needed, without undue resource requirements, in a controlled manner, and with minimal adverse impact on existing architecture elements.

State Business Objectives

Governor Huntsman has said, "We want to assemble the most effective and efficient government, driven by the best team possible, recognizing that the citizens are our customers." Accordingly, government and IT services are being aligned and driven toward more efficient and effective service delivery. The end goal for IT is to provide cost effective and responsive service that directly supports agency business requirements. These services have the potential to offer new and expanded opportunities for agencies to leverage IT toward carrying out their business. Table 1 lists the Governor's overall policy priorities for State government which provide additional context.

Governor Huntsman's Policy Priorities	
1) Economic Revitalization Agenda	**3) Quality of Life**
A) Tax Reform B) Business Development/Structural Issues C) Recruitment and Image D) Tourism	A) Water B) Transportation C) Energy
2) Education	**4) Governance**
A) Teacher Pay B) Focus on K-3 C) Public/Private Partnership D) Accountability E) K-12 Coordination with Higher Education F) School Choice	A) Ethics Reform for the Executive Branch B) Term Limits for the Governor C) Campaign Finance Reform D) Structural Efficiencies

Table 1.
Governor's Policy Priorities

State EA Baseline

Figure 1 illustrates a high level view of the current technical architecture of the State. Each of these layers may be devolved into greater levels of detail.[5]A new EA framework must be able to recognize and rationalize the defacto architecture, and provide a structure for future development and improvement.

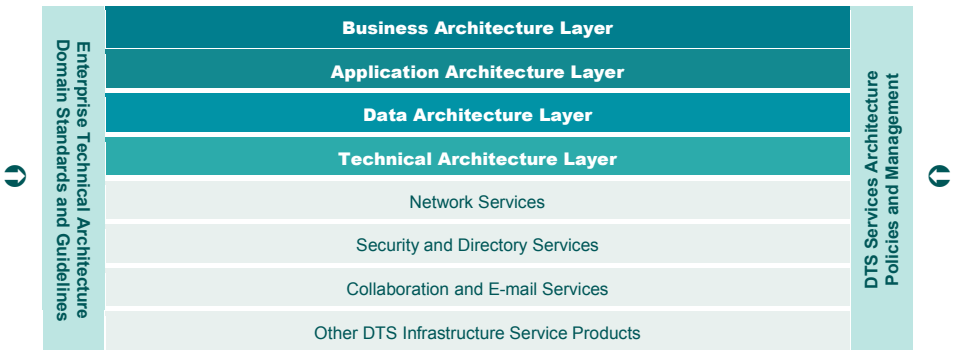


Figure 1.
Defacto State Enterprise Architecture Framework

Method

An effective EA must be holistic in scope, collaboration based, and alignment and value driven. The EA needs to support dynamic environments that are flexible and responsive to changing business drivers, budgets, and other organizational constraints. The EA needs to be able to have the ability to define solution sets that can be measured, validated, and mapped to real agency business requirements. The high level EA needs to be non-prescriptive at the architecture level and should not presume an implementation approach that is more properly an operations and standards concern.

This review has encompassed documented EA frameworks and evaluated them in the context of trends for enterprise IT, such as Service Oriented Architecture (SOA) and the related concept of enterprise Web 2.0 services, to name a few of the new and emerging trends that the framework must support. The framework must also provide useful benefits for legacy architecture environments. Accordingly, the focus of this evaluation has emphasized: structure; top down development; support for abstraction, constructs, and language; defined deliverables and artifacts; education and training alternatives, including certification for architects; EA development processes; operational integration; and, governance. An EA framework needs to support and enable the realization of this overall strategy and direction for the State.

Forrester[6] surveyed 196 European and US enterprises and found that 76% of the respondents use an architecture framework. Of that group, 55% use a custom framework that is not attributable to any single entity. Of the respondents:

- 24% used no framework;
- 30% used Zachman;
- 26% used a specific consulting firm framework, such as Gartner, Forrester, Capgemini, etc.;
- 16% used TOGAF;
- 20% used older IEEE and SEI frameworks;
- 3% used DODAF; and,
- 1% used the NASCIO framework.

Table 2 lists the EA frameworks that were reviewed for comparative purposes and that form the basis for the recommendations in this report.

Data in Table 2 was derived from Forrester,[7] Schekkerman,[8] and other organizational EA framework descriptions. There are 21 frameworks listed in this table, which certainly raises questions concerning the suitability of these frameworks for State use, since new frameworks are developed based upon organizational needs that were not met by existing frameworks.

Framework	Complete Name	Accompanying Methodology	Organization
ARIS	Architecture of Integrated Information Systems Framework	Y	Institute für Wirtschaftsinformatik
Bredemeyer	Bredemeyer Framework	Y	Consulting Company: Bredemeyer
BTEP	Business Transformation Enablement Program Transformation Framework	Y	BTEP Office at the Treasury Board of Canada Secretariat
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance	Y	Government
Catalyst	CSC Catalyst	Y	Consulting Company: CSC
CIMOSA	Computer Integrated Manufacturing Open System Architecture	N	CIMOSA Association
E2AF	Extended Enterprise Architecture Framework	Y	Institute for Enterprise Architecture Developments
EAP	Enterprise Architecture Planning	Y	Steven H. Spewak
FEA	FEA Reference Models	Y	Government
Forrester	Pillars of EA	N	Consulting Company: Forrester Research
Gartner	Enterprise Architecture Framework	Y	Consulting Company: Gartner Group
GERAM	Generalized Enterprise Reference Architecture and Methodology	Y	International Standards Organization
IAF	Integrated Architecture Framework	Y	Consulting Company: Capgemini
NASCIO	EA Toolkit	Y	Government
PERA	Purdue Enterprise Reference Model	Y	Purdue University
ProACT	Holistic Framework	Y	Consulting Company: proACT
RM-ODP	Reference Model for Open Distributed Processing	N	International Standards Organization
TAFIM	Technical Architectural Framework Information Management	Y	Government (US Department of Defense)
TEAF	Treasury Enterprise Architecture Framework	N	Government
TOGAF	TOGAF Technical Reference Model	Y	Open Group Organization
Zachman	Zachman Framework	N	Consulting Company: ZIFA

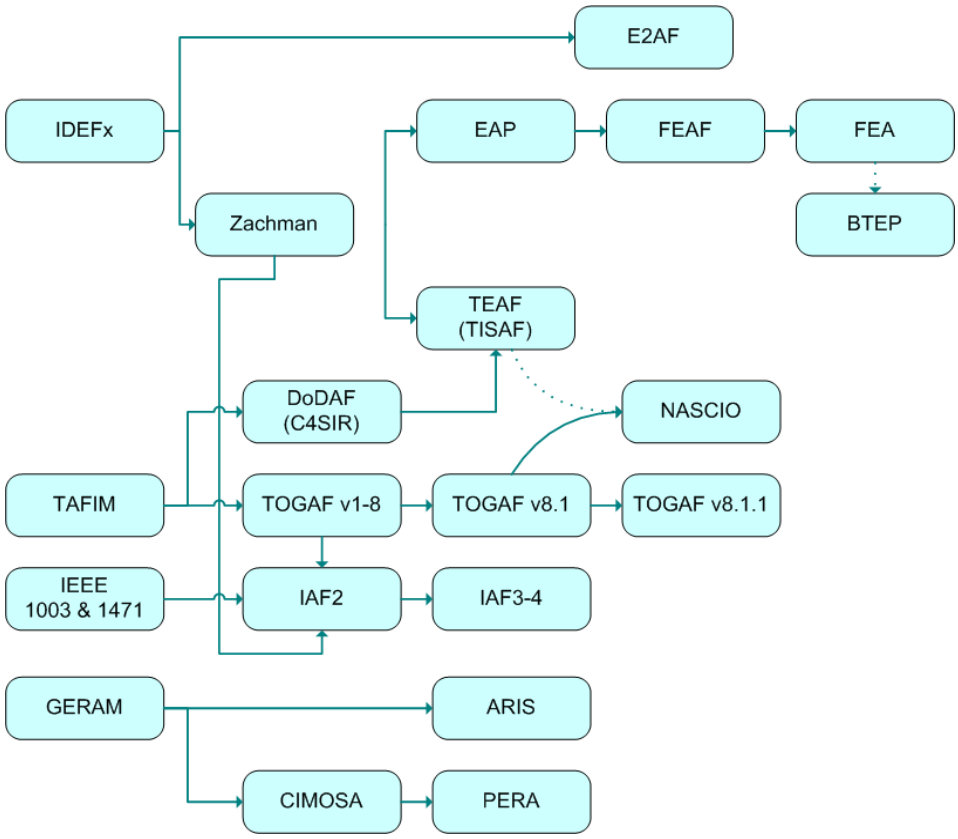
Table 2.
Currently Available Architecture Frameworks

The EA frameworks that were reviewed in this summary were selected based upon the following requirements:

- applicability and overall suitability for State government;
- ability to facilitate business communication and involvement;
- adaptability to meet specialized and rapidly evolving e-government needs;
- ability to easily integrate Service Oriented Architecture (SOA) principles;
- cost and personnel impact for startup and ongoing expenses;
- adaptability to business and technology change;
- operational integration and guidance capabilities;
- usability of artifacts and related documentation recommendations;
- availability of compatible EA modeling tool environments;
- practicality and repeatability of governance processes; and,
- availability of defined methodologies and training and/or certification.

Figure 2 illustrates the origin and relationships of many of the various frameworks that have been developed[9, 10] and are currently available. Relationships are important in that they help understand the core capabilities upon which a given framework is based.

Figure 2.
EA Framework Family Relationships



EA Framework Research Conclusions

Of the 12 to 15 frameworks that were closely analyzed, and the major organizations that use them, no instance was found of any organization using an EA framework without some modification to meet enterprise needs.

Conclusion 1:
There is no single dominant EA framework. Each framework comes from different sources and attempts to address different issues and objectives.

Conclusion 2:
Development of an EA framework from scratch is complex and expensive, so most organizations customize by adapting an existing framework.

Conclusion 3:
Enterprise architectures that meet the business requirements of complex organizations like the State require hybrid enterprise architectural approaches that facilitate collaboration and cooperation between agency operations and centralized DTS services.

Conclusion 4:
Enterprise architectures have design tradeoffs and give-and-take requirements. All of the requirements of enterprise architecture are not likely to be equally met for all stakeholders.

Conclusion 5:
Finding an appropriate balance, the right levels of interaction, the right layers of service component visibility and granularity, and the right governance models are complex undertakings and no single framework and associated methods and practices will work across the board.

Conclusion 6:
The level of detail often required by traditional EA efforts can be a substantial impediment to engaging stakeholders effectively on EA teams.

Conclusion 7:
Most of the extant EA frameworks and methods available today are in need of updating to address current business and technical realities. A focus on method tends to minimize the impact of changing business and technical realities.

Conclusion 8:
The EA framework needs to facilitate practices between enterprise service components and real time system specific architectures and systems deployed by State agencies.

Conclusion 9:
Architecture is not just a collection of documents and other artifacts. To be effective, an architecture framework must enhance collaboration and communication with the business, provide appropriate levels of documentation for operational and planning purposes, and finally, enable implementation of new technologies and processes.

Conclusion 10:
An effective EA framework will provide an effective resource base for ongoing architecture and development that includes case studies, taxonomy or a glossary, and reference materials, tools, and techniques for EA development.

Conclusion 11:
In an organization with finite time and personnel resources, the EA framework needs to enable results that are deemed useful by the State without undue time and cost.

Conclusion 12:
EA modeling tools are still in early stages of development, but sophisticated tool environments are available for widely adopted EA frameworks.

EA frameworks and the resulting architectures that are derived from them are most useful when they are developed collaboratively and focus on areas that have strategic importance to the State. An effective EA will not try to manage everything, but will place emphasis and focus on the things that matter most to State business and IT.[11]

EA Framework Recommendations

Choosing an EA framework can be as simple as adapting an existing framework or as complicated as inventing one. Selecting an EA requires attention to six basic areas:[12]

- Evaluate and understand the enterprise business environment.
- Define the goals and objectives that the EA framework is expected to support.
- Identify which existing EA framework fits best with the business environment and the goals and objectives for EA.
- Customize the existing framework and identify any required modeling techniques.
- Test the framework with some dry runs to ensure suitability.
- Refine the EA framework and associated processes.

After a thorough review of EA Framework alternatives, from both an abstract and ultimately a practical perspective, the framework solution that seems to offer the most value and flexibility for the State is TOGAF. TOGAF is an industry standard generic enterprise architecture framework.

TOGAF Overview

The TOGAF EA framework[13] is easily understood, with support for four core architectures, illustrated in Figure 3, including:

- Business Architecture
- Data and Information Architecture
- Application Architecture
- Technology Architecture

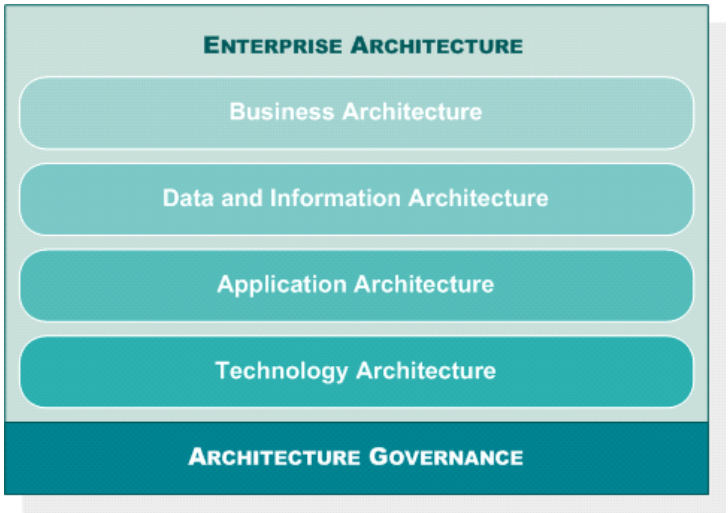


Figure 3.
TOGAF EA Foundation Framework Components

TOGAF is based upon the following mission and strategies:

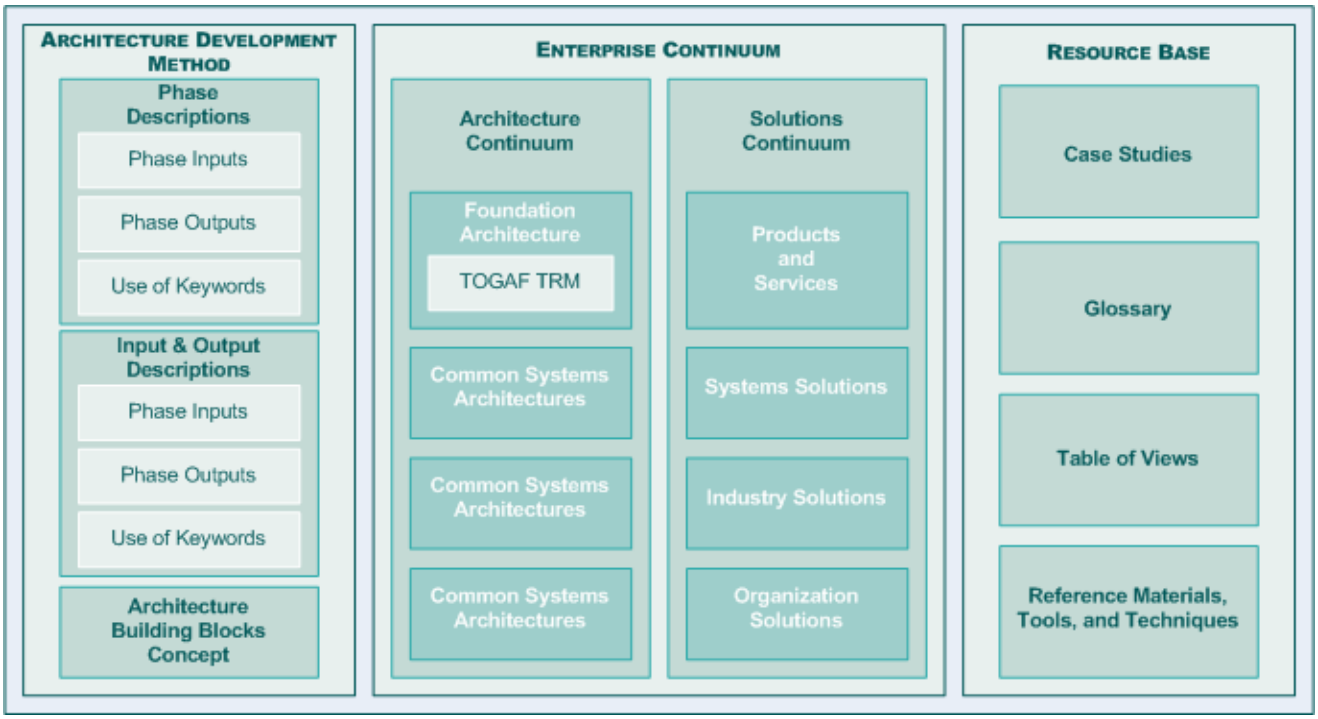
Mission: Drive the creation of boundaryless information flow.

Strategies:

- Work with customers to capture, understand and address current and emerging requirements, establish policies, and share best practices.
- Work with suppliers, consortia, and standards bodies to develop consensus and facilitate interoperability.

Figure 4 represents the implementation of a rich set of resources for architecture development methods, architecture building blocks, foundation and reference architectures, product and services solutions, and an extensive resource base.

Figure 4.
TOGAF Architectural Components



The TOGAF Architecture Development Method (ADM) illustrated in Figure 5 provides an overall repeatable EA process solution, for the development of specific architectures.

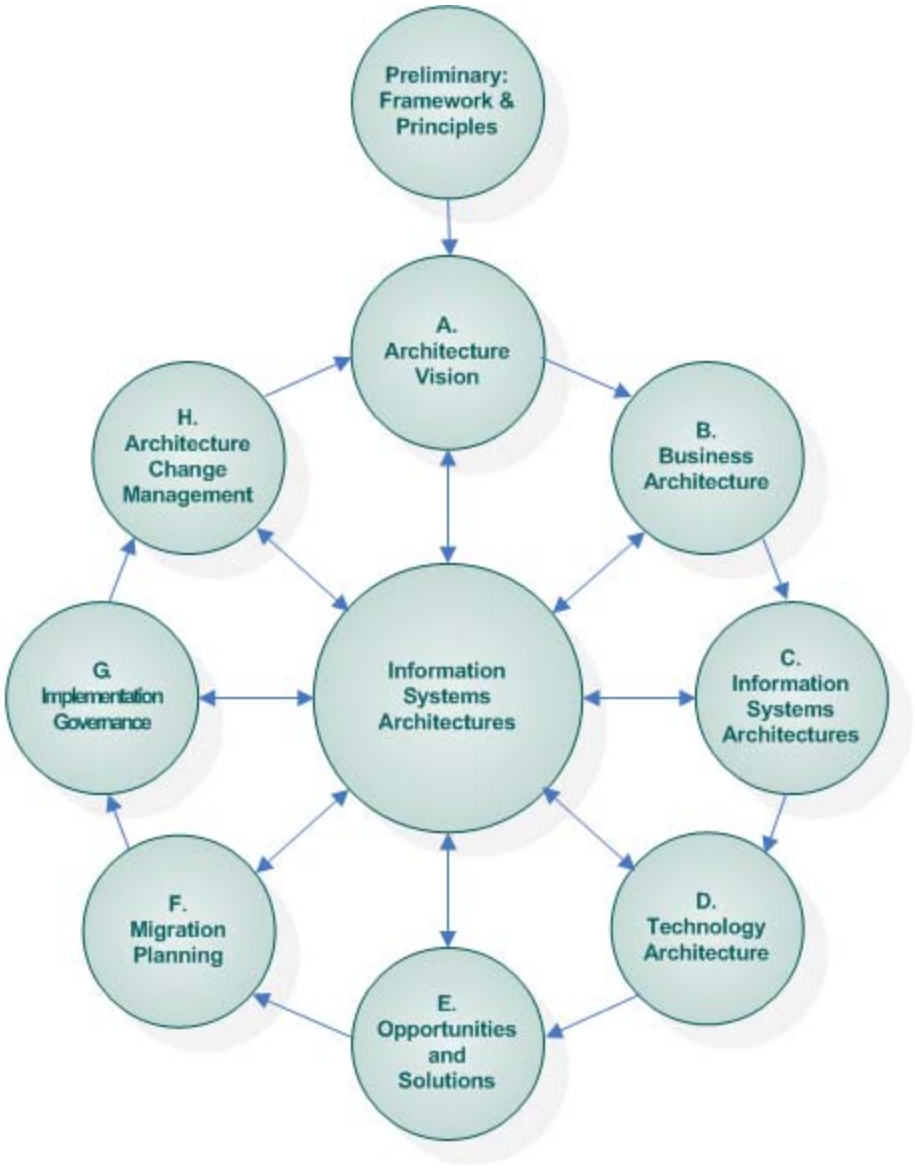


Figure 5.
TOGAF Architecture Development Method

ADM is an iterative method covering the entire process as well as between and within phases. Each iteration through the ADM suggests new decisions, including:

- Enterprise Coverage
- Level of Detail
- Time Horizon
- Architecture Asset Reuse:
  - Previous ADM Iterations
  - Other Frameworks, Systems, and Industry Models
- Decisions are Based On:
  - Competence and Resource Availability
  - Value Accruing to the Enterprise

Deliverables and/or outcomes for each of the ADM stages include:

Preliminary Phase: Agreement on EA Framework and principles.

Phase A (Architecture Vision): Initiates an iteration of the ADM process:

- Sets scope, constraints, and expectations.
- Validates the business context.
- Creates a statement of architecture work.

Phase B (Business Architecture): Shows how the agency or organization meets its business goals:

- Business goals and objectives.
- Business functions, services, processes, and roles.
- Correlation of organization and functions.
- Confirm context.
- Define baselines and targets.
- Perform gap analysis.
- Produce a Business Architecture Report.

Phase C (Information Systems Architectures): Shows how the IT systems meet the business goals of the agency and enterprise, and reviews the application systems and data architecture.

Phase D (Technology Architecture): This is the fundamental organization of the IT system. It includes:

- hardware, software, and communications technology;
- relationships between technologies; and,
- principles governing design and evolution of technologies.

Phase E (Opportunities and Solutions): Identification of the major implementation projects, including:

- decisions on approach:
  - buy versus build;
  - outsource;
  - commercially available software; and,
  - open source solutions;
- assess priorities; and,
- identify dependencies.

Phase F (Migration Planning): Produces an implementation roadmap and other relevant analysis, such as cost benefit and risk assessment for major projects.

Phase G (Implementation Governance): Defines architectural constraints on implementation projects, and establishes architecture contracts or agreements. In cooperation with the Project Management Office (PMO), monitors implementation work for conformance.

Phase H Architecture Change Management: Ensures that changes to the architecture are managed in a cohesive and architecturally consistent manner. Establishes and supports the EA to provide flexibility to evolve rapidly in response to changes in technology or agency business environments.

TOGAF Reference Models

The technology architecture component incorporates an extensible Technical Reference Model (TRM). The TRM is associated with a detailed taxonomy of services that defines the scope of each service category. The TRM also identifies system wide capabilities or qualities, such as service and management. Figure 6 represents a high level view of the TRM that is in place in most large organizations, including the State.

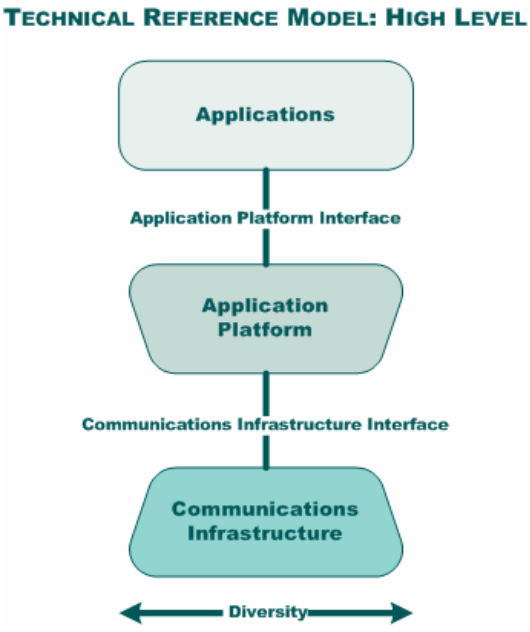


Figure 6.
High Level View of the Technical Reference Model (TRM)

The high level TRM seeks to emphasize two major common architectural objectives:

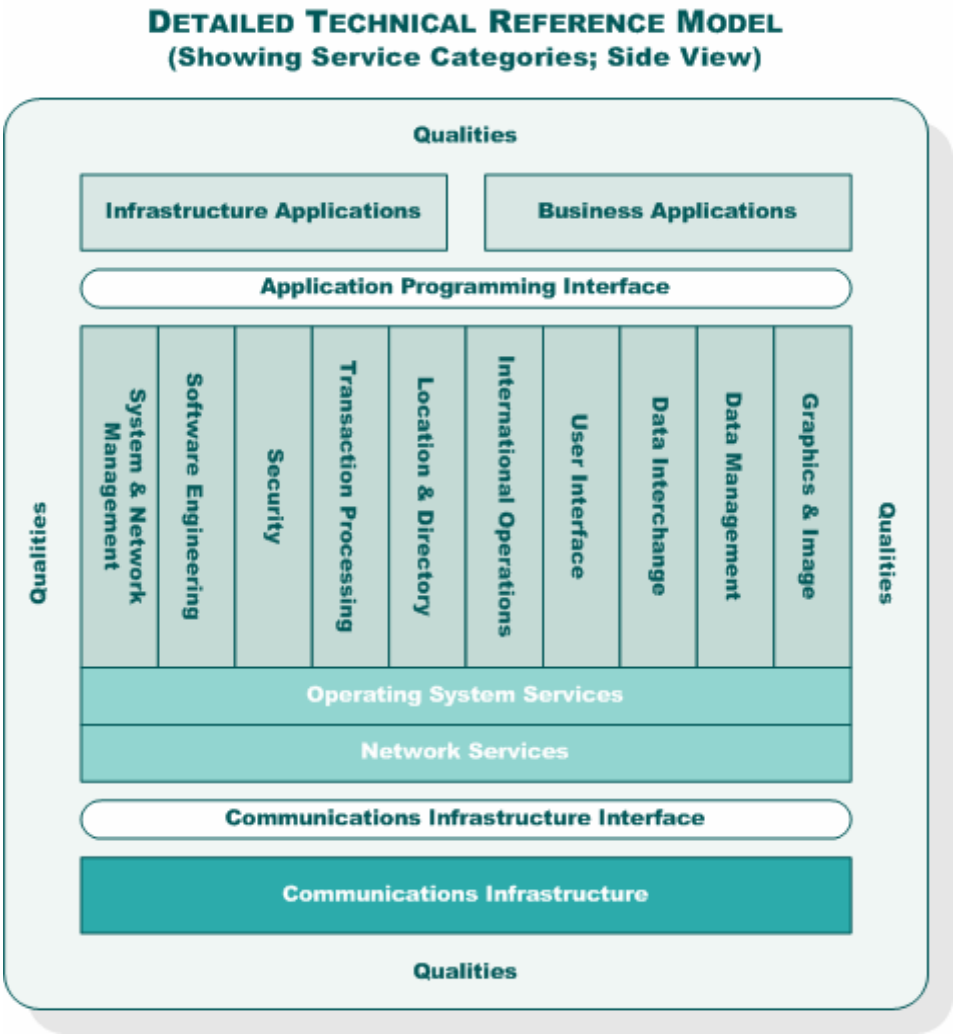
Application Portability, via the application platform interface (API) which identifies the services that are to be made available in a standard way to applications via the platform.

Interoperability, via the communications infrastructure interface identifying the communication infrastructure services that are to be leveraged in a standard way by the platform.

This high level model reflects the increasingly important role of the Internet as the basis for interoperability, both within the State and externally. The implication is that core services need to be supported by IP based networks.

Figure 7 is a generalized view of the technical reference model associated with technology infrastructure and the relationships of the TRM components. Figure 8 illustrates the TRM from a top down perspective, which shows the relationship of the communication architecture to other TRM components.

Figure 7.
Technology Architecture
Technical Reference Model (TRM)



Qualities identified in Figures 7 and 8 refer to:

Availability, or the degree to which something is available for use, including:

- **Manageability:** The ability to gather information about the state of something, and control it.
- **Serviceability:** The ability to identify problems and take corrective action to repair or upgrade a running system.
- **Performance:** The ability to perform tasks in an appropriate amount of time.
- **Reliability:** The resistance to failure.

- **Recoverability:** The ability to recover effectively from a fault or disruption.
- **Locatability:** The ability of a system to be found when needed.

Assurance, including:

- **Security:** The protection from unauthorized users.
- **Integrity:** The assurance that data or services are not corrupted.
- **Credibility:** The level of trust in the integrity of the system.

Usability, and ease of operation by users, including international operation or language, and cultural services.

Adaptability, including:

- **Interoperability:** The ability to communicate with other systems and infrastructure within and external to the State.
- **Scalability:** The ability of a component to grow or shrink its capacity based upon demand.
- **Portability:** Of applications, data, people, and components.
- **Extensibility:** The ability to accept and add new functionality.
- **Flexibility:** To offer access to services in new paradigms, such as Service Oriented Architecture (SOA).

Effective architecture implementations need to address these qualities to be useful. During the process of architecture development, qualities impact the choice of Architecture Building Blocks (ABBs) that are selected and used to implement the architecture.

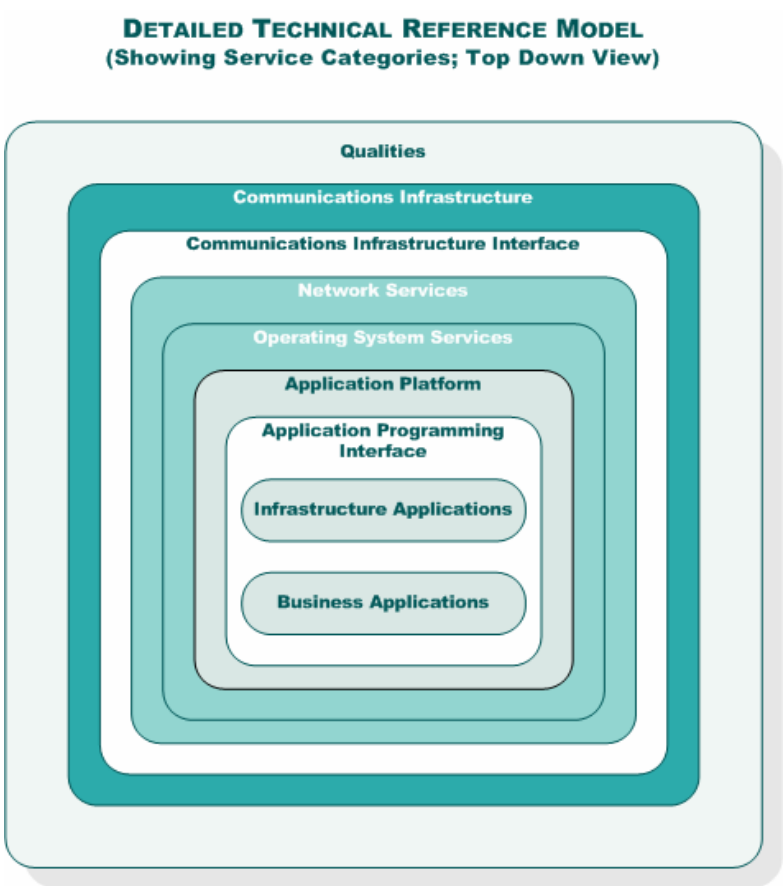
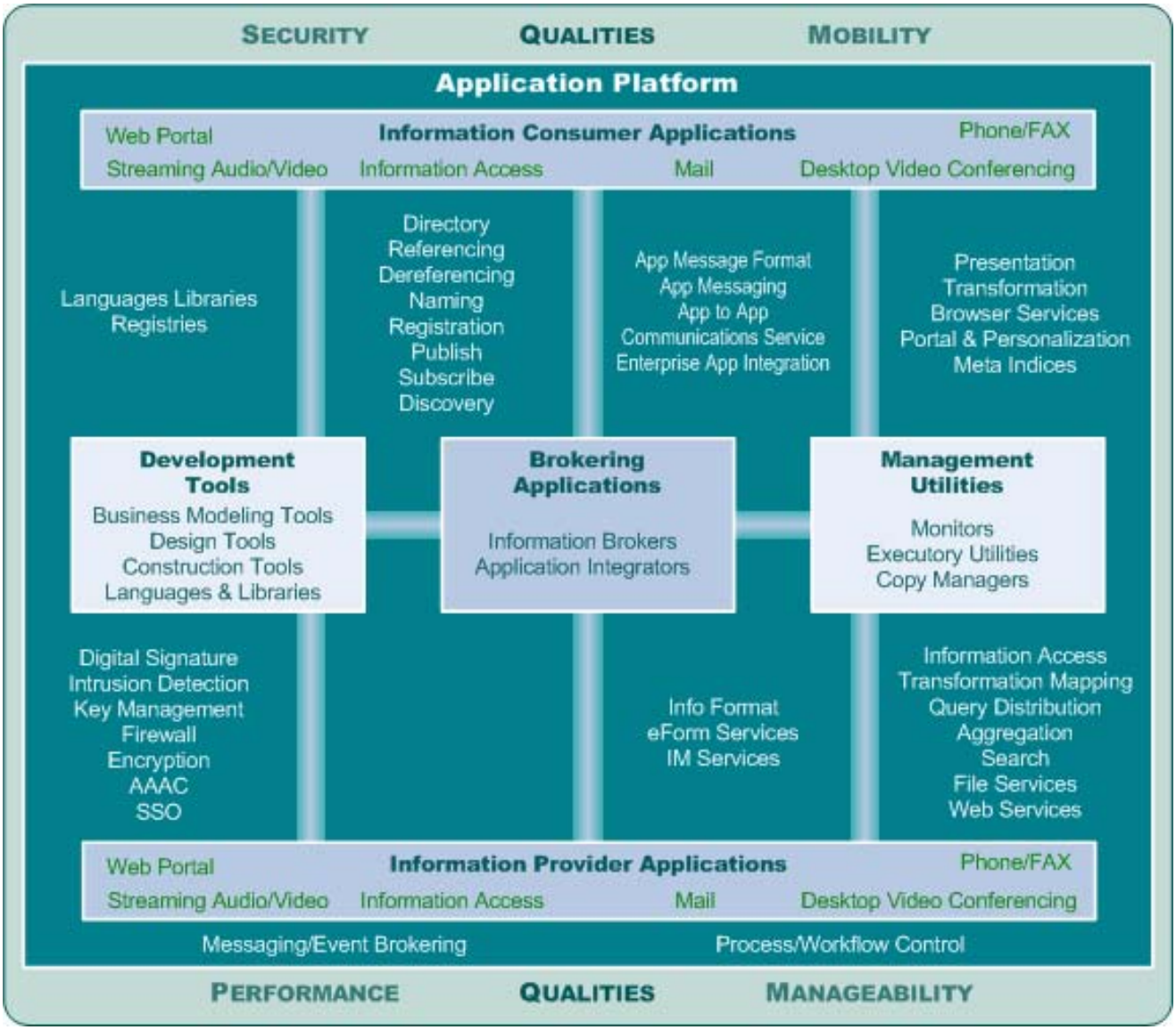


Figure 8.
Technology Architecture
Technical Reference Model (TRM)—Top View

TOGAF also provides an Integrated Information Infrastructure Reference Model (IIIRM) that is illustrated in Figure 9. This TRM is a model of the key components for developing, managing, and operating an integrated information infrastructure that supports the TOGAF goal of "Boundaryless Information Flow." It is a model of a set of applications that sit on top of an application platform. It represents an expanded set of the TOGAF TRM using a specific orientation.

Figure 9.
Integrated Information Infrastructure Reference Model—Detailed Model



As indicated in the TOGAF architectural component drawing in Figure 4, TOGAF uses an enterprise continuum approach to align and account for architectures and solutions that exist within and external to the State that have an influence on EA development. Figure 10 illustrates the two related continuums and components, including:

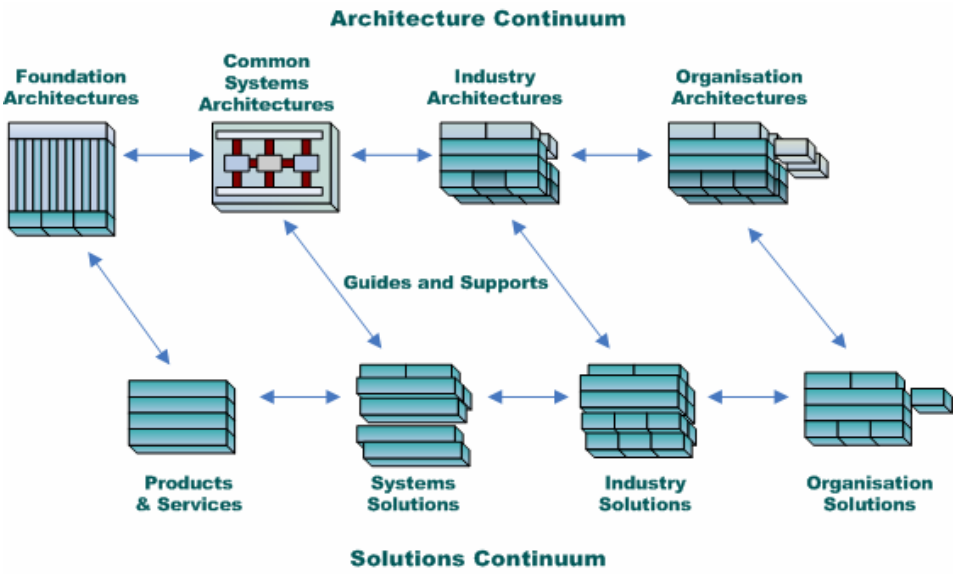
Architecture Continuum

- Foundation Architectures
- Common Systems Architectures
- Industry Architectures
- Organization Architectures

Solutions Continuum

- Products and Services
- Systems Solutions
- Industry Solutions
- Organizational Solutions

Figure 10.
TOGAF EA Continuum



TOGAF Information and Resource Bases

TOGAF provides a Standards Information Base (SIB) database of open industry standards:

- Content is determined by an Open Group consensus process.
- Standards are structured according to TOGAF TRM taxonomy.
- Standards are available for public Web access at www.opengroup.org/sib.
- Provides a gateway to many other linked EA resources.

TOGAF also provides a resource base that includes information in the following general areas:

Architecture Board: Guidelines for establishing and operating an Enterprise Architecture Board.

Architecture Compliance: Guidelines and checklists for ensuring project compliance to architecture.

Architecture Contracts: Guidelines for architecture contracts.

Architecture Governance: Arrangements for effective control of IT Architecture by enterprise management.
Architecture Patterns: Guidelines on architecture patterns.

Architecture Principles: Guidelines on developing Architecture Principles, and a generic set of Architecture Principles.

Architecture Views: Guidelines for developing viewpoints and views in architecture models.

Building Blocks Example: Examples illustrating use of architecture building blocks.

Business Process Domain Views: A set of function views aligned with the business process structure of the enterprise.

Business Scenarios: A method for deriving business requirements for architecture and the implied technical requirements.

Certification Training: Certification training and guideline for TOGAF certified architects.

Case Studies: Real-life examples of TOGAF in use.

Glossary: Definitions of key terms.

Mapping to Other Frameworks:

- Mapping TOGAF to OMG MDA Modeling Standards
- Mapping to Zachman
- Mapping to FEA
- Mapping TOGAF8 and DoDAF
- Mapping TOGAF8 and COBIT4
- Mapping TOGAF8 and ITIL Touch Points

Tools for Architecture Development: Generic evaluation criteria for architecture tools.

TOGAF has been developed by over 200 organizations on a worldwide basis, and currently has approximately 2,600 certified practitioners. The framework is complementary to many other frameworks such as NASCIO, FEA, Zachman, and Gartner, and represents an industry standard framework and method for EA. It also includes a best practice repository, and is designed to be vendor, tool, and technology neutral.

Rationale for EA Framework Selection

From a State business perspective, looking at overall comparative criteria, TOGAF appears to offer the broadest range of capabilities with the lowest cost to entry and adoption. TOGAF as an EA framework supports the following:

Architect Certification: Offers the largest and most successful EA certification path for architects. This would allow the State to certify architects at a variety of levels within DTS.

Business Focus: TOGAF is focused on business architecture and overall alignment with the other three core architectures. This is consistent with the DTS emphasis on aligning with agency business needs.

Core Documentation: The overall TOGAF EA framework is well documented in a standard TOGAF publication that is updated with each new release of the framework.

EA Artifacts: TOGAF does not require excessive production of EA artifacts. It suggests producing those items that have the greatest value to the enterprise and avoiding processes and artifacts that do not add business value.

EA Costs: TOGAF is free for use within an organization. Certification and training represent costs, as does the purchase of the standard TOGAF documentation, but these costs are minimal.

EA Development: Offers a consistent Architecture Development Method (ADM) that uses an iterative development method over the entire ADM process.

EA Method: Focuses primarily on method, whereas many other frameworks focus on product. The framework offers a core method for EA that can be filled out in the future as part of an overall EA roadmap.

EA Modeling: EA modeling tools are available for TOGAF from a variety of EA modeling tool vendors, including Agilense, Inteligile, TeleLogoc, and Troux.

Education and Training: Offers comprehensive education and training resources from multiple third party vendor training organizations.

Emerging Technology EA Patterns: TOGAF has already begun addressing issues with SOA and Web 2.0 within the EA framework.

Framework Integration: Provides mapping to other frameworks, such as Zachman, OMG's Model Driven Architecture (MDA), FEA, DoDAF, COBIT4, and ITIL.

Operations and Change Management: Addresses operational and change management issues effectively, and addresses integration with Project Management Office (PMO) functions, and aligns with Portfolio Management requirements and processes. The EA also maps to other common frameworks such as ITIL and COBIT4.

Repeatable EA Process: Teaching the TOGAF ADM method to other DTS employees is relatively straight forward and offers a lot of potential for implementation of a well defined repeatable EA process.

Standards Data Base: Provides a Standards Information Base (SIB) which is a database of open industry standards, structured using the TOGAF TRM taxonomy. Yje SIB is available for public access at no charge.

Technical Reference Models: TOGAF provides useful and relevant Technical Reference Models (TRMs) for the key architecture components, but facilitates the use of other EA TRMs that are applicable to the State.

Vendor Integration: Many major industry vendors, such as IBM, BEA, SAP, etc., use TOGAF as one of their EA development methods in conjunction with their own proprietary implementations.

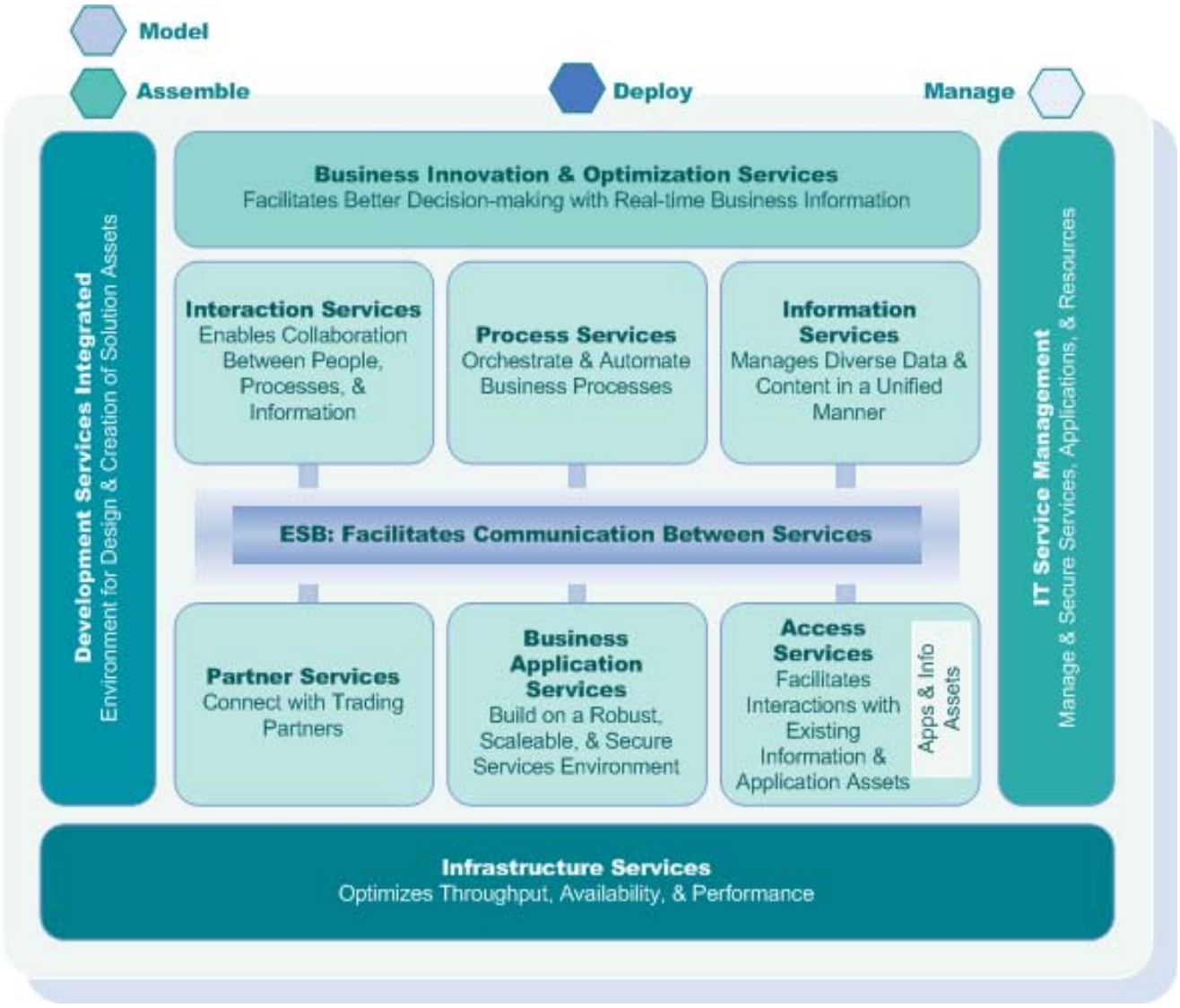
Using TOGAF as a core EA framework does not restrict the ability of the State to leverage useful development from NASCIO and other providers. It gives the State an optimal level of flexibility in actually implementing EA and leveraging a well developed and documented EA development process. The framework will also allow the State to make necessary customizations to meet specialized requirements.

SOA and EA Frameworks

Conventional enterprise architecture describes an information system in terms of structural properties of the system. The architecture identifies components, building blocks, standards, policies, and products which form the basis for planning and guiding systems delivery. SOA introduces change to the structural properties, with new and different building blocks, standards, etc. These do not necessarily replace the existing properties; mostly they complement and extend. However, there are also areas where fundamental differences apply, for example, in areas such as scoping and applicability, security models, and reuse policies.

SOA is basically a style or pattern of EA, and as such it needs to be tightly integrated with EA processes. SOA has the potential for major changes to application architecture and requirements for IT infrastructure. These kinds of impacts suggest a close relationship with EA. The TOGAF framework's use of TRMs make it particularly adaptable to changing patterns, such as SOA, and the addition of new services and capabilities. A more detailed look at SOA and the related reference architecture is detailed in a separate *SOA Reference Architecture* report[14].

Figure 11.
SOA Reference Architecture Framework



The SOA foundational reference architecture[15, 16], illustrated in Figure 11, is a technical reference model that forms a useful basis for part of the reference architecture for the State and integrates well with the TOGAF EA framework. The reference model establishes the pattern for SOA from an enterprise perspective, and in an architecturally neutral manner. The model includes the major service types and the relationships between components. This model serves as a specialized TRM that impacts Technical, Application, and Information architectures.

Summary

The EA framework for the State needs to be driven and aligned with agency business needs. The foundation of a State EA framework needs to be the Business architecture or business reference model for the State.

Deliverables

Implicit deliverables and artifacts from this EA framework model recommendation include:

- Revised EA Concept of Operations (CONOPS) documentation and implementation of designated EA groups specified in the CONOPS, and specification and integration with DTS operational resources and planning infrastructure, such as ChangePoint.
- Establish an initial operating budget for a small core group of EA resources. This budget should not represent a large cost burden to agencies, and should be baselined and measured to establish future EA cost benefit data.
- EA Development Methodology adapted from TOGAF and NASCIO.
- Utah EA Reference Models adapted from FEA, NASCIO, OASIS, and TOGAF:
    - Business Reference Model (NASCIO and FEA)
    - Technical Reference Model (TOGAF)
    - Integrated Information Infrastructure Reference Model (TOGAF)
    - SOA Foundation Reference Architecture (Open Group and OASIS)
    - SOA Solution Reference Model (Open Group and OASIS)
- EA Baseline Documentation for the Business, Application, and Information Architectures.
- EA Baseline Documentation for the Technology Architecture and specified major components.
- EA Targeted Architecture for Business, Applications, and Information Architecture and associated EA Roadmaps (5 Year).
- EA Targeted Architectures for the Technology Architecture and specified major components, and associated EA Roadmaps (5 Year).
- Establish certification and training requirements for Utah EA, such as TOGAF certification, and begin initial training of designated personnel.
- Ongoing development of standards documentation on an as needed basis.
- Definition of the EA touch points with infrastructure, engineering and development activities, and overall PMO activities.

Identification of each of these areas as a deliverable will help DTS to assess overall progress and clearly define what is needed for the EA framework to be effective. Much of the work can be adapted from the EA frameworks that are already mentioned, so the work of producing documentation will not be unduly burdensome. There could be a number of quick wins that can then be translated into ongoing operational and planning benefits.

Validation

While the DTS budgeting and capital planning model is evolving, the budget process needs to incorporate EA as a checkpoint for capital expenditures. There also needs to be a feedback loop for metrics for measuring value and compliance. Possible additional validation components for EA include:

- **Business behavior**, which produces the outcomes that fulfill key agency purposes. Behavior is governed by commitment, and is inherently more flexible than using business processes that are slower to change and often result in lack of EA responsiveness.
- **Solution sets** that are supported by information systems rather than just focusing on information systems. Information systems alone are often the result of vendor marketing, and external funding requirements more than the goals and objectives of agency business leadership. Information system focus alone can lead to misalignment between EA and business requirements. EA solution sets begin to look at common solution elements that are not focused on traditional agency boundaries (e.g., budget preparation, licensing and regulation, customer relationship management (CRM), assistance payments, etc.).
- **Map Solution Sets to IT Services and Applications**, so the alignment and value of EA and infrastructure investments is clear and so gaps become visible and overlaps can be eliminated.
- **Map Business Drivers to Architecture Solution Areas** to eliminate ambiguities about the reasons for implementing specific kinds of solutions.
- **Use Decomposition of EA to Business Solutions** as a key component of the analysis process and to enable multidisciplinary teams to work together from an enterprise view, while at the same time providing business specific analysis and validation. The State has recently had some success with this approach in evaluating Enterprise Reporting (ER) and Business Intelligence (BI) products and associated architecture and regarding SOA and Enterprise Service Bus (ESB) implementation.
- **Measure EA Adaptability** to establish risks and limitations, to better understand how flexible and extensible, or how dependent on a particular infrastructure an EA choice may be.
- **Identify Effective Deployment via Enterprise Program Management** by documenting results and benefits in EA migration and transformation plans.

The EA needs to have a great deal of objectivity that is non-prescriptive. A common failure of earlier EA implementations has been the tendency to view EA as something that looks like a software development lifecycle. This tends to result in too much documentation and unnecessary work with a resulting loss of focus as the level of specificity becomes too burdensome. This level of detail needs to be kept at reasonable and practical levels, especially as it impacts engaging business leadership in agencies.

Finally, EA needs to produce results. The ultimate operational goal of any agency is to optimize the alignment of their customer and partner needs, business strategy, culture, business, processes, and technology. EA can and should contribute to these goals in measurable ways.

Footnotes

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Appendix A
Architecture Framework Definitions and Terminology

Architecture
Architecture incorporates the structure of elements and their relationships including the principles and guidelines for their development over time.

Artifacts
Objects or descriptions of architectural representations are usually referred to as artifacts. These may also include visualizations, graphics, models, and narrative that depicts the EA and related design.

Baseline or As-Is Enterprise Architecture
Baseline architecture includes the set of products, business practices, and IT infrastructure that portray the existing enterprise.

E-government
The use of technology to promote more efficient and effective government, facilitate more accessible services, allow greater access to public information, and make government more accountable to citizens is commonly called e government.

Elements
Elements in architecture enclose the area of people, processes, business, and enabling technology.

Enterprise
An enterprise is any group of organizations, agencies, etc., that have a common set of goals and objectives. An enterprise in this context could be a single agency, groups of agencies with similar functional purposes, branches of government, or all State agencies.

Enterprise Architecture
EA relates organizational missions, goals, and objectives, to business tasks, activities, and relationships and to the technology or IT infrastructure required to execute them.

Migration or Transformation Plan
This plan provides the strategy for moving from the baseline to the target architecture. It provides tactical guidance for agencies to migrate to target environments, including schedules and required activities.

SOA
Service Oriented Architecture represents a model of loosely coupled applications working together by exposing services which can be shared.

Software Architecture
This architecture relates requirements and infrastructure to software structures in order to demonstrate software effectiveness.

System or Solution Architecture
This level of architecture relates external business requirements to system and solution structure so that the effectiveness of a system design concept can be adequately communicated.

Target or To-Be Enterprise Architecture
The target architecture includes the set of products, business practices, and IT infrastructure that portray the future or end-state architecture.