

A Proposed Model for Assessment of Enterprise Architecture for e-Government in Iranian Public Sector

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ABSTRACT

Increasing investment on information technology has forced to measure business value. Importance of architecture assessment is critical to assess business values. There are some maturity and assessment frameworks that have not scientific foundation and are based on practice in some specific enterprises. We have introduced an architecture assessment process and guidelines to improve architecture performance. We investigated on architecture assessment frameworks and evaluate them to find the best proposed model for enterprise IT Architecture assessment to evaluate enterprise architecture outputs and capabilities. We validated findings with Delphi techniques. So, we have an architectures overview and assessment models and then found the best criteria's to evaluate architecture outputs. Then we have proposed a comprehensive model that takes in hand all aspects. The paper provides clear framework to assess and validate EA in three domains of business architecture phase, data and application architecture and EA implementation phase.

KEYWORDS

Assessment, Framework, Enterprise, Architecture

1- Introduction

The main goal of every organization is to achieve complete alignment of its business operations and optimizing its processes to meet employees, customers and stake holder's needs. EA¹ is the most popular approach to view all of organization's facets together and try to align them. So, good EA will help organizations to reach optimum performance and achieve goals [EA validation full version, 2004]. EA is an effective tool to align business with IT. Well defined *alignment* is a key factor in EA success. It is *inevitable* for managers to know good EA is a necessary tool for business success [Richard Burk, 2004] because it views all of organizational aspects in an *integrated* way.

Prerequisites of good architecture are first, existence of defined business goals and second, acceptable organizational readiness (cultural, people, process and budgeting plans). Development of EA is an ongoing process. Enterprise architects of agency must hardly work to mature and improve EA to make

it adaptive solution. *Adaptive enterprise architecture* is required for business success in current situation with its rapidly changing conditions [Dynamic Enterprise Architecture, 2004]. Unified continuous assessment of EA is an important action to ensure efficiency and effectiveness of EA anytime at various conditions. Currently agencies use maturity models and assessment frameworks to evaluate efficiency and effectiveness of EA. Current assessment frameworks and maturity models mainly focus on evaluation of EA results and implementations. It seems they don't concentrate on *process* of EA development and implementation.

Current assessment frameworks just focused on defining problems of EA results only. There isn't an *integrated* approach that *comprehensively* views to all process steps of EA development and execution including EA justification, project definition (RFP ...), Vendor selection, Project management, and implementation process, while these subjects may be the root causes of EA results' failure and diagnose them before finalization of EA will dramatically decrease the risk of EA failure.

In this paper, a *comprehensive framework* will be proposed which focuses on assessment of EA development and implementation process from failure causes point of view. Popular EA Frameworks such as Zachman doesn't have specific method or

¹ Enterprise Architecture

well-defined approach for assessment of results or the process of results development. Proposed model introduce some key indicators to assess each step of lifecycle; we mean three phases of project justification, definition and initiation (mainly for decision makers), EA development and implementation. The integrated unified framework for assessment introduced here to evaluate EA process make EA more responsive to its defined mission. In this research, we viewed architecture assessment frameworks, find common used guiding factors and then we represent a comprehensive and integrated model for architecture assessment to assist you in developing and improving your IT Architecture processes. We proposed a model for architecture assessment using composite indicator development method to assess progress and provide the link between IT and business by using this assessment process.

2- Literature

Enterprise Architecture (EA) at agencies plays a major role in improving mission performance and the efficiency of business operations by guiding and constraining the creation of modernization blueprints [Thomson, 2001]. Each blueprint contains a set of initiatives that, in aggregate help transform into an envisioned future [DOI, 2003]. In turn, disparate and unreliable architecture products were leading to non-integrated, non-interoperable, and non-cost effective capabilities in the field [TOGAF 8.1, 2003].

The purpose of every EA assessment framework is to understand how well the architecture is aligned with its expected goals. EA assessment involves experiments, modeling and scenarios that exemplify requirements, as well as assessment by experts who look for gaps and weaknesses in architecture based on their experience. If there is some organizational commitment for EA review and re-architecture, it will be simpler to gain agreement on an assessment project. If you are not sure to have support, do what is necessary to ensure about their support, for the purpose of assessment and discovering problems [OMB FEA, 2004].

There are many frameworks and maturity models for EA assessment that we found some of them. So firstly, we introduce popular assessment frameworks and maturity models and then analyze their strengths and weaknesses in a comparative way. Some *performance evaluation* frameworks were chosen and investigated to find key elements of them. We studied on frameworks which is useful to implementation. DODAF prescribes standards for evaluation and prevent developing architecture without standards

[DOD, 2003]. TOGAF contains Architecture Development Method (ADM) uses capability maturity framework to assess architecture capability, its quality and level of aligning technology with business processes to achieve EA goals [TOGAF 8.1, 2004].

The other one which we consider here is Architecture Capability Maturity Model (ACMM) provides framework represents key components of productive IT architecture process. ACMM main goal is to aid conducting internal assessments of readiness for EA implementation [ACMM, 2004]. This framework represents key process components of productive IT Architecture and is composed of three sections, 1) EA maturity model 2) IT architecture's process characteristics of operating units at different maturity levels and 3) IT architecture capability maturity model scorecard. The first two sections explain the *Architecture Capability Maturity* levels and corresponding architecture characteristics for each maturity level to be used as measures in the assessment process [TOGAF 8.1, 2004]. GAO developed the EA Management Maturity Framework (EAMMF) as a result of government-wide survey about government agencies EA Programs. EAMMF outlines some steps toward achieving a stable mature process for managing development, maintenance and implementation of EA. Establishment of *current maturity level* gives a roadmap for EA management and helps improving it. By using this, organizations will be capable to manage EA effectively. Defining the scope of assessment is necessary to understand needs and purposes. EAMMF is comprehensive method of EA management that provides roadmap for EA planning and increasing flexibility. Amount and depth of assessment will vary depending on user needs and the purpose of assessment. This program is suitable to *define what to be done and how to be done* [EAMMF, 2005].

Another framework we consider here is OMB's EA assessment framework designed to help organizations assess *capability of EA program*. This framework gives a roadmap to assess current architecture and help developing solutions to improve and integrate it with decision making process. They can resolve issues and utilize potentials of EA development and improvement. OMB assesses maturity of EA, capabilities to improve EA products development and integration with other related architectures and gives potentials for collaboration between IT and business sides. OMB EA assessment framework has four main categories: *integration, governance, business alignment* and *change*. In each category, you should assign level 0 to level 5. You assign Level 0 for organizations that have not any architecture and level

5 for good optimized architecture. [OMB FEA, 2005]. FEA PMO cooperates with *Governance Accountability Organization* (GAO) on how collaborate to achieve *effectiveness and efficiency*. This program helps stakeholders to revise architecture and identify gaps. This model uses *scorecards* to review results. FEA PMO provides guidance to ensure achieve business goals and results, evaluate utilization and adopt FEA in execution phase. It uses method to ensure agency *adoption, utilization and execution* of EA and assesses agencies for alignment of performance with strategic initiatives and drivers to ensure using EA to promote performance. It uses *performance evaluation system* to provide *feedback and key metrics* [FEA PMO, GAO, 2005]. We briefly discuss aforementioned frameworks to better understand why a new approach will be proposed as subject of this paper. About GAO and OMB frameworks, GAO assessment framework seek opportunities to identify the extent to which an organization developed EA that support performance by influencing IT planning and investment decision, while OMB framework focuses on faithfulness of the outputs of EA program [GAO, 2004; OMB, 2005].

The Standard CMMI Appraisal Method for Process Improvement (SCAMPI) is the appraisal method associated with CMML. The SCAMPI appraisal method is used to identify strengths, weaknesses, and ratings relative to CMMI reference models [CMMI, 2005].

Adaptive and dynamic architecture enables to *change* and manage *complexities* inherited in large government agencies. *NASCIO EA maturity model* provides a path for architecture and procedural improvement. As EA matures, process will be controlled and effectiveness of architecture will be improved. These criteria's are consistent with generally accepted EA best practices in both private and governmental enterprises [NASCIO, 2004].

3- Proposed Model for Architecture Assessment

Some frameworks focus on EA process phases and some on EA development. In contrast, some of other frameworks focused on implementation issues. As it is clear, there is not any integrated and unified approach for EA assessment which both addresses the EA Process and results. Also there is not enough consideration of EA project definition and initiation process. These frameworks have some insight to decision making process to start architecture and goal

setting without any comprehensive analysis method to answer some key questions to assess architecture.

This model developed depends heavily on stakeholders concerns and is result of unstructured interviews. We validated findings with Delphi techniques and generate criteria's depend on views and viewpoints. We consider *comprehensive process framework* to assess architecture work; implementation and result point out architecture assessment views used in common assessment frameworks [OMB, 2005; ACMM, 2004; NASCIO, 2004]. In all phases of assessment, we use criteria's architects represent as key factors in EA assessment. We used some factors and key indicators. The model bellow shows key factors and their relationships. In this part, first, we introduce criteria's that is use full for this part.

• IT Current State and Readiness Assessment

Some architecture work done shows that successful implementation of IT architecture needs a good agency technology platform to achieve EA goals. In big enterprises with low level of IT readiness, EA works is process improvement and prepare infrastructure facilities to improve maturity. Step one in this process model is the assessment of IT readiness. You can't achieve interoperability goals when your organization is in low level of readiness. So assessment of IT readiness will help define goals near the reality and develop realized architecture. IT readiness assessment conducts before architecture definition when you write architecture principles and goals in steering committee.

• IT Governance & Architecture Goals Definition

EA program supports the implementation of policy and architecture, accommodating the need for Bureau-unique functionality and business requirements. The EA program supported by a methodology and system of governance promotes optimal outcomes across a highly diversified set of mission areas. In managed level, explicit governance of IT investment as formal process to manage variances and updating works. Some frameworks have direction to IT governance. IT governance considers owners view in architecture work and management support. IT governance committee should define main goals and policies to *drive* program. Architecture initial phase is to define main principles by IT governance committee to effective support related programs. These principles form the basis for making architectural decisions, accepting

results, and managing migration. They are based on industry best practice, agency's purpose, vision, values, policies, procedures, and standards. Definition these principles is key factor to assess IT governance support. Defining goals, principles for EA program and effective is main *enabler*. Program should be run based on EA purpose, vision, values, policies, procedures, and standards. Many frameworks support this part of model suitable for agency with specific notice to IT Governance. But many architecture programs run without clear and realized definition of goals and there is no *governance* to conduct integrated acts to achieve architecture goals. So, the level of IT governance importance to support program is another key factor to assess success of IT plans.

In this part of model, we focus on assessment of indicators related to IT governance, program goals, policies and standard definitions such as strategic direction of IT in top management area. Management support to *IT Governance*, define vision for EA; use policies and strategies necessary to develop successful architecture. Management involvement means the levels of its awareness about architecture efforts and its supportive activity; support program and help optimize and implement projects. Senior management reviews EA process time variances and involves in optimizing process improvement of EA development. Assessment of IT governance for program is recommended to enhance supports and reduce resistance for program. Because of the need for IT enabling technologies investment, EA should impose strong pressure on involving top management that result positive effect on delivering practical IT plan.

• Business Architecture Assessment

EA establishes an IT planning foundation based on business priorities. The agency Strategic Plan goals and outcomes provide business direction in developing key IT products and services defined to support business vision. Initiatives aligned with principle implications provide visibility into the agency's business needs to ensure proper sequencing, as well as to provide insight into dependencies among projects. Management view in business change to increase competition has important value. Mapping strategic direction of top management, help develop practicable technology plan which adopt management needs and take in organizational support for implementation. Different stakeholder's views utilize principles in different ways; help to develop cost-effective IT alignment with mission objectives. Many works develop architecture without realization

and definition of needs; many of works don't update architecture and finally resulted not be useful. Development of architectures without realizing them will develop, mountain of papers with little input from agency needs, isolation of architecture and developing architecture without any question and challenge with stakeholders will result not imbedding the architecture process with business functions and cause project failure. Considering stakeholders needs derive business value. Definition of architecture goals helps to consider stakeholders view. So, emphasis is to assess business architecture using indicators. Successful programs define principles and strategies to align business requirements with technology enablers. Developing realized architecture and feasible one is directly linked to meet stockholders needs and requirements. Requirement analysis is another critical factor to assess business architecture. We recommend assessing defined strategies and run assessment program with other related key indicators. We drive it to reflect views as important aspect.

This information defines stakeholder's views in other architectures such as technology and helps achieve goals. Some indicators used to business architecture assessment is *business linkage* means bind strategies to technology as *drivers* with standard models such as *balanced scorecard* and *best practices*. Business alignment is one of the key factors to assess architecture, means how EA insures *alignment* with agency's strategic goals and business targets. Perform formal modeling languages, tools, and method and process improvement techniques, provides communication between stakeholders. One of *business architecture assessment* issues is to investigate recommendations for implementation of *process improvement*.

• Application Architecture Assessment

The implications of architecture principle will still include strategic use of technology components, but with an understanding that the resulting, composite application must satisfy the business problems requiring a solution. This principle accommodates the need to *align* technology with business requirements. Good definition of application architecture principle is another key factor that should be evaluated in assessment program. This assessment is required to successful implementation of programs. Application architecture is affected by requirement analysis. We assess requirements definition in different views of stockholders, architects, designers and subcontractors view. Application architecture is another aspect, indicates that architecture is practicable or not.

Assessing application architecture is necessary to improve performance and the quality of application will develop based on these definitions and standards. We use main factors to assess application architecture after business architecture assessment in this model.

Convergence means how EA integrates *Business functions* to align IT as enabler with business to meet business requirements. *Integration* means how well EA insures interface, interoperability, information and connectivity standardized. They used *integration* criteria to insure meeting objectives of *integration* in data and application levels. Four main criteria's for *integration* is *interoperability*, *data*, *business logic* and *interface*. *Business alignment* means how well EA insures alignment with the agency's strategic goals to achieve business targets *Interoperability* is main goal of many architecture frameworks. *Service Oriented Architecture (SOA)* facilitates the development of an IT environment that will be modular and independent ("atomic") in nature. The *adaptive* SOA will enable *dynamic* capabilities and reconfiguration of the application services to respond to *business change*. The Level of attaining to SOA facilities is directly related to IT infrastructure readiness. So, the first step in developing architecture is measuring readiness to set goals compatible with reality of agency. In *high level of maturity* in agencies interoperability is main goals. Some frameworks intended to ensure descriptions are comparable and Integratable across joint and multi-national boundaries. One of indicators for application architecture assessment is *Integration* means how well EA insures *interface*, *interoperability*, *information* and *connectivity* are standardized. We use *integration criteria* to insure meet goals in four areas that are interoperability, data, business logic and interface. *Enterprise Application Integration (EAI)* facilities can help agency to attain this goal.

Some architecture frameworks use notations for application architecture. This approach to architecture uses multiple views to represent application architecture. Rather than prescribing fixed set of views, some frameworks support this approach suggest first ask from stakeholders determine which architectural representation best captures the information they need to do their jobs. The application architects create a table showing stakeholders and views that represent their viewpoints. The architects then combine views and prioritize them until a set of views that sufficiently covers the view types is selected. Developing *comprehensive architecture* with all views is another key factor that should be assessed to realize all stakeholder's views and needs.

Some frameworks have an application architecture approach that uses business architecture and strategic direction to define target applications and conduct a gap affects analysis to select vendors and applications. This approach doesn't conduct complete analysis of service portfolio and isn't recommended for who wants a great technical architecture because application architecture doesn't consist of application engineering framework selection. Accessibility and distribution of business process models (BPM) is one of the key factors to successful deployment of EA management practice. We recommend assessment means if agencies select suitable framework or not to select good framework with practical approach to design and implement application. Assessment the adoption of application architecture in details is necessary because some types of businesses have critical operation that should be analyzed in detail. For example, some frameworks depend on the presence of lower-level facilities described by architecture for operating system, support communications and so on.

• **Technical Architecture Assessment**

Organizations can use variety of information infrastructure and technologies (usually already available and present in agencies) such an intranet, web technology, etc. Using such a distribution mechanism process model can be made available to all stakeholders, and their access can be made platform (application and hardware) independent. So, key factor is the assessment of technical architecture distribution mechanism considered. The development of blueprints is influenced by Principle values ensuring a consistent and stable set of ideas to be implemented and supported by initiatives. These Principles represent business and integrate technology direction, the rationale and implications of each principle become guides for EA initiatives and priorities. Principles guide implementation of technology meet organization requirements, guide *decision-making* to maximize business benefit and adaptability of IT environment help us to define assessment factors related to goals and expectations. Target EA teams have major impact on detailed solutions align them with target architecture. Different stakeholders view and utilize EA Principles in different ways, with the common end goal of developing cost-effective IT aligned with agency mission objectives. Some frameworks support *technical reference model* facilitates architecture which proposed unified detailed specification to guide for developing EA with standards and *unified*

technical platforms in all agencies to increase *interoperability*.

Some Architecture Frameworks developed based on IEEE1003.0, greatly extended to include method for *technology architecture*. Some frameworks developed for technical platform blueprint and its specification aim to provide a common, agreed set of specifications for general purpose computing platform. Some standards such ISO/IEC14252 (IEEESTD1003.0) built up on standards. Some other frameworks support *technical architecture* without *technical reference model*. We define level of using standards and selecting platform for architectures. Assessment of technical architecture is based on *reference models* and *standards*. *Adoption* in common standards will result successful architecture. One of indicators, used for architecture assessment, is *convergence*. Convergence means how *business* integrates *IT* using specific criteria's provided by technical platform, component and security. Security is important factor in technical architecture. Formal analysis is best suited for small, fully-specified systems designed detailed security model. *Security* and *privacy* issues are another important factor for investment. Security/privacy details assess investment throughout life-cycle to include budgeting for them.

• Implementation and Performance Assessment

We focus on design, analysis and implementation of Information systems and technology plan. Defining principles and investigating from different view help implement EA successfully. We consider transition, change management; performance issues investment quality and so on. Builder's and subcontractors views are associated with design and implementation of architecture. They give *technical specifications* and *requirements* to develop system, data, business and application architecture, compatible with designer view. Linkage between architecture and design is key factor to successful implementation. Some frameworks focus on implementation, this view supported by enterprise functioning and builder view is affected but some frameworks do not have the taxonomy of various viewpoints and views. Level of considering different views is key indicator to assess EA implementation, leads to the *comprehensiveness* and *integrity* in the management of implementation program. Some frameworks focus on enterprise engineering with the practice of suitable tools and methods to implement with detailed enterprise engineering methodologies.

Some indicators will help to assess the way agency select framework and implementation method. In the high level of maturity, good selection will help improve business logic. We should represent this factor to assess framework.

Recommended indicators to assess implementation process qualification of IT architecture (in this part of model are: 1) *Organization functional unit's participation* means recognition and the support of personnel; Level of functional unit's participation in architecture and giving feedback to drive architecture process improvement. High level of involvement can help management reduce *complexity*, improve integration and enhance overall IT ability of operating units to achieve business goals; 2) *Architecture Management Process Definition*, means if process defined in the hearth of IT organization with strong linkage between IT and business processes. 3) *Program management*; means the level of existing project management disciplines or skills with formal priority setting mechanisms. In the high level of EA maturity, planning and scheduling activities help time-based development and implementation of EA program and projects risk assessment activities conducts based on architecture. EA at the agency plays a major role to improve *mission performance* and the efficiency of business operations by guiding and constraining creation of modernization. Each blueprint contains initiatives that, help agency transform into an envisioned future. Central to agency modernization success will be the adoption of EA throughout the organization and cultural perception help promote line of business interests within the Bureaus. One effective measure to begin ingraining EA into culture is setting of architectural principles which all bureau line of business and IT stakeholders can follow. Managing implementation of architecture and performance is another indicator. EA provides value added when its products and services align with business requirements, integrate to enhance *mission performance*, and as a *driver* to improve process execution. *Implementation of IT plans with efficiency* is another aspect found in performance measuring. *Balanced scorecard* and related methods for *performance assessment* can help us. People involvement in functional units indicates the *adoption* level of architecture work in organization. The figure 1 shows comprehensive assessment model for EA that indicates semantic relationship between parts of model.

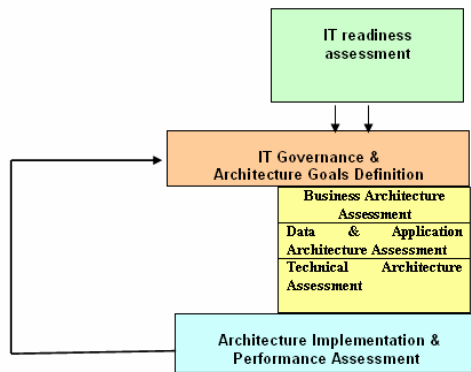


Figure1- EA Assessment Model

Change management is another aspect is important to drive good architecture; means how well architecture facilitates management of *change*. People have great effect on implementing EA and change management process help to enhance people *adoption* and *support*. In the high level of EA maturity, *change management* procedure exists and links to architecture review, adhere to formal EA methodology and conduct design review with cooperation of functional units such as IT Architecture work groups.

Some agencies use an *Earned Value Management System* that meets ANSI/EIA748 Standard and project is earning value for cost, schedule, and performance goal. Developing financial and non-financial indicators to assess performance is recommended. We should assess how well the agency done in baseline goals progress for attaining targets performance goals? Overall, the aim is to assess if the agencies have agency-level *component* of EA? If so, is the investment integrated with the EA plans and/or EA policies? If an EA developed, is there a credible migration plan (for data, applications, and legacy system phase-out) from the existing “*as-is*” to the proposed “*to-be*” environment? We assess if the investment has e-business technology, information security, standardized procurement, or wide area telecommunication elements; does the investment have interagency elements; has the *investment* been integrated with the EA(s) of interfacing agencies or mission areas? Are detailed management plans in place describing how this investment supported, maintained, and refreshed to ensure its currency and continued effectiveness, including training and awareness plan for users and technical staff?; Are *asset management processes* in place to inventory and manage this new asset (investment) from a property management perspective, to provide configuration management

support, and monitor system performance?; And how meaningful are the identified baseline for performance goals, measures and indicators in measuring the “value” of investment to the supported program? Investments support and enable the business strategic goals and objectives. Initiative should reduce cost and/or increase efficiency and effectiveness. So, finally we assess does the investment provide for increased customer centered government? Feedback from this assessment can be given to goal setting and governance of IT update architecture less practical and implementation issues. These feedbacks help agencies to develop EA, update and implement successfully.

4- Conclusion

We have considered this model to address relationship between architecture main issues. This framework has a *reference model* for architecture that has considered all aspects of architecture. This model can be useful for organizations that have great focus on architecture implementation. The method can clearly identify system bottlenecks and lead to architecture improvements and/or roadmaps. It can also help improve management objectives aligned with product development for cost reduction and obtain better product quality. This paper describes an architecture framework assessment model to aid the architects to define good architecture in a reproducible way.

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