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Development Experience of National Enterprise Architecture Framework: A Case Study

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Abstract

The eGovernment Authority (eGA) of the kingdom of Bahrain embarked on a three year eGovernment program aimed at improving service delivery to citizens through seamless integration and connected governance. In order to achieve this objective, eGA realized the need for a Kingdom-wide strategy and holistic guiding plans, and hence decided to design and develop a National Enterprise Architecture Framework (NEAF). NEAF is an aggregation of models and meta-models, governance, compliance mechanisms, technology standards and guidelines put together to guide effective development and implementation of an Enterprise Architecture by different government entities across Kingdom. This paper will describe NEAF development project success story, its objectives and its importance to Bahrain's economical vision 2030. It describes the NEAF development lifecycle and highlights at each stage the findings and challenges faced during the project.

Introduction

Governments around the world are leveraging advances in Information and Communication Technologies (ICT) to enhance their service delivery mechanism so as to improve citizen's satisfaction towards government as well as gain competitive advantage over other nations in attracting investments.

Building on the believe that there exists a positive correlation between the desired level of eGovernment capability and maturity and the required level of Architectural maturity, the eGA embarked on a three years eGovernment program aimed at improving service delivery to citizens through seamless integration and connected governance. In order to achieve this objective, eGA realized the need for a Kingdom-wide strategy and holistic guiding plans, and hence decided to design, develop and implement NEAF for kingdom of Bahrain.

Aspirations for economy, government and society in accordance with the guiding principles of sustainability, competitiveness and fairness have been described in "economic vision 2030" of kingdom of Bahrain. NEAF was designed and developed in alignment with this vision.

NEAF would help in managing complexity, manage IT portfolio, deliver road map for changes, support system development, support business and IT budget prioritization etc. Different issues in any organization like legacy transformation, business changes, infrastructure renewal, and application systems renewal and business/IT alignment can be resolved by designing an Enterprise Architecture (EA).

In the following sections, the paper will start with objectives and scope of the project and after a brief theoretical background on EA concepts, the approach taken to developing NEAF is described. Each stage of the approach is then discussed and the findings and challenges are highlighted. During the architecture assessment stage (As-Is), an EA maturity view is established and concluded. This builds a foundation to developing the target architecture along with the design of governance and compliance process. Additionally, the definition of a set of standards and guidelines, to help government entities focuses on certain technologies and reduce their cost and interoperability in the long run, will be highlighted. Finally, the gap identified between the As-Is and To-Be architectures, that triggered a set of initiatives at national level and specific to government entities, will be described. The paper is closed by a summary of NEAF development outcomes.

Project objective and scope

NEAF is an aggregation of models and meta-models, governance and compliance mechanisms, technology standards and guidelines put together to guide effective development and implementation of EA by different government entities across the country.

EA is practiced in many industries; private and public sectors. It is very important before embarking an EA project that the objectives to be achieved are defined clearly. As a trend, EA could serve different objectives; to lower the cost of IT, fix its effectiveness, fix its strategic value, use IT to generate new strategic value or in many cases to transform the business with IT. For instance EA could help with coping legacy complexity and cost, reintegrating the supply chain, integrating public services, enhancing channel capabilities or even delivering a better customer services.

The main objective of NEAF is to assist the kingdom of Bahrain to design, develop, deploy and use enterprise architecture for better strategies, processes, plans, structures, technologies and systems across the government entities for successful implementation of e-Government. Specifically, in case of Bahrain, the focus was to

- Simplify and speed up services deployment to citizens

- Diversify services delivery channels

- Ease and improve integration between various ministries and government authorities.

- Achieve cost benefits of consolidation and standardization. Hence, reinvest the savings into modernizing the service delivery and provide more innovative services to citizens

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Used as a guiding tool, NEAF was believed to provide a structured and comprehensive process for evaluating the impact and consequence of changes in business direction, business processes, avoiding silo base IT decision making and achieving the required alignment in the acquisition and implementation of technology tools.

The first iteration of NEAF (development phase) covered 167 services across 26 government entities (ministries and authorities). The aim was to move the government entities from business silos state towards standardized technology and rationalized data and applications. The output of the first iteration of the initiative was:

- Target architecture for government service delivery
- Technology standards and guidelines
- Initiation of EA maturity program
- Governance and compliance framework to guide all the above

Apart from the above initiatives, the project also identified a set of projects to be implemented to achieve the target architecture. These projects range from simple enhancements to a system through major introduction of new application systems. Several awareness building sessions and training workshops for all involved government entities were also conducted under this initiative, as final deliverable of the project.

Enterprise Architecture: a Theoretical background

Enterprise architecture defines the business, the information necessary to operate that business, the technologies necessary to support the business operations, and the transitional processes necessary for implementing new technologies in response to the changing needs of the business [1].

As illustrated in Figure 1, EA is simply defining the four layers of Business, Information, Application and Infrastructure architectures. These layers are usually called domains and can be described as follows:

Business domain: represents the functions and processes that support the business, the organizations that perform the business processes and the locations where the business is performed, and the factors that could cause the business to change.

Information (Data) domain: identifies the major types of information needed to support the business functions. It identifies and defines the information model, data sets, metadata repositories, and their relationships to the business functions and to application systems.

Application domain: identifies and describes applications and modules, as well as their relationships to business processes and other applications systems and modules. The application architecture identifies the major applications needed to support the crosscutting business processes of the enterprise.

Infrastructure domain: identifies the major technologies, or *platforms,* necessary to support the enterprise's applications and data systems, and associates those platforms with the various applications in the architecture.

In every EA project, the above current domains status (As-Is) architecture are first defined to measure their EA maturity of the organization. Then and based on a comprehensive study of the organization, the target architecture (To-Be) would be developed. The journey of moving the organization's current to target architecture with a set of action plan is called the Transitional plan.

Finally and in order to complete the circle such transitional plan would not be possible without management and a governance process. These processes provide policy guidance, advice and assistance in the definition, design and implementation of the enterprise architecture discipline and practice throughout the company, an understanding of the process for making co-operative and collaborative IT investment decisions and designate who within Flabella is responsible for making these decisions [2,3].

The Development Process and Methodology of NEAF

Alignment of Bahrain's economic vision 2030 with the vision, mission, goals and objectives of each ministry or government agency would drive their Business Architecture. Business-IT alignment for better Return of Investment (ROI) and efficient service delivery to the citizens would drive the IT architecture covering Application, Data and Technology. Common infrastructure for the service delivery on multiple channels and national data set for Symantec interoperability are primary contributors for the standardization and seamless integration across the ministries and agencies. These are the key drivers for the adoption of enterprise architecture across the Kingdom of Bahrain.

eGA has taken initiative to design the EA framework at the national level (NEAF) which consists of reference architecture, standards & best practices, guidelines and policies along with governance and compliance to be adhered by each ministry/agency.

NEAF development followed two well known EA frameworks; The Open Group Architecture Framework (TOGAF) from the Open Group, which is a process and methodology oriented framework [4]; and Zachman enterprise architecture framework, one of the most popular enterprise architecture frameworks developed by Mr. John A. Zachman and which is more perspective and taxonomy oriented focused [5,6].

As shown in Figure 2, the design of NEAF follows a stage approach covering the Baseline architecture (As-Is), target architecture (To-Be), gap analysis and finally the implementation roadmap as well as migration plan. The baseline architecture for all the ministries/agencies provides business and IT landscape in current scenarios and the interactions/integration between different entities. Target architecture in the context of NEAF is Reference architecture with project/opportunities to be implemented by relevant ministries/agencies. Gap analysis is required to ensure the reusability of existing asset (business
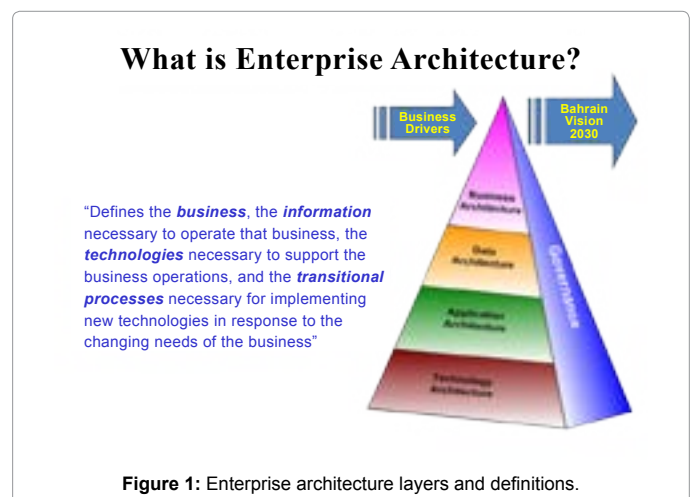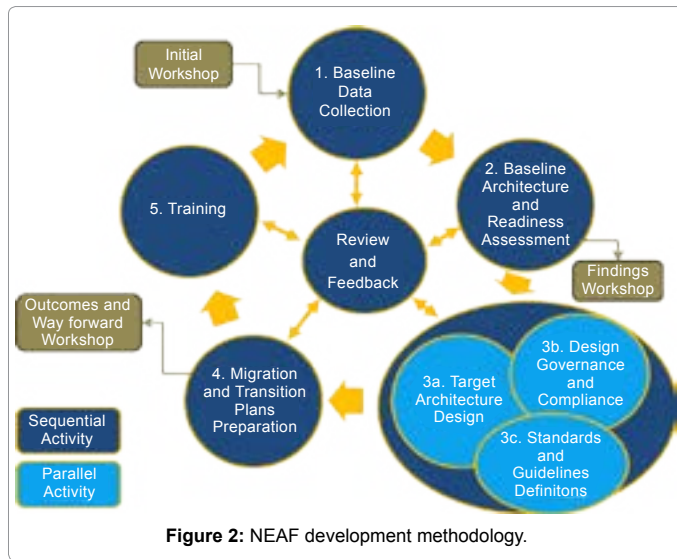

Figure 1: Enterprise architecture layers and definitions.

Figure 2: NEAF development methodology.

and IT) as well as the additional components required to achieve the EA vision at the national level, aligning with Bahrain economic vision 2030. Implementation roadmap and migration plan is the list of initiatives/projects to be taken by each ministry/agency to ensure target architecture at the national level is achieved.

EA maturity model has been designed for the kingdom of Bahrain to assess the capability of each ministry/agency to be able to implement the initiatives/projects recommended as the outcome of NEAF. Overall assessment of the EA in different ministries/agencies has been summarized at the national level with the maturity level matrices ministry wise and domain wise. This will be elaborated further in the coming sections.

One of the success factors of the NEAF project was education, communications and awareness. Therefore, throughout the project, several workshops, awareness meetings, focused discussion groups for both data gathering, gap analysis and finally EA/NEAF training were conducted to all key members of the government entities involved in the project. Some of the key workshops are shown in Figure 2. In the last phase of the first iteration of development of NEAF, more specific and targeted training was conducted for those personnel from government entities who would play critical roles within the specific government body. Eighty five trainees from twenty six different government entities attended the training [2].

Overall, the development process follows sequential activities, except for stage 3, where three key deliverables are developed in parallel, as by this stage, all the necessary data would be available. These are the target architecture design, the governance and compliance design, and the definition of NEAF standards and guidelines.

In summary, built on the pillars of business, data, application and technology, design and development of NEAF involved following steps:

- Creation of awareness about the EA initiative amongst the government entities.

- Collection of data for the government entities' vision, goals, business processes, IT organization, skill sets, capabilities, systems, infrastructure deployment, IT planning and budgeting.

- Validation of data collected with the stakeholders from the

government entities. Missing data wherever identified was also collected.

- Based on the data collected, assessment of the baseline architecture of the individual government entities and also the kingdom as a whole was carried out. This assessment shed light on the EA readiness of the government entities (measured on EA maturity model developed specifically for the project), technology landscape across the government entities, IT planning, governance and policy related issues such as data sharing, source code management, documentation of systems and IT ownership.

- Development of target architecture to address the requirements of integrated service delivery for government entities.

- Comparison of the target architectures vis-à-vis the baseline architectures to identify the gaps between the two states.

- Preparation of the migration plan, spanning over three years, identifying the projects and initiatives to be undertaken by the government entities to migrate from baseline to target architecture. The projects were prioritized based on the readiness of the government entities, business alignment and functional and data dependency.

- Discussion regarding the migration plan with the individual government organization to align the projects to their plans and requirements.

Architecture Baseline Assessment (AS-IS Stage)

The findings of the baseline architecture assessment provided crucial insights into the architectural landscape of the government entities. The assessment identified factors that were either conducive or impeding the movement towards target architecture. A few favorable factors identified include:

- Employing Balanced Scorecard systems to ensure alignment between visions, objectives & business services.

- Defining and implementing different layers of access controls in information systems, and

- Taking initiatives in improving the reliability and availability of services.

However it was identified that such factors were restricted only to few government entities. The hindering factors, which were more prevalent amongst the government entities, include:

- Lack of a policy framework for defining and governing ICT investments in the kingdom. This resulted in poor utilization of government funds and investment in redundant IT systems, data sharing and system interoperability.

- Absence of defined standards and guidelines.

- Duplication of work due to lack of definition and availability of reusable components.

- Lack of an application integration framework.

These factors led to delayed and poor quality of services delivered to citizens.

EA Maturity Level (Architecture Readiness Assessments)

The comprehensive data collected from the targeted government

entities, also enabled the project team to assess their EA maturity, both at entity level and overall government level. All four domains (business, data, application and technology) of the architectures of the government entities were assessed across eleven architecture elements on a five point maturity scale. The eleven architecture elements considered for assessment were; Governance (design and execution of Governance), planning (EA program roadmap and implementation plan), framework (processes of templates used for EA), blueprint (collection of the actual standards and specifications), communication (education and EA awareness), quality of service (focusing on reliability, performance and maintainability), compliance (adherence to published standards, processes and other EA elements), integration (touch-points of management processes to EA), security (standards and framework), process (Architecture processes) and involvement (support for EA program through the organization) [7,8].

The maturity levels in eleven elements across four architecture domains were used to calculate weighted mean enterprise architecture maturity level for the government entities. On the scale of 0 to 5 (0 being the lowest and 5 being the highest maturity level), the architecture maturity levels of government entities varied from a low of 0.21 to a high of 1.22. The average enterprise architecture maturity of all government entities stood at 0.77. Relatively low levels of architecture maturity indicate presence of wide ranging opportunities for improvement in the architectures of government entities. The architecture elements average maturity measured across all the 26 government entities are shown in Figure 3.

EA Assessment stage: Findings and highlights

The methodology and maturity frame work description are not the focus of this paper, therefore no more elaboration will be given in this regards. However, what is more important are the key finding and observations identified from the above maturity assessment exercise. These findings helped the project team as an input to development of the target architecture, and they can be summarized as follows:

- Most of the ministries/agencies have identified the need for EA.
- Alignment their vision, mission, goals and objectives with economic vision 2030 is top priority for everyone.

Figure 3: Average maturity of architecture elements measured across 26 government entities.

- Skill enhancements, resource pooling, funding for new initiatives are common concerns.
- Skill shortage or en-balance is common issue. Despite the fact that ICT adoption is becoming the main target of every government entity, IT/IS departments/directorates suffer shortage of human resources both in quality and quantity.
- Overall need to have centralized governance to assist their EA and to support their businesses is common consensus.
- Data/information sharing between ministries/agencies is major concern for delivering the business services by most of the ministries/agencies.
- Well established frameworks for seamless integration between ministries/agencies to deliver the services are high priority action point considered by everyone.
- Architectural artifacts are partially created across the ministries/agencies due to missing EA initiative either at the national level or at the ministry/agency level.
- Business-IT alignment is ad-hoc and inconsistent in most of the ministries/agencies and hence IT investment and ROI is not completely justified.
- Security has been addressed in ad-hoc way in most of the places except few who has adopted industry standard and recommendations.
- Senior management involvement is visible as initial stage but not to the expectation to deliver the business services in effective and efficient manner across the ministries.
- Ownership of the services is not very clearly defined and Service Level Agreement or Operational Level Agreement (SLA/OLA) is missing across the kingdom between ministries/agencies as well as with vendors and suppliers.
- Training programs, awareness, knowledge management are major areas of improvement in the kingdom to drive the EA initiatives across the ministries/agencies.

Summary of Baseline Assessment (AS-IS Stage)

National enterprise architecture for the kingdom of Bahrain will be a key vehicle for successful implementation of the eGov strategy and other key initiatives across the ministries/agencies. Several focus areas in economic vision 2030 can be directly linked with NEAF and hence it is very critical for each government entity to align their EA with the national EA.

Service delivery to the businesses, citizen and within the government in seamless integration manner by executing processes owned by different government entity can become reality only if all these entities adopt a common framework for the business and IT architecture and adhere to the national standard for the business and IT service design and implementation.

National level bus infrastructure (*National Service Bus*) for the service mediation and integration, message routing, transport and transformation and also to offer message broker supporting web service standards are few of the justification to invest and utilize for the effective service delivery as per agreed SLA and OLA.

Symantec Interoperability between all the government entities can be achieved by defining enterprise-standard like metadata
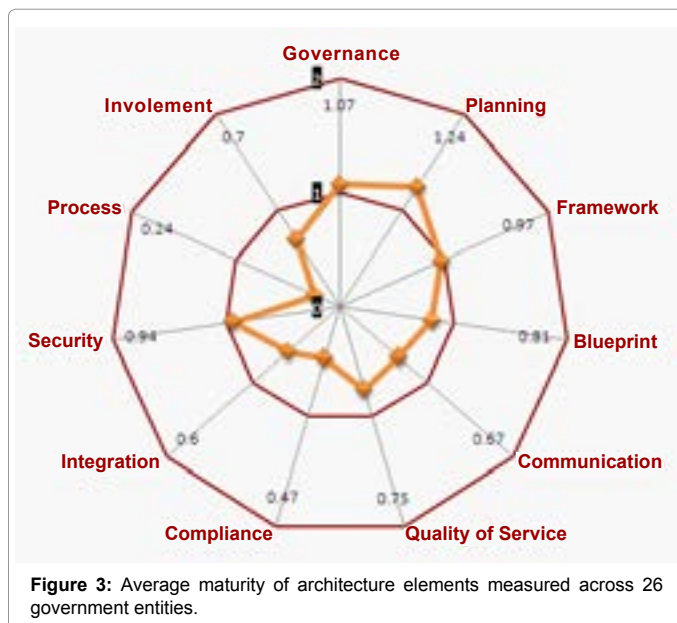
schema and industry-standard vocabularies for service delivery area & support of service delivery areas as scalable way for boundary-less information flow, and by incorporating Symantec technology within the infrastructure across the Kingdom. This can be achieved by mapping the data between different ministries, by providing Symantec integration across the country as well as exchanging data in consistent, flexible way for the providers and consumers of the services. Metadata repository at the national level can be leveraged to define National Data Set (NDS) as well as the key sources for the services to access the required information from different ministries/agencies.

The kingdom of Bahrain as one enterprise or rather "ONE BAHRAIN" consisting of different government entities as separate enterprises will be delivering the services using multiple delivery channels and hence authentication and authorization process will cut across multiple enterprises. This requires robust security architecture for different types of delivery channels and federated identity management to provide assembled identity of the user's information stored across multiple distinct identities management systems. Single Sign On (SSO) at the national level can be another initiative to align with EA needs.

Governance will play key role to ensure that government entities within the kingdom of Bahrain will comply with the standards and policies to provide the quality of the services as per the SLA with the customers and OLA between the enterprises. EA Governance Authority with proper roles and responsibilities will guide and mentor the ministries/agencies to design their own EA in line with national level EA.

The Target Architecture (TO-BE Stage)

In this stage the findings of the baseline architecture along with the kingdom's economic vision 2030, eGovernment strategy and other business requirements and current planned initiatives will be used as an input to developing the target architecture (To-Be). To achieve this the architecture vision, principles, requirements, constraints was defined; service delivery architecture was developed, which consisted of Business, Data, Application and Technology architectures; conducted an architecture trade-off analysis, to decide what items from the current identified architecture to be reused, and what are obsolete and have to be changed when developing the target architecture. Additionally, two more important deliverables are the outcome of this stage; 1. the definition of architecture Governance and 2. Compliance and the design of Standards and Guidelines. These are described in detail in the following sections.

Architecture governance

The aim of enterprise architecture is to improve the alignment between IT and business by enhancing the ability of the organization to better control IT-related changes in a manner that supports the overall business strategy. To do this, the organization is required to map its current and future EA states of the organization in relation to the business and IT perspectives and consequently prepare a transition plan that closes the gap between the two states - in other words, the organization's IT blueprint.

Architecture governance is the set of mechanisms through which architecture is enacted in the enterprise. Governance is essentially about ensuring that business is conducted properly. It is less about control and strict adherence to rules, and more about guidance and effective and equitable usage of resources to ensure sustainability of an organization's strategic NEAF objectives [9,10].

Architecture governance provides a practice and orientation by which architectures can be effectively managed and controlled at an enterprise level. During the assessment of the baseline architectures of the government entities, it was observed that a major factor that has resulted in lower values of architecture maturity in these government entities is lack of an architecture governance framework. This led the NEAF team to propose the formation of an architecture governance body and the design and development of architecture governance framework.

The recommended governance structure for NEAF is a federated architecture governance model and it provides advantages in cost, schedule, autonomy, scalability and robustness. The federated governance structure maintains a good balance between enterprise-wide standards, reference architecture and frameworks, and localized business-area driven innovation [11]. Four steps Governance process model namely (Enable, Ensure, Evolve and Enhance) was recommended for NEAF, as follows:

- **Enable**: identify strategic projects and secure funding for the identified projects.

- **Ensure**: conduct architecture reviews for NEAF compliance, perform EA maturity assessment, and guide government entities on IT initiatives.

- **Evolve**: keep NEAF up to date and manage standards, policies and guideline.

- **Enhance**: manage capacity building and perform vendor enablement with regards to NEAF.

A central enterprise architecture team has a primary responsibility for reference architecture, standards and frameworks that are common across the kingdom of Bahrain. The governance authority would provide guidance and assistance to the government entities and enable them to enhance the architectural maturity level. One of the key responsibilities of the governance authority would be to guide and assist the IT architects in the government entities. This would be aimed at enabling these architects to guide the initiatives in the government entities in alignment with the key infrastructure initiatives identified in the roadmap.

Technology standards and guidelines

NEAF tries to achieve interoperability across platforms and services, while ensuring that technology is used cost-effectively to support the business. Technology standards and guidelines form a critical component of NEAF and guide cross-ministry standardization. Thereby improving enterprise efficiency and effectiveness by incorporating consistent integration, improved resource utilization, reduction in overall costs & risks, optimization of project schedule, efficient IT operation, optimize technological diversity and provide increased opportunities for sharing and collaboration between the government entities [7,8].

Products and technologies currently being used across ministries/agencies were compared to the leading products and technologies in various technology areas of interest, together with understanding of maturity level and transformational values of existing and emerging technologies by studying analysts' reports and predictions on products and technologies, to develop and define the technology standards.

Domains: Technology standards and guidelines across fifty nine technology areas have been defined under NEAF. These standards and

guidelines would be adopted by the government entities of Kingdom ensuring that the technology is used in a standardized manner to support the services being provided. The fifty nine technology areas were categorized under seven technology domains, viz. Application, Collaboration and Productivity, Data, Enterprise IT Management, Network, Platform and Security.

Migration Plan

The migration plan established as a part of NEAF definition identified 65 critical initiatives that would be undertaken for enhancing the setup and service delivery at the Kingdom as well as the government body level. Prioritized on the basis of business alignment, dependency of government entities on each other (for functionality and data), complexity, business value, organizational impact and readiness of government entities, these initiatives have been distributed for implementation over a period of 3 years Figure 4 shows the outcome of the development stage and the initiatives that would be carried out over next 3-5 years. In general, these initiatives are divided into two categories; government entity specific projects and national level projects. The former are initiatives that would be managed by concerned government entity, as they are either introduction of new specialized system or enhancement of an existing one, whereas the latter are initiatives that do not have specific owner and they impact all or several government entities, and these initiatives would be carried out by eGovernment Authority. In the following sections these initiative will be further elaborated briefly with more focus on standard and guidelines, shared service and critical national initiatives.

Critical nationwide initiatives

The nation-wide initiatives would be aimed at improving the interoperability of the Information systems, ensuring availability of accurate data and information across government entities and providing improved returns on IT investments.

A critical initiative, National Gateway Infrastructure (NGI) provides a crucial integration framework required to connect the services offered by various government entities and provide a seamless integrated environment to the consumers (citizens and residents). It enables optimized distribution of information between different types of applications across multiple locations. NGI has been architected over an Enterprise Service Bus (ESB) which forms the basis of communication between various disparate systems. NGI would provide various services such as adapters, web services connectivity, data services to facilitate interactions between the systems.

Figure 4: NEAF Evolution over 3 years.

Another critical initiative, National Data Hub (NDH) is one of the pillars of the target data architecture. NDH system would realize the concepts and functionalities being sought for improving the exchange of information between the government entities while maintaining the accuracy. The core of NDH system would be formed by the National Data Set (NDS); the master data, and the system to manage this master data. The NDH system would be integrated with the data sources in the government entities. Data integration services would facilitate this integration that would happen through the NGI. The NDH system would clean and blend/merge data from multiple sources and populate the master data set according to the defined schemas. Concepts of metadata would be utilized to manage and govern the data. The NGI and NDH would form the core IT components for realizing the unified service delivery. Providing unified services to the customers is identified as one of the key element of the vision of eGovernment Strategy 2007-2010.

Along with the NGI and NDH important initiatives such as Authentication system, centralized Email and Short Message Service (SMS) gateways, Payment Aggregation system and Central Enterprise Management systems have also been recommended.

Other than the critical nation-wide initiatives the government entities need to undertake initiatives that would enhance the existing systems and enable them to enact the role of being a constituent of Service Oriented Architecture (SOA). These initiatives are primarily aimed at enhancing the functionalities in existing information systems and migrating the systems to next generation of technologies.

Shared services concept

Two key initiatives that have been developed as local service but over the time the owners, encouraged by the government, started offering services to other government entities on request basis. These initiatives are Human Resource Management System (HRMS) that is owned by Civil Service Bureau (CSB), and Financial Management Information System (FMIS) owned by Ministry of Finance (MOF). Based on the analysis conducted by NEAF team, it was found that they both lack much functionality that encouraged some government entities to seek alternatives and invest unnecessary in other expensive solutions. Additionally, the way these services were provided lacked many good operational and services features, such as SLA and customer service. Therefore NEAF team decided to adopt these systems and manage them under their national initiatives to support the concept of formal shared services. This initiative, as believed by NEAF team, would have a big impact on the cost and service quality on the long run, and would meet one of the key strategic objectives of the NEAF project and Bahrain 2030 strategy.

Summary of NEAF Development Phase

NEAF was a very strategic but challenging project that has been carried out as one of the major initiatives of eGovernment authority of kingdom of Bahrain. The project was one of the few ones that met its objectives, completed on time (1 year) as planned and within the allocated budget. This success would not have happened without the full support received from eGA and government's top management. The other key success factor was the NEAF team composition. Both the consultants and the eGA team were selected carefully considering their strength, experience and team work capabilities. May be the most challenging point in the project was dealing with big number of government entities, that had no clue on EA or its benefits. In fact the very low EA maturity identified proved this claim. However, with well
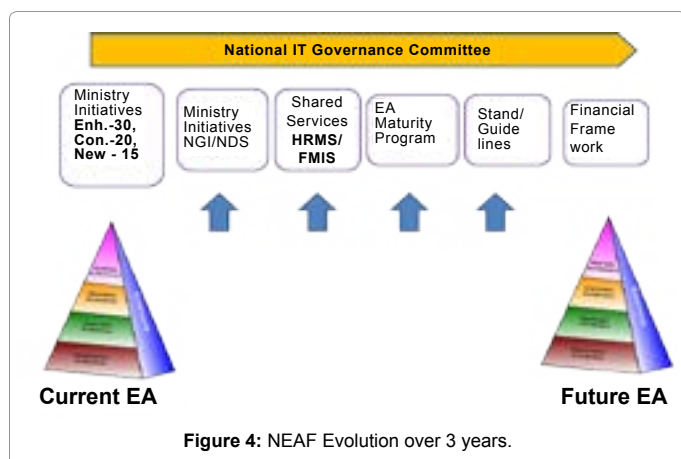
planned communication strategy and full top management support this gap was bridged and the project team was able to meet the tough deadlines.

To summarize the development phase, a snapshot of NEAF project achievements, are listed below:

- NEAF developed on four pillars of EA, viz. Business, Data, Application and Technology.

- Recommendation to establish and architecture governance body approved by Bahrain Supreme Committee for Information and Communication Technology (SCICT).

- Established the baseline architectures and carried out assessment to define the EA maturity levels for government entities.

- Defined target architectures for Business, Data, Application and Technology for use by government entities.

- Defined a roadmap spanning a period of 3 years recommending the critical nation-wide as well as government entities specific initiatives required by Kingdom.

- Nation-wide initiatives include NGI, NDS, central Authentication system, Payment Aggregation system and others. Ministry specific initiatives include implementation of EA, SOA enablement of IT systems and initiatives to achieve target architectures.

- Defined 59 technology standards categorized under 7 technology domains.

- Conducted regular workshops to increase awareness about EA and associated concepts.

- Training conducted to develop capacities in terms of skills and competencies to effectively utilize the benefits and outcomes from NEAF attended by 85 people from 26 government entities. This is shown as the last stage of NEAF development methodology (Figure 2).

- Enterprise architecture tool was evaluated and selected. This system would assist in architecture change and compliance management, conducting what-if scenario analysis, identifying critical project to be undertaken and generating holistic view of architecture in public sector of the Kingdom.

Conclusion

In this paper, the development lifecycle of the national Enterprise Architecture framework of kingdom of Bahrain was discussed. Starting with objectives and scope of the project, and after a brief theoretical background on EA concept, the approach taken to developing NEAF was described. Each stage of the approach was then discussed and finding and challenges were highlighted. During the architecture

assessment stage (As-Is), and with the large number of the data collected from 26 government entities, an EA maturity view was established and concluded. This built a foundation to developing the target architecture along with the design of governance and compliance process, and definition of a set of standard and guidelines to help government entities focus on certain technologies and reduce their cost and interoperability in the long run. The gap identified between the As-Is and To-Be architecture triggered a set of initiatives at national level and specific to government entities. These initiatives were sorted through certain criterion in migration and transition plan stage. The awareness and training was the key to the success of the project, hence it was a core activity at each stage of the development process. The outcome of phase I (Development phase) became the objectives of phase II of NEAF (Implementation phase). Since at the time of writing this paper, NEAF implementation was still going on, it was not possible to shed further light on the progress on phase II.

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