Enterprise Architecture Definition Framework for IT Service Providers

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Abstract. As Enterprises evolve, they invariably end up with heterogeneous IT systems. The software applications for the IT systems would have been deployed on multiple platforms and built using varied programming languages or packaged software. Customers require approaches to plan enterprise wide strategies that lead to scenarios of well integrated IT systems within their organizations. Suitable integration strategies have to be adopted to ensure that the systems which are currently available are well-integrated as well as enable future systems to be easily brought into their fold through seamless integration.

In order to address customer requirements for developing enterprise architectures and also to develop strategies to maintain them, customized approaches have been adopted. This resulted in the development of an Enterprise Architecture Definition Framework that IT Service providers can apply in consulting assignments. The paper presents the best practices for enterprise architecting and integration. Two case studies have also been included in the paper to illustrate the approach, one based on a native integration framework and the other based on Enterprise-Wide Service Oriented Architecture.

1 Introduction

The Information Technology services department of a typical organization has moved from playing the role of a supporting partner to that of a strategic partner.

From the scenario of having an Electronic Data Processing Officer/Manager who would generate the required reports for the user departments we have reached a stage where large enterprises have Chief Information Officers and IT Directors to drive the IT strategies of their enterprises. Information Technology (IT) has become the backbone of almost every business enterprise. Consulting organizations are being employed to develop and setup the required applications/systems on a large scale. Hence, there is a need to provide detail to the various stake holders at a level of abstraction that they are comfortable with, when communicating with others.

Further, large enterprises would have already invested a considerable amount of resources while evolving to the current state of IT implementation. Consequently, there is a need to integrate the heterogeneous applications/systems and also to have a clear path to integrate the applications/systems that the enterprise would acquire in future.

Thus, there is a need for effective communication of the requirements of various stake holders within an enterprise and also while communicating with an outsourcing partner, when the enterprise engages an IT Service Provider. The communication would be highly effective through an Enterprise Architecture. This paper discusses an Enterprise Architecture Definition Framework for IT Service Providers.

The paper is based on customer engagements that involved recommending and providing Enterprise Architecture based solutions. In this paper, large-scale business applications built on distributed systems are referred to as "Enterprise Applications". Two customer case studies have been discussed in the paper.

The rest of this paper is organized as follows. Section 2 discusses the concept of Enterprise Architecture (EA) and its current stage of adoption. Section 3 discusses the Enterprise Architecture Definition Framework for IT Service Providers. Section 4 describes the generic approach to Enterprise Architecting and instantiates it with two case studies, one based on a native integration framework and the other based on Enterprise-Wide Service Oriented Architecture. Section 5 concludes the paper.

2   Enterprise Architecture – The concept and its current stage of adoption

Enterprise Architecture involves the integration of processes and applications across an enterprise and is a collection of architectures. It involves the gathering and documenting of AS-IS/Current state and TO-BE/Future state requirements of

various stake holders from different dimensions, such as business, information, applications, infrastructure and security. In case the enterprise contains stove-pipe systems then the enterprise architecture would come up with a plan to migrate to a seamlessly integrated enterprise wide IT system, i.e. the integration architecture. The process dimension of the Enterprise Architecture would contain the roadmap to move from the AS-IS to the TO-BE scenario and also a Governance model for the architecture.

In the year 1987, John Zachman published a paper titled "A framework for information systems architecture". [6] But, it did not capture the industry's attention to the required extent for more than a decade. In an article published in 1999, Zachman enunciated why architecting did not catch industry's attention and also listed reasons why an architectural revolution was imminent for every enterprise that intended to be a player in the information age. [7] Zachman's analysis is now getting validated as a large number of players in the current scenario are adopting enterprise architecture.

Gartner, in September 2005, states "Many CIOs have established or inherited enterprise architecture programs with high hopes of improving IT by managing complexity, increasing IT agility and reducing cost and risk. These programs frequently flounder because many CIOs don't apply EA in their everyday work with the business, their staff, vendors and business partners." [10] The report identifies some drawbacks on enterprise architecture implementation by CIOs. However, the very fact that such a research was conducted illustrates how wide spread and established the titles of CIOs and the concept of enterprise architectures are in today's organizations.

3   Enterprise Architecture Definition Framework

Based on our experiences, we have formulated an Enterprise Architecture Definition Framework (EADF). The framework, like any framework, provides a skeletal structure that needs to be populated depending upon the context of the problem to which it is applied and needs to be adapted to the problem at hand. The key elements of an EADF are shown in Table 1.

The EADF provides guidance on how to develop various architectures constituting the enterprise architecture by way of drawing attention to the points that should be kept in mind while arriving at respective architectures which are shown as rows in the EADF matrix below. The various decisions related to business development and technology innovations need to be considered in a systematic manner within the framework of various architectures. Choices of methods and techniques have to be made in the context of the goals and objectives. [2]

Constituents of an Enterprise Architecture and relationship between the AS-IS & TO-BE Architectures and concerns:

As discussed in section 2, an Enterprise Architecture is made up of various architectures like Business, Information, Applications and Infrastructure Architectures. Further, each of the Architectures is related to various concerns.

AS-IS Architecture or AS-IS Artifact =
    function (Rationale, Process, Actors, Information, Location, Time)

However, one may not have much control in documenting AS-IS artifacts and Architectures. The customer might not be willing to spend more time and effort in documenting the existing scenarios. The Enterprise Architect would have to use discretion in identifying existing artifacts and architectures that would be useful in documenting the AS-IS scenarios and needs to negotiate with regard to the ones which are essential.

TO-BE Architecture or TO-BE Artifact =
    function (Rationale, Process, Actors, Information, Location, Time)

Enterprise Architecture needs a detailed sequencing plan to evolve the baseline architecture to the target architecture. The plan's major elements include program/business improvement IT projects and major infrastructure and technology upgrades. [14] Migration from AS-IS to TO-BE might use approaches like service-oriented architecture and building integration frameworks. The architecture governance identifies the roles and responsibilities of concerned stake holders. An escalation mechanism is planned and documented. Thus, both the model and process are captured.

Strawman Table of Contents for EA documentation and governance:

The EADF is supported by a Strawman version of Table of Contents (ToC) that would guide in documenting the important architectures of the EA. Points mentioned in the matrix have to be checked against when arriving at their respective architectures.

1. How to use this document
2. Introduction
3. Business Architecture
    a. AS-IS Architecture
    b. TO-BE Architecture
4. Information Architecture
    a. AS-IS Architecture
    b. TO-BE Architecture
5. Application Architecture

Architecture or Artifact, Primary Stake-holder (s)	Rationale	Process	Actors	Information	Location	Time
Solution Overview, Program/Project Sponsor	Business goals/strategies, need for taking up the project	Processes the business performs	Organizational units important to the business	Things important to the business	Locations in which the business operates	Events/cycles important to business
Business Architecture, Business User and Business Domain Expert	A tool for visualizing how individual business processes fit into the overall value-producing chain, 'siloed' vs. 'enterprise' management.	Business Process Model	Work flow model (key stakeholders in different organizational units (OUs) and their reporting relationships, with a work-flow relationship)	Functional model, Process model, Business entities, Workflows, Key business components (functions)	Business logistics system (business locations and linkages - detailed information on different OUs)	Master schedule (including business events and cycles), investigation of suitability of service orientation
Information and Data Architecture, Business Domain Expert and Technology Expert	Development of strategies to satisfy the needs of the end users (both naïve and advanced) and the Senior Management	Identification of online queries, summary reports, queries that give intelligent reports (e.g. use of data warehouse)	Who can access the data/informati on, which data elements to protect and the extent of protection?	Functional Requirements which lead to identification of data elements, Data Model, Information requirements	Location of users who would need the data and information	Identification of Real time, Near Real Time and Batch Processing requirements
Application Architecture, Business Domain Expert and Technology Expert	Identification of Applications that need to be replaced and relationship between new and retained applications	How the applications interact with each other (e.g. synchronous, asynchronous)	Who should access which applications?	Names of different applications (both products and those developed in-house)	Position of applications in layers and also their geographical location	Identification of communicatio n styles (e.g. Messaging, service oriented, etc.) between applications
Infrastructure Architecture, Technology Expert and Developer	Identification of required hardware/ software and guidance on their selection, deployment and maintenance	Load, performance, scalability and considerations like trade-off due to selection of one implementation style over other (e.g. use of tomcat vs. WAS)	User wise Access permissions for varied users, at a high level	Servers, Clients, Databases, Networks, Operating Systems	Connectivity issues for the chosen environment (e.g. bandwidth considerations)	Support for style and type analyzed above (e.g. Message Oriented Middleware like MQ Series, Enterprise Service Bus, etc.)

Architecture or Artifact, Primary Stake-holder (s)	Rationale	Process	Actors	Information	Location	Time
Security Architecture, Security Architects	To have a secure operating environment	Navigability across screens for different types of users and screen formats (e.g. presentation or UI aspects)	Identity (people) and job (work) mapping document for security	Zones of control (e.g. Insecure un-trusted & trusted and Secure trusted & un-trusted), Access Control List entries like "write access", audit trail record written for all file attempts	Security within and across locations (e.g. SSL)	Time dependent security, if any, possibly due to operations in different time zones
Integration Architecture, Designers	To develop integration strategies, for the integration of existing/retained and new applications (e.g. interface framework or SOA)	How the applications interact with each other (e.g. synchronous, asynchronous, batch), data transfer direction – in, in/out, out)	Who can access which applications?	Applications to be retained & new application(s) (e.g. comprehensive list of all external applications that need to be integrated)	Physical location of the external applications within the operating environment	Identification of Synchronous and Asynchronous interfaces

Table 1 Enterprise Architecture Definition Framework

4 Case Studies

There is no one right way or a single industry standard for defining architecture, so agreement within an enterprise is more important than theoretical perfection. [3] Based on customer engagements we have arrived at an EADF, as discussed in section 3 above. The case studies deal with the integration of information systems.

Many existing Information Systems (IS) supporting an organization's business processes, are considered "automation islands", since they cannot communicate easily with systems inside the organization and even less outside it, with external systems of clients and suppliers. In order to provide a complete, efficient and reliable support, the IS must be integrated. IS integration means to unify independent IS, with the purpose of providing shared information and give a valid support to the whole organizational process. [8]

4.1 Enterprise Architecting for a large Bank

The customer is a large bank that has grown rapidly through mergers and acquisitions. This inorganic growth has led to the bank having heterogeneous applications for the same functionality. This led to a scenario of stove pipe applications or "automation islands". The bank has decided to centralize the functionality and has identified a third party vendor who would provide an off the shelf solution.

In order to see how the entire business processes and the information/data would get integrated Enterprise Architecture was defined. Our organization had been engaged as an IT service provider to finalize the EA. In this context we used the EADF to document the EA, provide a road map and architecture governance. Apart from the offshore study an onsite visit was undertaken to arrive at the EA. Among others, the team included a Domain Architect and an Enterprise Architect.

The AS-IS and TO-BE architectures of the business, information, application, infrastructure and security were documented. The EADF was used to guide in the definition of the architectures. It was ensured that the concerns mentioned in the columns of the EADF, shown in Table 1, were part of the architecture/artifacts for each of the architectures/artifacts. Thus, for a given row, the architecture/artifacts addressed all the mentioned concerns. Further, it was ensured that there is traceability between the various architectures for a given concern i.e. as we go down a given column of the EADF, shown in Table 1, the architectures/artifacts are generally at a lower level of abstraction but there is continuity of thought process for a given concern. The standards and guidelines related to the different architectures were included in the appendix. A road map to migrate from the AS-IS to TO-BE state, and architecture governance framework were recommended. Roles and responsibilities of concerned stake holders along with an escalation mechanism, in case of deviations, were documented.

The customer had taken a decision to take the non-SOA path, as its policy is to be an early follower than to be a leader in the adoption of new or emerging technologies. Hence, a solution that involves the creation of an Integration Framework was recommended and is as shown in Fig. 1.
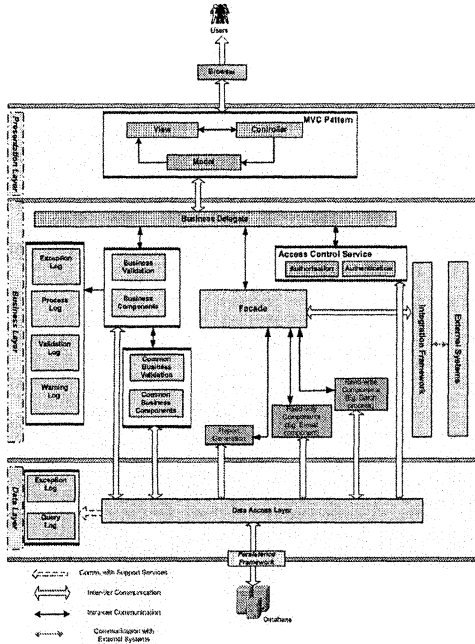
Fig. 1. A J2EE based application that would integrate with other applications through the Integration Framework

The design of the Integration Framework adopted an approach of integrating various applications in a plug and play manner.

4.2 Enterprise Architecting for a Financial Services customer

The customer is a large financial corporation. Over a period of time, it has developed and acquired varied systems that cater to the required functionality. The existence of varied legacy systems had led to a situation where it was becoming difficult to maintain them. The customer wanted a migration of their applications to newer platforms. Proactively, it wanted to have an EA that would make the systems maintainable and enable it to integrate any new technologies/applications that the customer would develop or acquire in future. An approach similar to the one discussed in the earlier case study was used to arrive at Enterprise Architecture.

As the customer was willing to adopt SOA, a solution based on SOA was proposed. Strawman architecture for enterprise wide SOA was recommended.

Subsequently, a detailed study of the IT systems was undertaken to arrive at the final recommendation.

A central aspect of Service Oriented Architectures is the loose coupling between applications (services) that are achieved when services publish their functional and non-functional behavioral characteristics in a standardized, machine-readable format as indicated in [9]. In this section, discussion is not restricted to a particular technology. A generic view of a service is considered.

The Strawman Architecture presented in this section could serve as a starting point for developing a SOA based solution for an Enterprise. Fig. 2 represents a Strawman for Enterprise-Wide SOA recommended to the customer.

It can be seen from the figure that the enterprise has several applications that need to talk to each other. A key feature of the architecture is the use of Enterprise Service Bus (ESB) that enables a smooth communication between the applications. ESB is often described as a product, especially in the marketing literature of various vendors. But, in a strict sense, ESB is an architectural style. The Strawman architecture for Enterprise-Wide SOA has the ESB as the heart of communication between applications. [1, 11, 12]
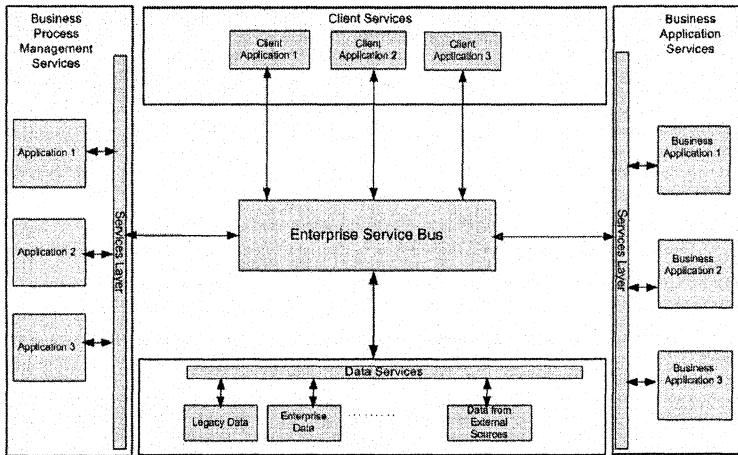

Fig. 2. Strawman for Enterprise-Wide SOA

5 Conclusions

This paper has captured experiences in providing EA based solutions for enterprise applications.   The Enterprise Architecture Definition Framework

enables an Enterprise or an IT Service Provider to quickly arrive at the required Enterprise Architecture definition. The strawman table of contents helps in documenting the enterprise architecture, a road map to migrate from AS-IS to TO-BE state and an architecture governance model. The SOA and non-SOA based approaches for integration that have been discussed as part of case studies provide approaches for enterprise and solution architecting of the enterprise's applications. The framework, tools and techniques discussed in the paper would reduce the time and resources required for enterprise architecting by IT service providers.

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