Enterprise Architecture – An Overview

Applies to:
Diploma thesis about “The Impact of the Enterprise Service-Oriented Architecture on the Future Role of the Enterprise Architect” written at the University of Applied Sciences, Karlsruhe / Germany.

Summary
From a business perspective, enterprise architecture has long been considered as a concept to primarily cut costs and increase the efficiency of the company. However, in these days of globalization, with high complexity and high rates of change, enterprise architecture is seen as a concept that focuses on quality of products, services and business processes, as well as agility to realize ever-changing business, IT and organizational strategies.

It is important to underline, that enterprise architecture must be considered a central process and should not be performed in a vacuum. It also leverages the business value.

Author: Sven Feurer
Company: SAP Deutschland AG & Co. KG
Created on: 20.04.2007

Author Bio
Sven Feurer joined SAP AG in 2005. Sven studied Business Information Systems at the University of Applied Sciences in Karlsruhe / Germany. He worked out his thesis on "The Impact of Enterprise SOA on the Future Role of the Enterprise Architect" in SAP’s Solution Marketing, now holding a master's degree. Today, Sven works as an Industry Advisor and consults SAP NetWeaver customers of different industries.
# Table of Contents

- Article at a Glance .......................................................................................................................... 3
- Definition ........................................................................................................................................ 3
- Enterprise Architecture: The Foundation for Execution ................................................................. 3
- Enterprise Architecture Frameworks .............................................................................................. 4
- Enterprise Architecture Building Blocks ........................................................................................ 6
- Bibliography .................................................................................................................................. 13
Article at a Glance

The advent of enterprise SOA goes along with changing requirements for enterprise architects. To face these changes architects have to adopt new skills. What kind of impact the implementation of enterprise SOA has for enterprise architects is discussed in the diploma thesis “The Impact of the Enterprise Service-Oriented Architecture on the Future Role of the Enterprise Architect”. It is based on a very extensive customer survey in collaboration with ASUG and SAP. This thesis is the foundation for the now beginning series.

In this first article you will find an introduction into the meaning of enterprise architecture for today’s companies. Furthermore it provides detailed information about the most practiced enterprise architecture frameworks. Relating to these results you will also find an explanation of the enterprise architecture building blocks based on the Gartner EA Framework.

Definition

What exactly is enterprise architecture? There are many definitions for enterprise architecture, all of which can be captured in one short answer: Enterprise architecture is how to build an enterprise. Gartner Incorporation, a global leader in business research and consultancy, describes enterprise architecture as follows [LaHa06]:

*The process of describing, and the description of, the desired future state of an organization's business process, technology and information to best support the organization's business strategy. The definition of the steps required, and the standards and guidelines to get from the current state to the desired future state.*

Gartner defines enterprise architecture by differentiating three important architectural perspectives: business, technology and information.

Enterprise Architecture: The Foundation for Execution

The purpose of enterprise architecture has changed since companies are highly affected by globalization and overall business processes. An interconnected, globalized world facilitates collaboration between employees, teams and organizations in a way never seen before. It enables companies to set up highly vibrant ecosystems of customers, partners, suppliers and other interest groups or stakeholders. Customers also benefit from this trend because bargaining power moves to their side. They are able to compare offerings of international companies easily and then pick out the most favorable products or services. Companies of virtually every industry have recognized this and have become more demand-driven today. They adjust their business processes around customers’ requirements to fulfill one of their major goals - high and sustainable customer satisfaction.

Many companies are currently changing their business focus from cost to quality and also from efficiency to agility. From an IT perspective, you can determine a continuous cycle of three steps: quality, speed and cost. This cycle is closely associated with the economic situation in the IT industry. For instance, you can compare the step 'speed' with the phase after Y2K when companies intensively invested in e-business applications in order to accelerate their financial transactions with suppliers, partners and customers. After this time there was a phase of economic instability wherein companies had strong cost awareness, like the step ‘cost’ demonstrates. Today, spending for IT is increasing, but it is done more prudently in the step ‘quality’. Companies primarily want to achieve higher quality goals with their IT investment programs, while factors like costs and speed are not forgotten. Enterprise architecture often represents one of these quality programs [LaHa06].

There are several definitions of enterprise architecture that prove helpful to getting a general impression of what enterprise architecture is and which business goals are to be achieved. But before you think about
enterprise architecture, you first have to critically challenge why enterprise architecture should be the answer for achieving organizational goals. In quick reply to this question, enterprise architecture plans and supports the organizational strategic goals. Enterprise architecture provides the foundation for execution by ensuring that all the money spent in information, technology and process improvement leads to new opportunities and enables rapid responses to an ever-changing market environment [LaHa06].

**Enterprise Architecture Frameworks**

Especially in modern and large organizations, a rigorously defined enterprise architecture framework is fundamental. An enterprise architecture framework is something that provides structure when specifying how technology needs to be organized to support the business. It helps to grasp a vision of the “to be” architecture, clearly identifies the state of the current architecture and also provides a process to close the gap between both architectural states. This enterprise architecture process can be very complex, and so enterprise architecture frameworks must align many different aspects from multiple viewpoints. Enterprise architecture frameworks can be considered a master plan that forces coordination and alignment between strategic enterprise planning activities, business operations and the technological infrastructure of the company. Such integrative efforts need to have strong governance principles.

Today many enterprise architecture frameworks coexist. Enterprise architecture frameworks\(^1\) can be categorized into three major groups:

- **Government and authoritative frameworks**: Government frameworks are developed and utilized by public agencies primarily in the defense area. Defense departments have started development of such frameworks because of an increasing need for standard architectural approaches for multinational military operations. Frameworks such as Zachman or TOGAF are very authoritative and elaborated. Many frameworks today are built as specific refinements and add-ons based on authoritative frameworks.

- **Vendor-specific frameworks**: These are frameworks mainly developed by software vendors. They provide their experiences and best practices, obtained from past architectural projects, in the form of frameworks.

- **Miscellaneous frameworks**: This group comprises multiple frameworks focused on special industries or providing further features and functions.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gartner EAF</td>
<td>Capgemini’s Integrated Architecture Framework</td>
<td></td>
</tr>
<tr>
<td>TOGAF (The Open Group Architecture Framework)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zachman</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Classification of enterprise architecture frameworks

---

\(^1\) Government and Authoritative Frameworks

\(^2\) Vendor-Specific Frameworks

\(^3\) Miscellaneous Frameworks
Table 1 lists enterprise architecture frameworks assigned to major categories. Most of these frameworks are very important for the companies who participated in the survey. Frameworks listed in the table above represent 96% of all responses in total. However, 22% (31 people) of the participants did not complete the question about relevant enterprise architecture frameworks. Sometimes they included comments such as ‘I don’t know’ or ‘tell me more’. That is not surprising at all because enterprise architecture frameworks are the most important area of content for education programs (34%).

**Question 3.3: What are relevant frameworks for your sector?**

![Graph 1: The importance of enterprise architecture framework](image)

Graph 1: The importance of enterprise architecture framework

Based on the survey, the graph above (graph 1) demonstrates the importance of single enterprise architecture frameworks:

- Both DoDAF and MoDAF reached a relative frequency of 8%. DoDAF was developed by the U.S. Government Department of Defense. It mainly focuses on the architecture of military systems, but it is also applied in the public, private and voluntary sectors. MoDAF was created by the U.K. Ministry
of Defence in order to realize an integrated and coherent approach to better acquire, manage and operate military capabilities.  

- **Gartner’s Enterprise Architecture Framework** was chosen by 29% of the participants and ranked third with a relative frequency of 18%. This framework explicitly drives architecture out of the business strategy and supports governance by both the framework and the process.

- **TOGAF** is the most popular framework among the participants. It was selected by 54% of the participants and reached a relative frequency of 33%. This vote clearly results from the fulfillment of almost all of the important criteria to evaluate these frameworks. TOGAF provides a robust advice on architecture governance and is aligned to a process for developing enterprise architecture.

- The **Zachman** framework reached a relative frequency of 22%. The framework is one of the “richest” frameworks in terms of detail.

- Only 5 of 139 participants (4%) chose **E2AF** as an important framework. This framework, created by the Institute for Enterprise Architecture Development, is influenced by several other frameworks (e.g., by the Zachman framework) [Sche04].

- **Capgemini’s Integrated Architecture Framework** reached a relative frequency of 11%. It is a comprehensive framework developed from the experiences and best practices of architecture professionals in Capgemini[^3].

- The **NIH (National Institutes of Health) Enterprise Architecture Framework** was not selected by the participants. This framework mainly supports the mission and goals of NIH’s IT strategy[^4].

As you can see above, the survey identifies TOGAF, Zachman and Gartner as the most important enterprise architecture frameworks. Together they reached a relative frequency of 73%. Utilizing frameworks are no one-time effort. Companies often need to adapt and reassess their frameworks from time to time to remain in sync with changing architectural requirements. Groups, vendors or governments responsible for their frameworks typically provide updated documentation of their frameworks that can be downloaded; however, companies may need specific add-ons that are not provided by one single framework. Because there is no ‘one-size-fits-all’ approach, they may evaluate several frameworks to combine different approaches. Furthermore, 29% of the survey participant had not utilized enterprise architecture frameworks at all.

One crucial responsibility for enterprise architects is to evaluate and select an enterprise architecture framework when defining the architecture approach.

As the Gartner Enterprise Architecture Framework is clearly structured and well-defined, the following subsequent paragraphs define enterprise architecture building blocks by terms of Gartner’s notion.

### Enterprise Architecture Building Blocks

It is not easy to describe a general approach to enterprise architecture since every enterprise is different. A clear and sophisticated enterprise architecture design is shown in figure 2.

Shown in the figure below, enterprise architecture is business-driven based on the business context. That is the highest level of abstraction, but it is not directly part of enterprise architecture and so belongs to wider business strategy and enterprise planning activities[^5], which have their own lifecycles within the enterprise [Toga03].

Therefore the business context is primarily for CxO-level executives who need to get a “big picture” in order to make strategic decisions. The business context defines the business strategy and its implications for the enterprise. It also considers environmental factors (market, regulatory or technology pressures) and their influence on the enterprise architecture. The business context also includes a set of high-level, principles for ensuring that the business strategy is properly translated into architecture design.
The model describes an enterprise architecture from at least three fundamental viewpoints. The business viewpoint represents the business architecture, which mainly deals with the enterprise in its business environment. The second viewpoint, the technology viewpoint, specifies technological elements (such as hardware, software, network and data) of the underlying infrastructure. The last perspective focuses on information architecture. This architecture provides an effective use of information (on both a logical and a physical level) to best manage the information structure, assets and flow.

![Enterprise Architecture Viewpoints](image)

Figure 2: Enterprise architecture viewpoints

Each fundamental viewpoint (the business, the technology and the information viewpoints) of the framework is divided into three different levels of abstraction: the conceptual, the logical and the implementation levels. These layers enforce a traceable decomposition from the conceptual design of the architecture to an extensive and detailed implementation plan. On the conceptual layer, strategic decisions have already been made by executives and are now conceptualized by the senior management. Senior managers also have the “big picture” in mind. They ensure that architecture issues, as well as opportunities, are addressed and reflected in the long-term and short-term business plans of the organization. The logical layer is mainly for operational management, which has a logical view of enterprise architecture. The lowest level is implementation. It is the scope of change agents who go into detail when implementing systems and improving processes. Abstraction is important to effectively communicate layer-specific issues with different stakeholders [JHLG05].
It is important to point out that all three different viewpoints can be described by, at the least, architectural requirements, principles and models. These architectural elements (artifacts) are not only developed within each viewpoint, but also for each level of abstraction (figure 3).

**Figure 3: Abstraction layers of the technology viewpoint**

**Business Viewpoint**

The first architecture that can be identified when you view the enterprise from a business perspective is the business architecture. It represents the process and organizational concerns of business architects. Business architecture (sometimes called ‘enterprise business architecture’) is the most dominant architectural discipline to improve performance of the enterprise. This architecture shows the business value which results from other architectural efforts, such as information, technical and solution architecture. Business architecture gets initial input from wider enterprise planning activities which themselves define business mission, vision, strategy and goals. The architecture has the task of translating these high-level business goals into business requirements that are relevant for this architecture. Analyzing enterprises architecture from a business perspective is mostly a complex issue. A comprehensive approach to business architecture defines end-to-end business processes (sometimes called ‘core processes’) and their relationships to internal users and external customers of an organization. Furthermore, business architecture
creates an architectural blueprint for meeting or even exceeding customers’ requirements, competing and sustainably operating in a market, as well as interacting with suppliers, partners and employees [WiMy04].

Core processes are customer-centric and can span multiple functional departments. They are designed to deliver effective and efficient results in functional organizations. Finally, the performance of these processes can be evaluated by linking them to previously defined, measurable results of a long-term business goal [Whit05].

Defining the business architecture raises the question of how much the architecture actually relates to business process management. The business architecture ends with the creation of optimized business process models that are aligned with the business strategy. Presently, business process management uses these business process models, aims to automated them, and creates end-to-end business processes. Medium-term both disciplines are expected to converge [Hand06].

Technology Viewpoint

Historically the focus of enterprise architecture has been on the technical architecture (sometimes called ‘enterprise technology architecture’). This architecture represents the technical implementation and operational concerns of technical architects. Technical architecture provides the technical foundation that reflects and supports the other architectural viewpoints. From a technical viewpoint you can identify and plan a consistent set of technical components upon which enterprise solutions can be built or even purchased.

The technical architecture addresses several technical components in eight technical domains. Each of the domains is an important component of a holistic technical architecture approach [Vita06].

- **Application domain**: The first domain provides the technical foundation for implementing and adapting business processes to be able to respond to changing business requirements.
- **Database domain**: It includes technical topics and components for databases and data management systems that best support storage, retrieval and backup of data.
- **Information domain**: It addresses technical topics like reporting, data management, business intelligence and knowledge management. This domain defines a logical structure of multiple databases and describes a methodology to integrate data sets.
- **Integration domain**: It includes tools and services that integrate databases, messages, services and applications, even when they run on multiple platforms of many different vendors.
- **Networking and communication domain**: This domain identifies technologies and services to provide a comprehensive communication infrastructure.
- **Platform domain**: It is a very important domain that aims to standardize and simplify the platform landscape of the enterprise. A platform describes some sort of framework, both in hardware and software, that enables software to run. This domain typically includes technology topics like personal computing devices, servers and utility services.
- **Security domain**: The purpose of this domain primarily is to establish, maintain and improve information security across the enterprise technology architecture. Components of this security domain address secure systems interoperability, data, physical and personnel security, as well as other security engineering topics.
- **Enterprise systems management**: It primarily concentrates on infrastructure topics and components. There are three core processes addressed within this scope: service delivery, which controls management activities to meet customers’ business needs; operation management, which provides operative infrastructure components; and service support, which ensures that users have access to services to support business functions.
Information Viewpoint

Information is a fundamental driver for the successful operation of a business. The information viewpoint makes up the discipline of information architecture. This architecture represents the information (flow) modeling concerns of information architects. The main objective of information architecture (sometimes called ‘enterprise information architecture’) is to leverage all types of information across the enterprise. Accurate and timely information is needed for several purposes. It helps to determine profitability and efficiency. Furthermore, information is needed for monitoring quality, managing people and communicating with suppliers, customers and business partners. Finally, information is very valuable for decision-making at operational, tactical and strategic levels.

Peter Drucker once defined information as [Druck89]:

*Information is data endowed with relevance and purpose.*

This ancient definition has not lost any relevance to this day and often appears in literature about information management and information architecture.

Information in any business is based on structured and unstructured data - the fundamental bricks of information architecture. Structured data is typically stored in relational tables, which normally consist of multiple entries (rows) that are characterized by several criteria (columns). These entries need to be interpreted and contextualized in order to make sense of them. Structured data includes business data and metadata (data about business data). It is often stored in databases, spreadsheets and word processing tables. Compared to structured data, unstructured data cannot be interpreted easily. It is mostly in the form of word processing documents, presentations and similar incoherent documents. To understand the meaning of unstructured data, you need more of it than you would need of structured data. Furthermore, metadata is essential for describing the context of data and properly grasping the content [RuRu06].

The major challenge of the information architecture is to find the right balance between structured (concrete) and unstructured (abstract) data and to make it available throughout the organization; therefore, it is critical to differentiate four categories of information [RuRu06]:

- **Public information**: There are no security constraints for sharing this information publicly inside and outside of the enterprise.
- **Internal information**: This type is not confidential but provides internal information about the operation of an organization, such as network information, internal user names, etc.
- **Confidential information**: This information should be private and only divulged by authorized people. It is typically salary data and other private employee information.
- **Secret information**: This information is critical to the enterprise’s success and should only be shared with trusted and authorized parties.

In order to drive and build the information architecture, you need an inventory that represents what information assets are currently available. Furthermore, the inventories show where and how information is stored, as well as how timely, mature and accurate it is. Information plays a significant role, e.g., in application systems and business processes, and thus relates to other disciplines of enterprise architecture.

In addition, the information architecture gives consideration to external regulations, for instance, the Sarbanes-Oxley Act, the Health Insurance Portability and Accountability Act and the Gramm-Leach-Bliley Act, all of which prescribe and control how organizations have to manage information [RuRu06].

Solution Viewpoint

On the one hand, business has special demands (e.g., real-time enterprise, BPM, business intelligence); on the other hand, technology has appropriate solutions (e.g., enterprise SOA, model-driven architecture). That is a statement that exactly defines the situation of enterprise solution architecture today.
Solution architecture describes a challenging, and perhaps the most important architectural viewpoint. It describes the combination and unification of all enterprise architecture viewpoints (enterprise business architecture, enterprise information architecture, and enterprise technology architecture) which are loosely coupled and are often contradictory. Solution architecture represents a meta-architecture because it describes an architecture combined of other architectures. This leads to an aggregated architecture for a specific enterprise solution. Solution architecture helps to structure solutions in order to deliver value, leverage appropriate systems and identify risks and complexity. Many other enterprise architecture frameworks unfortunately lack this viewpoint or deal with it in an insufficient way. Definitions of both enterprise solution architecture and enterprise solutions are listed below [JHLG05]:

**Enterprise solution architecture** is a consistent architectural description of a specific enterprise solution. Enterprise solution architecture combines and reconciles the requirements, principles and models of intersecting stakeholder-specific viewpoints into a complete architectural description of a specific enterprise solution.

Visualized in figure 4, the solution viewpoint combines loosely-coupled architectural descriptions of diverse viewpoints (business, technology and information viewpoint) to provide a unified, holistic and non-conflicting foundation for creating enterprise solutions. Typically enterprise solutions are the final outcome of architectural efforts. This makes it important to provide a clear definition of enterprise solutions:

An enterprise solution is a system that addresses a business problem, issue or function (or a set thereof) that spans the enterprise. It is composed of sub-solutions (or subsystems) that may span only part of the enterprise (that is, a specific business unit or line of business).

The more agile and mature the enterprise solution architecture, the faster enterprise solutions can be developed in an efficient and qualitative way.
All three different viewpoints are incorporated in enterprise solution architecture by identifying their architectural requirements, principles, models, etc. This holistic view of solution architecture builds a complete set of architectural descriptions that form an enterprise solutions portfolio [JHLG05].

In this context we should clearly distinguish between both enterprise applications which are an integral part of the enterprise technology architecture and enterprise solutions (also called business solutions) which are the result of the enterprise solution architecture. Application architecture both designs and engineers applications and so builds the technical platform for enterprise solutions. Enterprise solutions in turn represent a holistic and geared product that reconciles all architectural viewpoints. To better understand this differentiation between these terms, please have a look at this simple example about SAP’s enterprise resource planning (ERP) system, mySAP ERP®.

- **mySAP ERP** is an application. It describes data processing software that handles business processes and information.
- **mySAP ERP Financials** represents a solution. An enterprise solution primarily wants to solve business problems. It typically facilitates information flows, automates business processes, and involves people whenever human intervention is required.

Traditionally, boundaries of enterprise applications are closed and highly inflexible. Based on these applications, enterprise solutions are either developed by company-internal groups or they are bought from external software vendors. These enterprise solutions do a fantastic job as long as requirements remain constant and nothing has to be expanded or adapted. Such solutions mostly focus on fixed user groups utilizing pre-defined user interfaces.

As a result of their inflexible enterprise applications, companies were unable to create or change enterprise solutions efficiently. Different teams tackled the hurdle of consolidating expensive custom code into cost efficient standard applications. Another obstacle is the existence of different technology platforms that make it difficult to compose new, innovative solutions while leveraging existing packaged applications.

So packaged enterprise applications need to be more open and standardized for creating an interoperable solution architecture. This is the advent of the service-enabled, packaged applications. These packaged applications expose particular business functionality in the form of reusable, modular components (enterprise services) based on open standards. In addition to buying applications versus building or changing your own custom applications, composition represents the “third alternative” for creating flexible and customer-specific solutions at an affordable cost. Over time, a core of standardized services will become available and new services will appear on the market. Companies may directly use these services or extend them in a way that differentiates them from competitors. These solutions may not only consume functionality exposed by service-enabled, packaged applications but also consume functionality provided by custom-developed applications [Robe06].

Now we are at the doorway to enterprise SOA and the evolving role of the enterprise architects.

**Coming up next:**

Within next week’s article you will learn more about how the enterprise service-oriented architecture has evolved and what kind of benefits it exposes for modern companies. Furthermore you will find out what enterprise services are and how they can bridge the gap between business and IT.
Bibliography


1 This is just a small selection of enterprise architecture frameworks.
3 Source: http://www.capgemini.com/services/soa/ent_architecture/iaf/.
4 Source: http://enterprisearchitecture.nih.gov/.
5 Strategic business planning is the process of defining the mission and long-range objectives for conducting the business and developing the strategies for achieving them [Spew93].
6 Additional viewpoints are possible and may be extracted from the business, information and technology viewpoints. For instance, a separate viewpoint for compliance provides a chief compliance officer with a specific compliance view of the architecture.
7 Technology domains are sometimes also called ‘technology areas’.