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An Approach to Enterprise Wide Information Management

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Abstract

The paper outlines enterprise wide information management as a means of business IT alignment. It is based on an enterprise architecture approach. The domains of architecture, the business -, applications -, and infrastructure architecture are sketched and three basic views on architecture are introduced. The component view describes the elements of architecture and their relationships. The communication view shows how the elements interact with one another. The distribution view describes how the elements are distributed in terms of location or organizational assignment. Key element of architecture design is to account for interdependencies among the building blocks of architecture. Blueprints are introduced as a means in planning the deployment of architecture on a large scale. Blueprints give a comprehensive view on the building blocks and how the interact. They show the effects of architecture design between business, application, and infrastructure architecture. The main stakeholders for information management and their respective usage of the design techniques are outlined.

Keywords

Information management, enterprise architecture, views, blueprints, stakeholders

Enterprise Wide Information Management by Architecture Development

Enterprise architecture Domains

The paper outlines enterprise wide information management based on an enterprise architecture approach. Architecture is a commonly used term in the design of information systems. Yet, it is used very differently in scope ranging from the architecture of computer systems to information systems architecture. IEEE Standard 1471-2000 defines architecture as „.. the fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution" (IEEE 2000). We summarize the understanding of architecture in "architecture is the art and practice of designing and building structures".

Enterprise Architecture comprises the entire business with all its constituents. The alignment of the business and organizational design of the enterprise with the IT architecture is fundamental. However, understanding and structuring of the basic elements differs (see the discussion in Buhl and Heinrich 2004). The wide range of different domains and scope of enterprise architecture and its high complexity are characteristics of enterprise architecture. The ground for architecture design is to define a framework which structures enterprise architecture in key domains and building blocks in order to give a comprehensive view on all relevant aspects of enterprise architecture. It is used as a reference for a systematic and orchestrated development of all constituent parts.

There exist a number of different architecture frameworks (for an overview on enterprise architecture frameworks see Schekkermann 2006, p. 85f., Lapkin 2004a and b). Examples for frameworks are The Open Group Architecture framework (TOGAF 2003), Federal Enterprise Architecture Framework (FEAF); Framework for a Generic Reference Enterprise Architecture Methodology (GERAM), Gartner and META Group Enterprise Architecture Framework (Gartner, META Group 2002), and Zachman Framework (Zachman 1987, Sowa/ Zachman 1992). Comparing the different classifications for enterprise architecture, naming and structuring of architecture domains differ. Regardless which one to choose, it is important to base architecture development on a framework which is essential for transparency, communication, and a systematic approach.

The Open Group Architecture framework (TOGAF 2003, Version 8.1.1) is widely recognized and plays a prominent role. It consists of four domains: The business (or business process) architecture defines the business strategy, governance, organization, and key business processes. The data architecture describes the structure of an organization's logical and physical data assets and data management resources. The applications architecture provides a blueprint for the individual application systems to be deployed. Finally the technology architecture describes the logical software and hardware capabilities that are required to support the deployment of business, data, and application services.

However, since the data architecture is defined as the 'logical and physical data assets of an organization it mixes business requirements with technical implementation. In difference to TOGAF the architecture framework introduced in this paper clearly separates the domains of business and IT architecture. This provides for a clear distinction of the business oriented description of the enterprise architecture and the derived technological implementation. In difference to TOGAF the information architecture is not described as a separate architecture domain but rather split in a building block of the business architecture in terms of logical information structures and a building block of applications architecture in terms of implementation of data repositories. Furthermore, the framework details the domains in architecture building blocks to give a comprehensive overview of all constituents of enterprise architecture.

The three basic domains of the enterprise architecture framework introduced in this paper are defined as:

- Business Architecture
- Application Architecture
- Infrastructure Architecture

Each of these three architecture domains is composed of distinct architecture building blocks (see Figure 1).

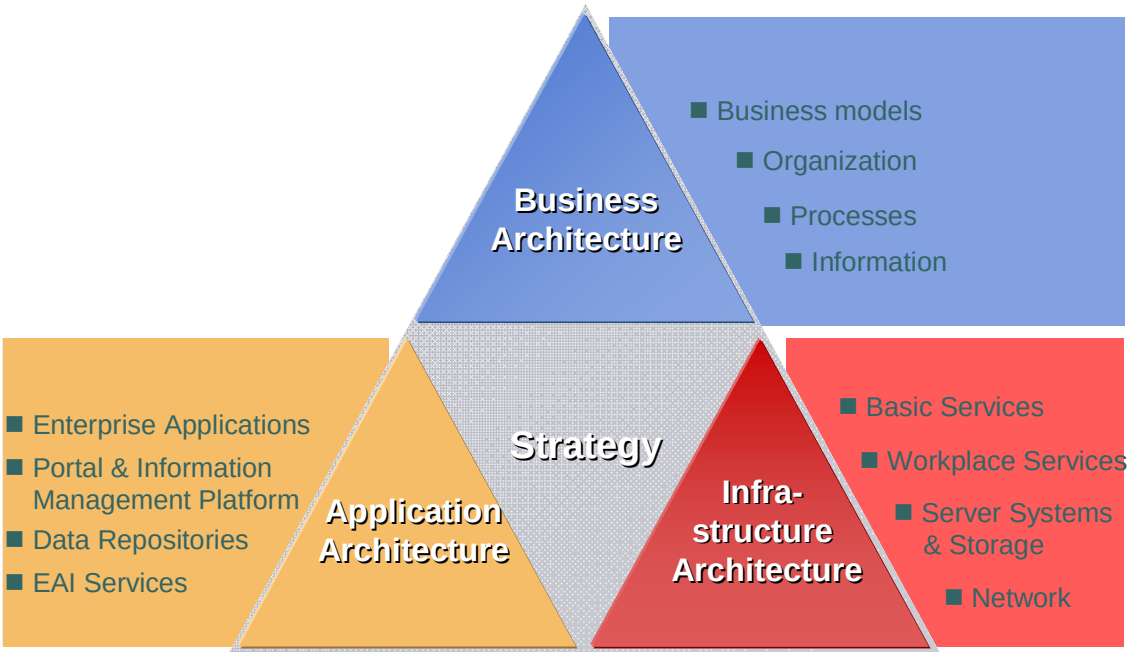

Figure 1: Enterprise Architecture Framework

With this architecture definition in mind, it should be obvious that Enterprise Architecture is more than the collection of the constituent architectures. The interrelationships among these architectures, and their joint properties, are essential to the enterprise architecture.

This paper can only give an outline on the domains of enterprise architecture framework and sketch the main building blocks at a high level. All building blocks are detailed down to the level of modules, systems and components. The framework gives a comprehensive description of all relevant elements of enterprise architecture providing a principal structure and classification schema used as a reference for architecture development.

Process of Architecture Development

Enterprise architecture management includes the process to create, update and manage the evolution of the architecture domains in line with business strategy. Thus, the design of business architecture determines the development of the IT architecture. Figure 2 sketches the architecture development process (compare Meta Group 2002, pp. 5, 57f., TOGAF 2003, Introduction to Architecture Development Method (ADM), Dietsch 2005, pp. 634f.). Architecture development is linked to business strategy which is the starting point for the definition of the IT strategy taking environmental and technological trends into account. The strategy is needed for the transitional processes in order to implement new technologies in response to the changing business needs. This strategy alignment is basically the first cycle of business/ IT alignment.

The strategy is detailed to features of the enterprise architecture. Here the architecture framework comes into place, which links business -, applications -, and infrastructure architecture and the respective building blocks. This is the kernel of architecture development where the techniques introduced in section 2 are applied.

Based on “as is blueprints” of the IT landscape “target blueprints” for all architecture building blocks are defined. They are derived from the business and IT strategy. In addition, an adaptability analysis is performed in order to assess how the information systems in place can adapt to a changing environment. The results are used for the definition of target blueprints.

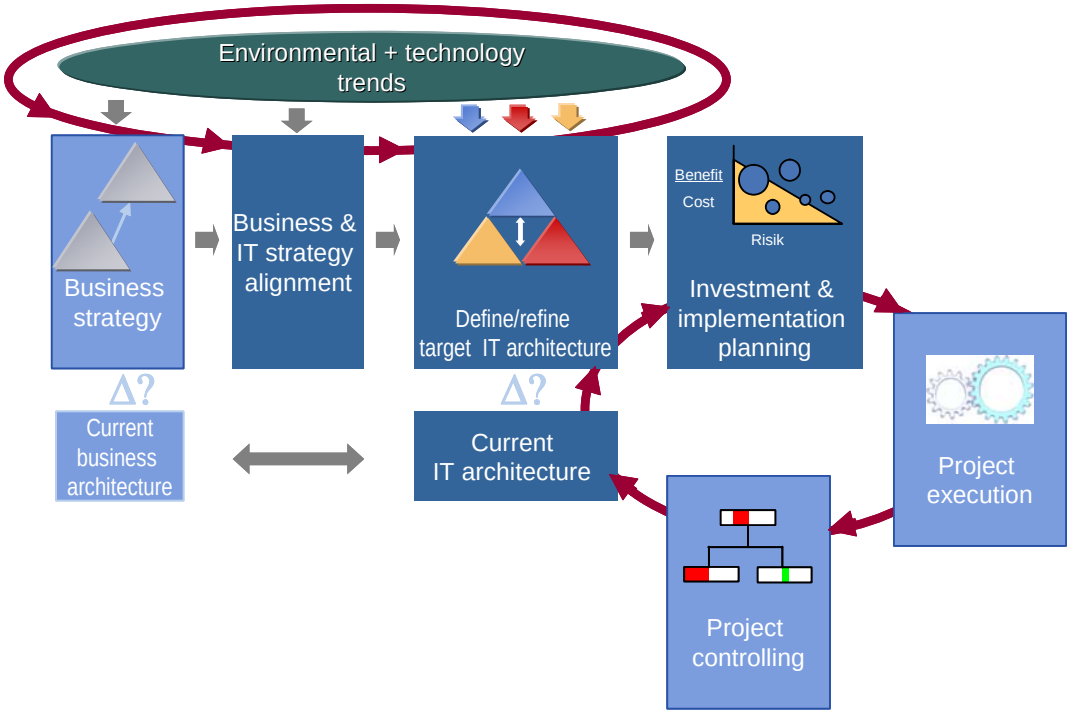

Figure 2: Overview on the architecture development process

The blueprint of the target architecture describes the deployment plan to implement IT strategy. From the gap analysis of “as is” and target architecture IT projects are derived. The projects are prioritized and the overall IT program is defined. The execution of the respective IT program and projects finally result in changes to the current IT architecture and IT service operations. The implementation of the target architecture forms the second cycle of business/ IT alignment.

The following listing sketches some objectives to be pursued with enterprise architecture (Aranow 2002, p. 9f., Masak 2005, p. 9f., Meta Group 2002, p. 6f., 49f., Günzel/ Rohloff 2003, p. 424, TOGAF 2003):

- Strategy and business orientation
  - enabling, leverage of IT, new business models
- Transparency
  - complexity and dependencies of architecture building blocks
- Communication between business and IT community
  - different people from management to IT experts involved
- Planning
  - target oriented, steering of I&C program with strong impact and to secure compliance to corporate standards
- Synergies
  - develop & implement the I&C landscape in a systematic manner and to utilize synergies
- Adaptability
  - dynamic development of market, business, and technology, provide for scalability and growth

Enterprise Architecture is a means to support business and IT alignment. It is the core for an enterprise wide information management, especially for the development of the IT landscape. At the same time architecture provides the agility to react fast to market requirements.

Enterprise Architecture Design

Architecture Description

An architecture description is a formal description of a system, organized in a way that supports reasoning about the structural properties of the system. It defines the building blocks and components that make up the overall system, and provides a plan from which products can be procured, and systems developed, that will work together to implement the overall system. The IEEE-Standard "Recommended Practice for Architectural Description of Software Intensive Systems" (IEEE 2000) can be used as a basis for an architecture description: every system has an architecture, which can be recorded by an architectural description. The architectural description is organized into one or more constituents called (architectural) views. Each view addresses one or more of the concerns of the system stakeholders. The term view is used to refer to the expression of a system's architecture with respect to a particular viewpoint (Bachmann 2000, Clements et al. 2003).

In contrast to information systems architecture, which is widely discussed under the aspect of a single information system being integrated in an organization and aligned with business processes, enterprise architecture takes the entire IT landscape into focus. In comparison architecture is understood as city planning and not only as planning the architecture of a house (Gartner Group 2002, Burke 2003). It requires the definition of development plans for an entire area and not only the construction plan for a building. The development of the IT landscape in contrast to the information system architecture of a single system is architecture design on a large scale. It requires adequate features for architecture description.

Essential requirements for "architectures in the large" (compare Dern 2003, p. 81-83) are:

- Reduction to core entities and construction principles
- Balance of abstraction and specialization
- Representation of mutual dependencies
- Integration of architecture in the large and in the small

In the following we will show how three distinct views on architecture support the reduction to core entities and construction principles. Blueprints give overview on the IT landscape and show interdependencies between the building blocks of architecture. Views and blueprints can be combined for large and small scale architecture development. Both are essential elements of the architecture framework and the corresponding These techniques for architecture description are part of the framework used for architecture development (compare with the framework for information systems, Sinz 1997, p. 3). The architecture framework is based on the following elements:

Views: Each enterprise architecture domain can be described taking a specific view, which looks at the architecture, its structure and elements from a specific perspective.

Relationship/ dependencies between the enterprise architecture domains can be described using the concept of blueprints.

Standards are an essential element being used for all architecture building blocks which provide for inter-changeability, ease of across system communication etc. Besides the use of standards identification and usage of commonly recognized pattern is also an important objective for architecture design.

We focus on the introduction of three distinct views for enterprise architecture and the description of architecture dependencies with the means of blueprints. Pattern and standards are not described in this paper.

Views on Architecture

The principle of views is the basis of every reasonable architecture description and the need for multiple views in architecture descriptions is widely recognized in the literature. The IEEE standard 1471 (IEEE 2000), however, describes only the concept of views, stakeholders and concerns. Because of the wide range of opinions on selecting appropriate views, the standard does not make any statements on selecting views, the notation or name of views. There exists a variety of views. Data-, function-, process oriented views, and dynamic aspects are often named, sometimes supplemented by an organizational and resource view (e.g. for different views see the information system architectures discussed in Bernus et al. 1998).

Zachman (1987, p. 291) was one of the first to state "There is not an information architecture but a set of them" and he introduced different views on architecture. This work was continued over the years (Sowa/ Zachmann 1992, Zachman framework). It comprises more than 30 views in a matrix with data, function, network, people, time, and motivation in scope from planning to implemented architecture. The main drawback is the fact that

there are too many views included in it. The framework is a mix of views, domains of enterprise architecture, and different stakeholders.

Taking a close look on the diversity of views, we identified three basic views which are sufficient to describe all relevant aspects of enterprise architectures:

*Component view***:** The view describes the logical and functional structure of the architecture in scope. All building blocks and their systems and components are described in terms of composition, structure and relationships among one another. The component view allows for different level of detail. Components, systems, subsystems, building blocks can be grouped or decomposed. The segmentation of the diagram is in building blocks based on the respective architecture in scope.

Communication view: The view describes the communication (interaction) between systems and components. The relationship among the systems is decomposed in the interaction of components within a system and to other systems. Different types of communication can be described with distinct notation for communication lines. The segmentation of the diagram is in communication areas based on the respective architecture in scope.

Distribution view: The view describes the allocation of systems or components in terms of geographical or organizational distribution. The diagram is segmented in organization or location based on the respective architecture in scope.

For the design of architecture a "Service Oriented Architecture" (SOA) approach is followed (for an overview on SOA e.g. Allen 2006, Bieberstein et al. 2006, Marks/ Bell 2006; Pulier/ Taylor 2005). Basically, IT-architecture can be always seen as providing services to the business e.g. an application supporting a business process, office and communication services at the workplace supporting each individual employee. Taking these perspective puts the value add of IT in the focus. Consequently the building blocks of the architecture framework are structured in service groups, core services, and service modules.

The example of an Email Service for Siemens AG is used to demonstrate the description of this service using the three views. An Email Service is a basic service (see architecture framework definition in section 1). It is composed of client -, server -, and storage components, like the Email client system; internet mail server, internet ip-addressing (DNS), Siemens corporate directory (SCD), Virus competence center (VCC), public key infrastructure (PKI), security, local mail service, mail transfer server (MTA proxy and firewall), and the lifetime email system (LTE) at the server and with the LTE repository at the storage side. All are constituents of the Email Service. The three views describe all relevant properties of that Service, each with a specific viewpoint.

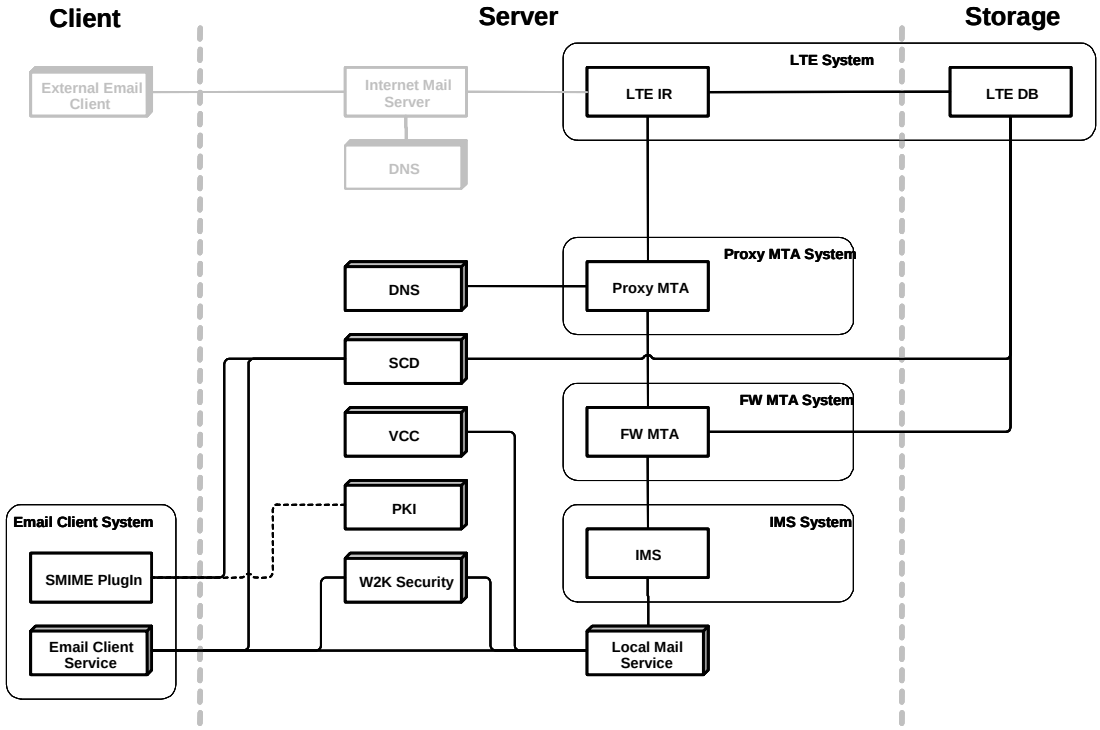

Figure 3: Component view (example Email Service)

The component view is used to convey the functional and logical structure of architecture. As depicted in figure 3, the view is divided vertically into three major parts: client systems, server systems, and storage systems

(infrastructure building blocks). All service modules, systems, and components are described in terms of composition, structure and relationships among one another.

The communication view describes the interaction between the service modules, systems, and components of the Email Service. The diagram is segmented in the communication areas Internet, Extranet, Intranet, Campus LAN, and Data Center LAN.

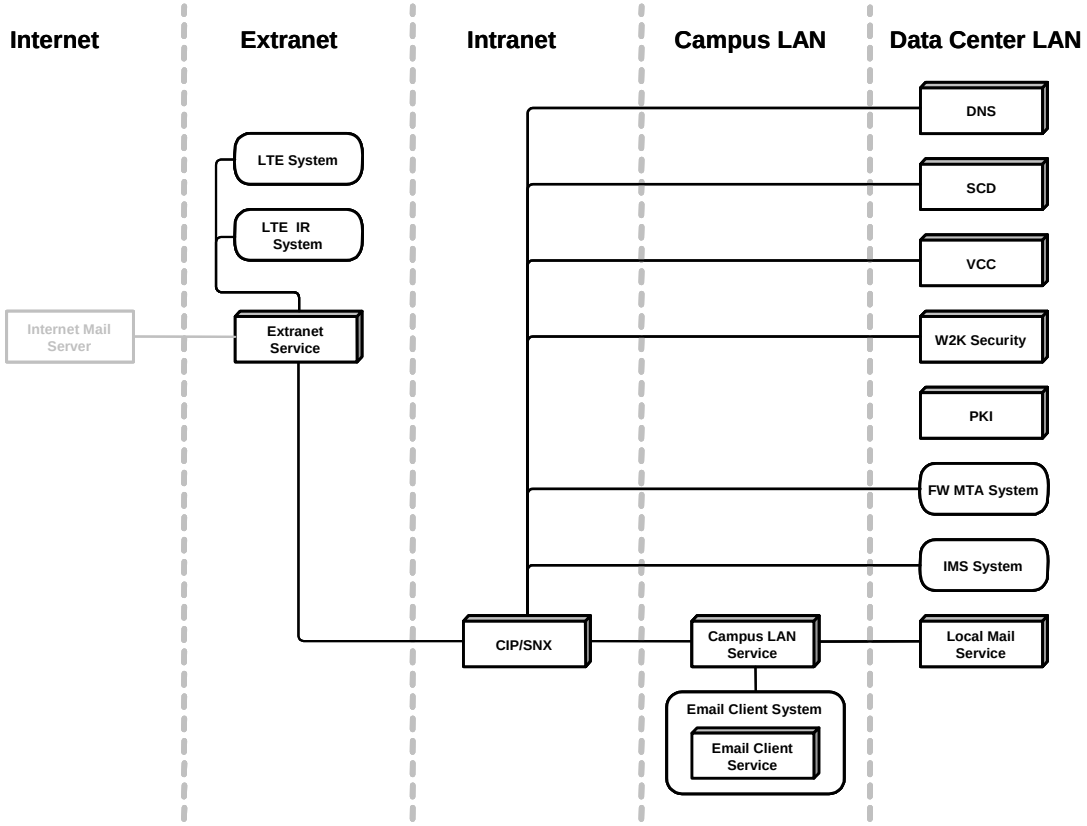

Figure 4: Communication view (example Email Service)

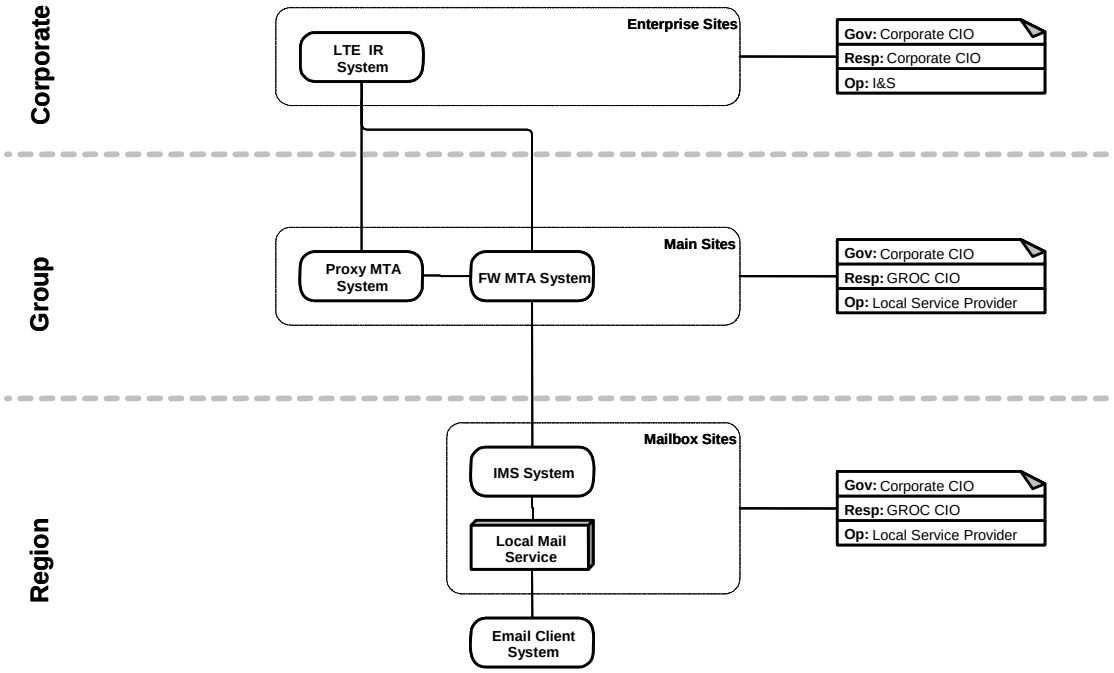

Figure 5: Distribution view (example Email Service)

The distribution view describes the allocation of service modules, systems, or components in terms of geographical or organizational distribution. Like the component view, the distribution view is divided into three major parts. However, the distribution view is divided horizontally rather than vertically. The segmentation of the diagram follows the company's organization in corporate, group, and region (GROC = group, regions operating companies). In addition organizational responsibility of a site is assigned in the categories Governance (defining the rules), Responsible (to ensure adherence to the rules), and Operator (implementing the rules). Note that the horizontal distribution in the example diagram is due the organization set up in focus, it would look different for any other organization. However, the principal layout of the proposed distribution diagram is similar.

The Email Service example illustrated the use of the three views for infrastructure architecture. The same principles for the design of the views are applied for applications architecture using the respective building blocks for the segmentation of diagrams. The views can be used at any level of detail for the decomposition of the chosen part of architecture (building block, service module, system). The combination of the architecture descriptions derived can be used for an integration of architecture in the large and in the small.

Dependencies of Architecture Building Blocks

Enterprise Architecture is more than the collection of the constituent architectures. The inter-relationships among these architectures, and their joint properties, are essential to the enterprise architecture. Thus, the architecture domains should not be approached in isolation. Key element of architecture design is to account for interdependencies among the building blocks of architecture. Blueprints are introduced as a means in planning the deployment of architecture on a large scale. Blueprints give a comprehensive view on the building blocks and how the interact. They show the effects of architecture design between business -, application -, and infrastructure architecture.

In the focus of enterprise architectures is the alignment of business and IT. In other words, the design of the business architecture determines the IT architecture which has to support and enable business. The building blocks of business architecture, with the process architecture as the core, define the frame for the design of the IT landscape. The dependencies between the different architectures can be described in blueprints. A blueprint is a plan which describes the deployment of an architecture building block across the enterprise. It pictures the landscape of this building block in a matrix of two business dimensions.

The Figure 6 illustrates the derivation of main IT blueprints from the organization and process architecture.

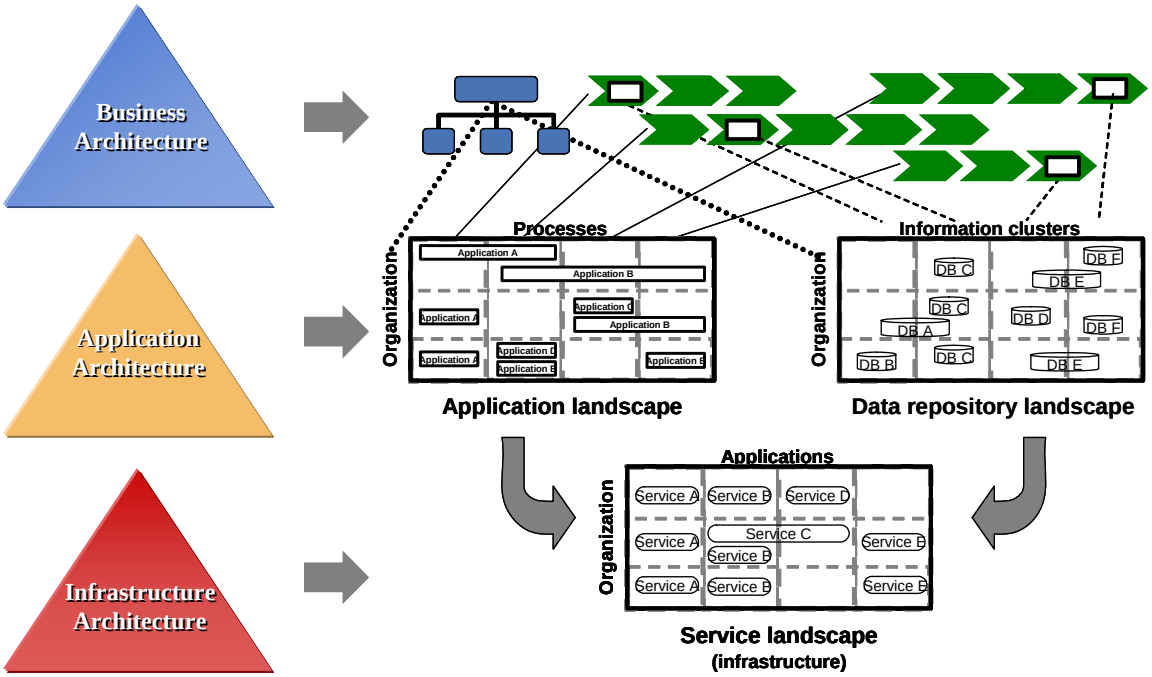

Figure 6: Main blueprints for IT architecture development

The application landscape describes for each business process how it is supported by applications. The second dimension shows the deployment in organizational units, like divisions, business segment etc.

The data repository landscape describes the deployment with databases and how they support defined information clusters of the information architecture. The second dimension shows the deployment of the databases in organizational units.

The service landscape shows the deployment of infrastructure services and the support of applications. The second dimension shows the deployment in organizational units.

In general, different types of blueprints can be generated depending which dependency of business -, applications -, and IT infrastructure architecture or respective building block is in focus. Also, the matrix dimensions can be chosen at different level of detail. However, the experience in architecture projects shows that a high level is sufficient in order to derive decisions for architecture development. Generating to detailed blueprints involves a lot of resources and time without enriching the decision base in the same degree. The three blueprints introduced provide a good information base for management decisions.

The figure 7 gives a simplified, illustrative example for an application blueprint. The applications in use are mapped to the company's business processes. The second dimension shows the deployment in organizational units, like divisions, business segments etc.

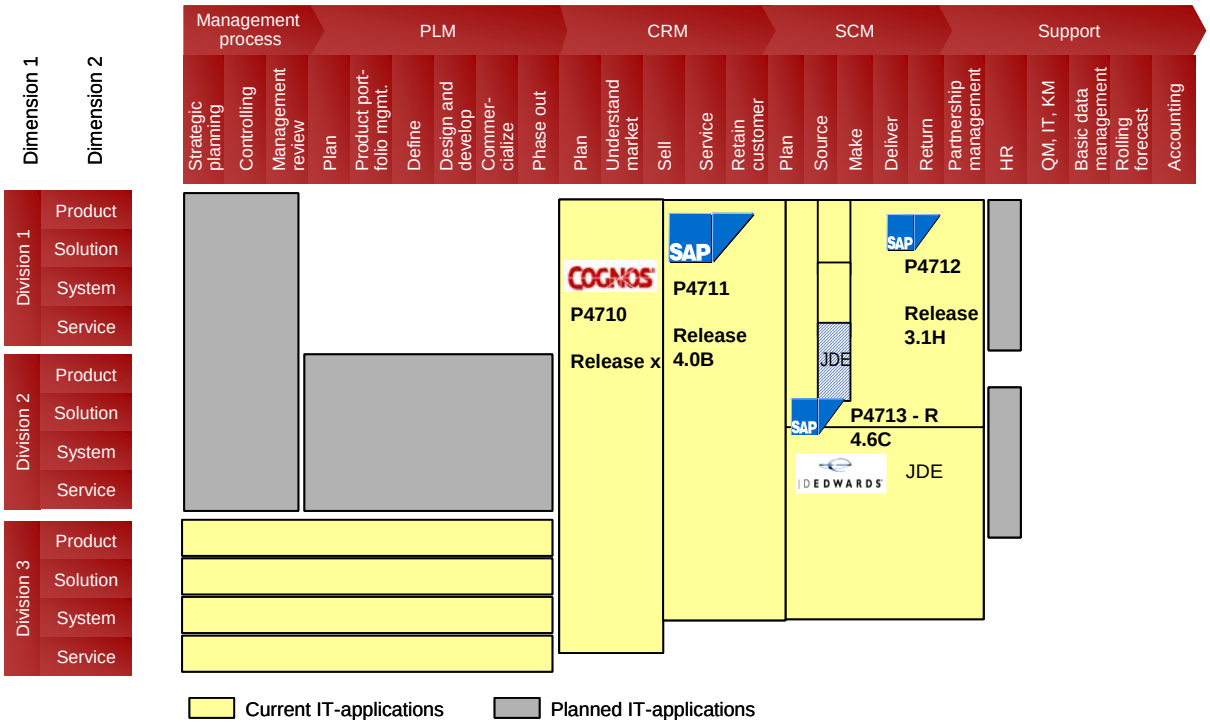

Figure 7: Principal layout of an application blueprint

In a number of projects blueprints have been proven to give a transparent overview on the application landscape and are a sound basis to derive architecture decisions. At a glance one can see processes not supported by applications or redundancies where more than one application is in place for a process. Blue prints are used for presentation of "as is" as well as target architecture.

Stakeholders in Architecture Development

The scope of enterprise architecture and the architecture development process, ranging from strategic formulation to implementation, in mind it is obvious that a number of people coming from different organizational backgrounds and disciplines are involved. Figure 8 outlines the main stakeholders involved in an enterprise architecture management. It shows their basic roles and usage of architecture design techniques (see Dern 2003, p. 108f., META Group 2002, pp. 69f., 205f., 333f., TOGAF 2003). An anchor point on the line of a particular role shows the usage of the marked technique. The size of the technique outlines the use across the three architecture domains. In addition to the techniques discussed in the prior chapter, methods for IT strategy definition and implementation are included in this overview due to the fact that this is the major reference for architecture development.

The stakeholders like CEO/CFO; CIO, IT strategy planer, and program manager are involved in the business/ IT strategy and decisions for direction, objectives of architecture, and IT program. They merely use methods of

business IT alignment, IT impact, portfolio techniques and blueprints. Architecture principle and pattern are partly used.

The central role plays the enterprise architect who leads the architecture development and coordinates all respective activities. He is responsible for as is/ target-architectures and the dependencies among architectures. In addition, there are other domain related architects involved. Responsibility of architects can be on diverse domains ranging from enterprise - to system architecture. Architects use the entire range of techniques with different levels of detail depending on their respective domain.

Process owners focus on blueprints which show how processes are supported by applications and services. Principles and patterns for business architecture are also used.

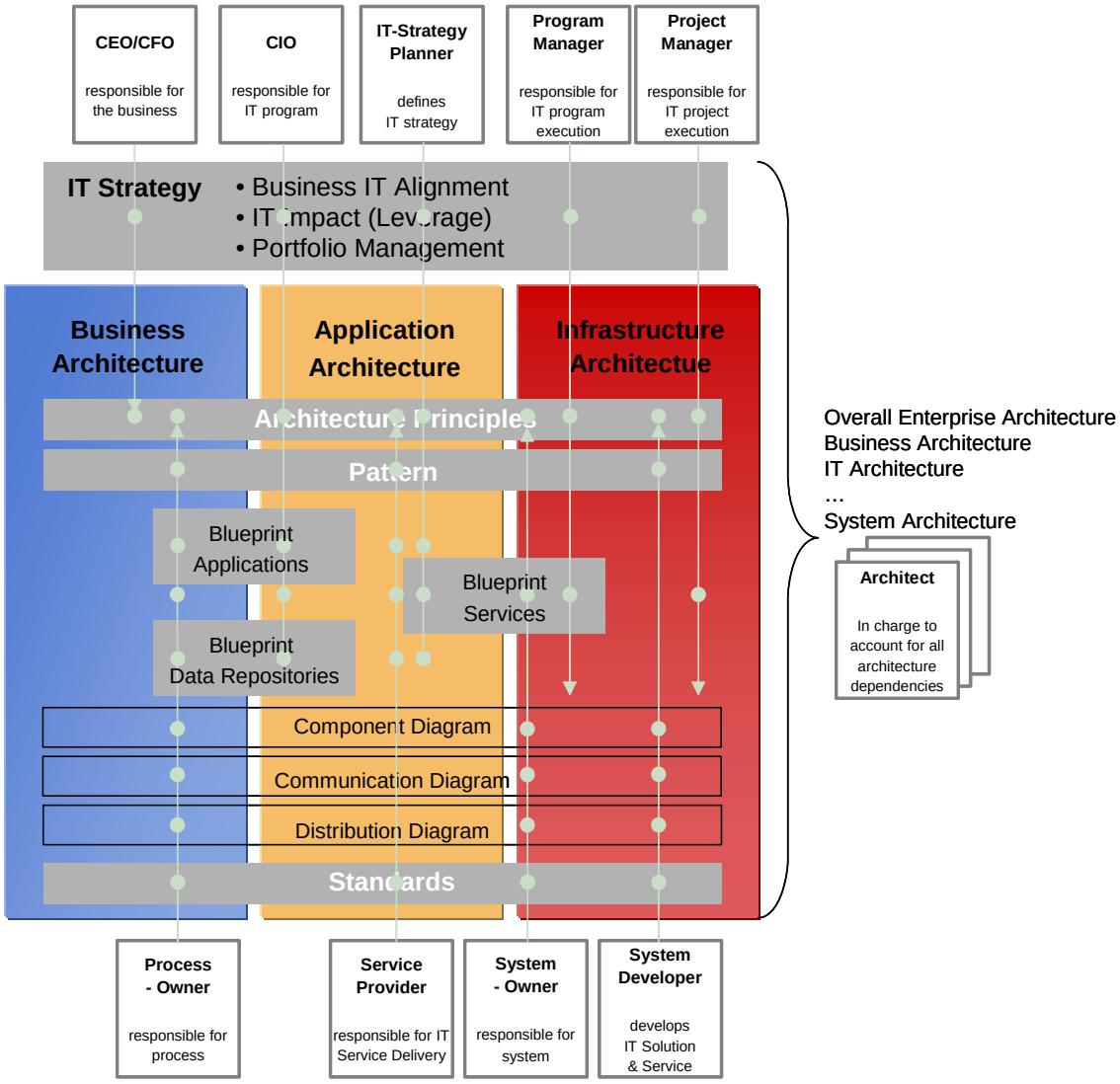

Figure 8: Architecture design techniques and stakeholders

Service providers use blueprints for an overview of the IT landscape and to allocate services. Principles and patterns are also used.

System owners and system developers use component -, communication - , and distribution diagrams with focus at system level. Defined principles and pattern are basis for their work.

Thus, these techniques are used differently by the stakeholders depending on the respective scope of work. The different ways of architecture description are an important means of communication among the stakeholders involved in the architecture development process and the alignment of business and IT. However, architecture development is very much management and communication among the different parties involved and not only technical construction. Within the scope of this paper only an outlook on the main stakeholders could be given. Architecture management is fundamental for a business oriented, sustainable development of enterprise architecture. Project experiences in this area will be addressed in a separate paper.

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