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Managing Change: Business/ IT Alignment and Adaptability of Information Systems

Norbert Gronau
University of Potsdam, ngronau@wi.uni-potsdam.de

Michael Rohloff
mri Management Consulting, michael.rohloff@mri-consult.de

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Norbert Gronau, Chair of Business Information Systems, University of Potsdam, Germany,
ngronau@wi.uni-potsdam.de

Michael Rohloff, mri Management Consulting; Munich, Germany
michael.rohloff@mri-consult.de

Abstract

The ability to adapt to frequent changes has emerged as a new paradigm for successful business operations. The paper outlines an approach for business/ IT alignment taking organizational transformation into account.
A framework for enterprise architecture is introduced which links business - , application -, and infrastructure architecture. Key element of architecture design is to account for interdependencies among the building blocks of architecture. Blueprints give a comprehensive view on the building blocks and how the interact.
The criteria and process how to analyse the adaptability of information systems are described. Based on the assessment principal strategies for information system deployment are pointed out.
Finally the architecture development process and the main stakeholders and their respective usage of the design techniques are sketched.
Keywords: business/ IT alignment, organizational change, adaptability of information systems, enterprise architecture, architecture management, blue prints, architecture development process, stakeholders.

1 PROVIDING FOR CHANGE IN BUSINESS BY ENTERPRISE ARCHITECTURE MANAGEMENT

1.1 Business in Need for Change

Business change is one of the most outstanding and most pervasive qualities of global economies. There has been some consideration of business change itself, but less emphasis has been on studying the outcomes of this change with regard to information technology (IT) and its interrelation. Organisational change requires the information systems architecture of an organisation to adjust too (Gronau 2003). The necessity of adjustment for information systems according to organisational environment adds an important dimension to the general discussion of business/ IT alignment (Avison et al. 2004, Baumöl 2006, Henderson/ Verkatraman1999, Luftman 2003, 2005, Weiss/ Anderson 2004).

A means for the business/ IT alignment is an architecture development based on an enterprise architecture approach. Architecture is a commonly used term for the design of information systems. However understanding and structuring of enterprise architecture and their basic elements differs (e.g. see the discussion in Buhl/ Heinrich 2004). 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 (business architecture) with the IT architecture is fundamental. The wide range of different domains and scope of enterprise architecture and its high complexity are characteristics of enterprise architectures. The following sketches some objectives to be pursued with enterprise architecture management (Aranow 2002, p. 9f., Dietzsch 2005, p. 36f, Masak 2005, p. 9f., Meta 2002, p. 6f., 49f., Günzel/ Rohloff 2003, p. 424, TOGAF 2003, Umek/ Tannhäuser 2004, p. 55f.):

- Strategy and business orientation
  - enabling, leverage of IT, new business models
- Adaptability and continuity
  - dynamic markets, business, and technology, provide for scalability and growth, adapt to organisational change
  - provide for continuity by lasting architecture principles and structure
- Effectiveness and efficiency
  - success oriented, strategy based architecture
  - to develop & implement the I&C landscape in a systematic and efficient manner and to utilize synergies
- Planning and controlling
  - target oriented, steering of I&C program with strong impact and to secure compliance to standards
- Transparency and communication
  - complexity and dependencies of architecture building blocks
  - heterogeneous composition of people involved (from management to IT experts)

1.2 Building Blocks of Enterprise Architecture

In the following a framework is introduced which structures enterprise architecture in key domains and building blocks in order to give a comprehensive view on all relevant aspects of enterprise architecture (for an overview on other enterprise architecture frameworks Lapkin 2004a 2004b. Examples for frameworks are The Open Group Architecture framework (TOGAF 2003), Federal Enterprise Architecture Framework (FEAF); Gartner and META Group Enterprise Architecture Framework (Gartner, META Group 2002), and Zachman Framework (Zachman 1987, Sowa/ Zachman 1992). 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 architecture domains introduced in this paper follow the basic structuring of TOGAF and detail the domains in architecture building blocks to give a comprehensive overview of all constituents of enterprise architecture. 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. This provides for a clear distinction of the business oriented description of the enterprise architecture and the derived technological implementation.

The framework (Rohloff 2005) is composed of three basic domains with distinct architecture building blocks:

- Business Architecture
- Application Architecture
- Infrastructure Architecture

The *business architecture* describes the fundamental organisation and requirements of the business based on business strategy and objectives. It is composed of the four building blocks business model, organizational architecture, process architecture, and information architecture.

The *application architecture* gives an overview on all applications supporting the processes of the business with the building blocks enterprise applications, portal & information management platform, data repositories, and EAI Services.

The *infrastructure architecture*, also referred to as technology architecture, comprises the software, hardware and network infrastructure required for operations of all applications. Infrastructure building blocks are basic services, workplace services, server systems & storage, and the network.

Security is integral part of all architecture building blocks and described in an overlaying structure.

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.

The figure 1 depicts the architecture framework and the corresponding techniques for architecture description. It is based on the principal elements of the architecture framework for information systems described by Sinz (Sinz 1997, p. 3). The 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 (IEEE 2000, Clements et al. 2003).

The *component 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 *communication 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. The d*istribution 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. All views allow for different level of detail of the architecture. 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 (Rohloff 2005, Lichtenegger et al. 2003).

Relationship/ dependencies between the enterprise architecture domains can be described using the concept of 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 *application blueprint* 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 blueprint* describes the deployment with databases and how the support defined information clusters of the information architecture. The second dimension shows the deployment of the databases in organizational units. The service blueprint 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 building block is in focus. Also, the matrix dimensions can be chosen in different level of detail. The three types of blueprints provide a good information base for management decisions. The following chapter gives an example of an application blueprint as a means of business/ IT alignment.

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.

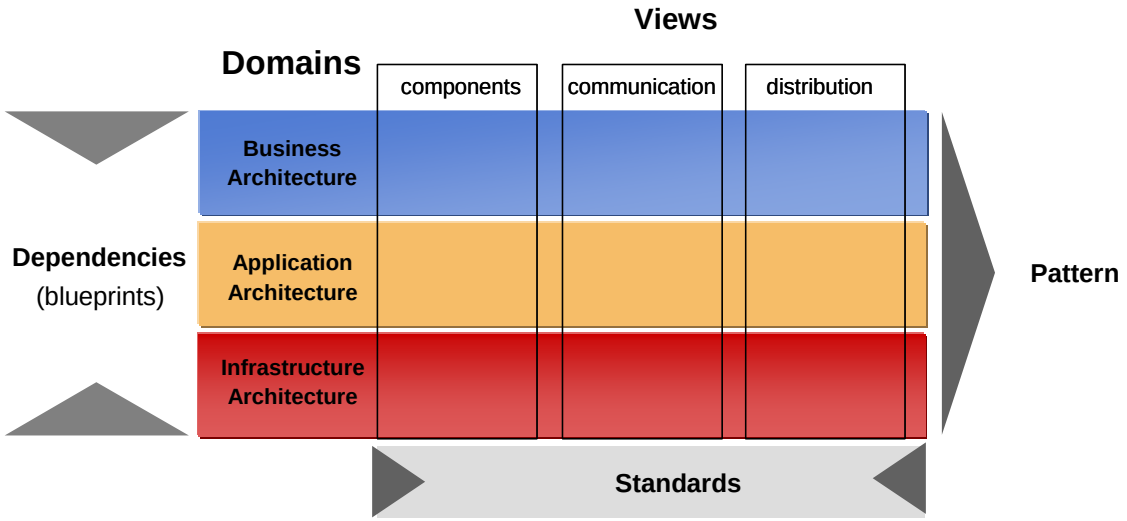

Figure 1. Architecture framework and architectural description

In this paper we exemplify the framework and architecture design by illustrating architecture dependencies with the means of blueprints and outlining the adaptability analysis and the derived principal strategies for information systems deployment. Both are prominent techniques for the design of the information systems landscape.

2 DESIGN OF THE INFORMATION SYSTEMS LANDSCAPE

2.1 Blueprints: Building the Information Systems Landscape

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.

A blueprint describes the deployment of an architecture building block across the enterprise. *Application blueprints* are in the main focus in order to show IT support for business (for alternative layout, e.g. Lankes et al. 2005, Dern 2003, pp. 71f., Krcmar 2005, p. 197). It pictures the application landscape in a matrix of two business dimensions. The application blueprint describes for each business process how it is supported by applications. The figure 2 gives a simplified, illustrative example. 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.

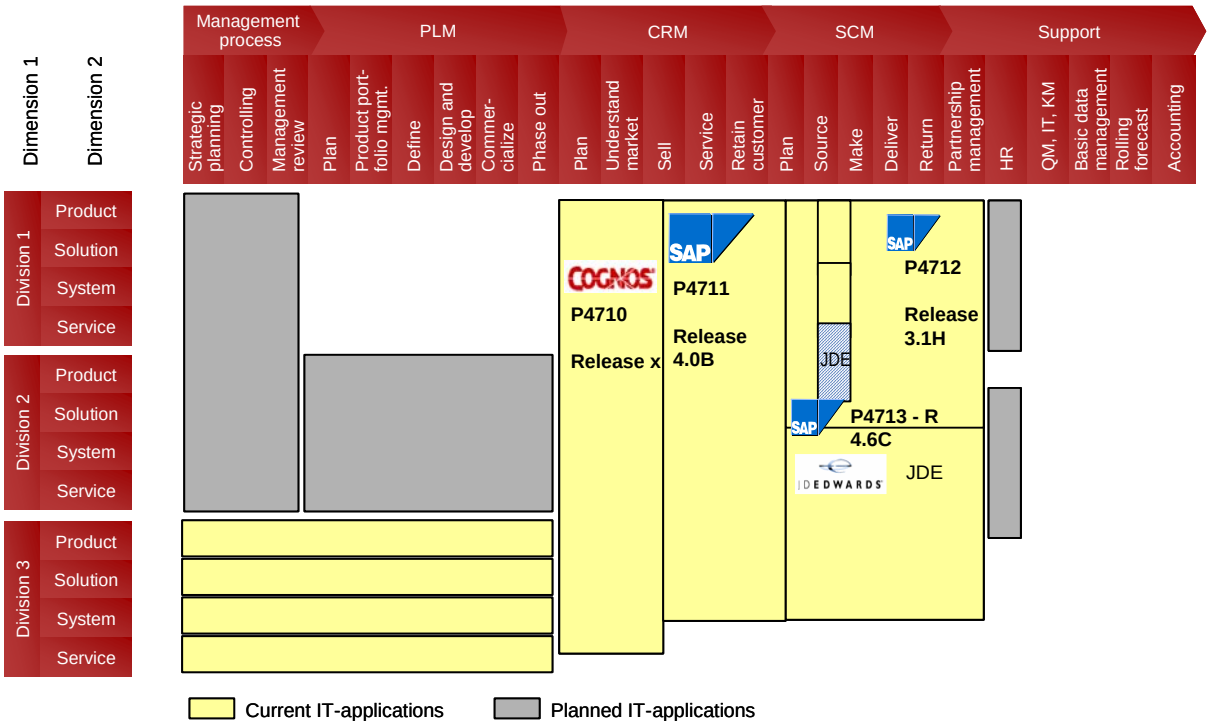

Figure 2. Principal layout of an application blueprint

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 (see chapter 3).

2.2 Evaluation of the Adaptability of Information Systems

Given the assumptions of organisational change presented in the first section an analysis of the enterprise and its environment as well as the information systems in use is undertaken. The development of a methodology, in order to determine the specific importance of the transformation necessity for the individual enterprise, forms the basis for a structured procedure for the adjustment of the adaptability of an enterprise surrounded by a dynamic and precipitously changing environment. In this point of view an increased susceptibility exists, when environmental influences are estimated as turbulent. Therefore a larger change pressure for the enterprise exists. As a contrast, environmental conditions which are estimated as being rather constant imply that no necessity exists, to anticipate modifications.

The first phase consists of two steps. First the analysis is directed towards general factors of influences in a certain branch of industry. Here the specific conditions of the individual enterprise are not addressed. In a second step the sensitivity of the individual enterprise is considered. From this evaluation a key figure is generated, which represents the turbulence index (Ty).

Table 1 shows the determination of the specific turbulence index using the example of a medium-sized cable manufacturer. Since the procedure considers individual relevance values of the company, its application for arbitrary enterprises is given. The industry-specific information can be generated from available statistics. Thus, it is possible to describe the susceptibility of the system enterprise in a specific index (turbulence index) per criteria. Afterwards a general statement about the aggregated susceptibility to environmental turbulence is possible (Andresen et al. 2005, pp. 68f.)

Factor	Weight	**Effect**	**Points**
	100	0<=p<=10	
Industry Competitors	12	7,5	90
New Entrants	10	5	50
Products of substitution	13	4,5	58,5
Buyers	45	7,5	337,5
Suppliers	7	7,5	52,5
Technological environment	5	6,5	32,5
Politival-legal environment	2	2,5	5
Labour market	2	3	6
Money- and capitalmarket	2	6	12
Ecological environment	2	3	6
Turbulence index			**65**

Table 1. Determination of the Turbulence Index Ty

In the second phase the information systems of the enterprise (e.g. ERP systems) are examined in terms of adaptability. Indicators for the adaptability are examined for the information systems in use (as illustrated in the application blueprint in figure 2). All evaluations of key-applications form the aggregated index for the adaptability of an enterprise (Wx). In phase 3 both index figures are combined into a portfolio and assigned to one of four quadrants. From the position of the value within the portfolio recommendations for future arrangement of the IT strategy are derived. The allocation of an enterprise and the evaluation of a branch always reflect the current condition at a certain time, in which all substantial structures and conditions of the surrounding field are included.

This research suggests that it is possible to observe a number of patterns that exist specific to adaptability requirements in information systems (figure 3). The detected patterns are based on iterative analyses of business process requirements and technical features with regard to adaptability and its attributes such as efficiency and flexibility for instance. Identified patterns for information systems fall into two main categories. The first of these identifies technological artefacts. This category is termed system-based patterns of adaptability. System-based patterns relate to the enterprise system and its given architecture elements. Patterns of this dimension enable the system to adapt. The second dimension recognises patterns in the process of applying enterprise systems in real world scenarios. Business patterns outline the business need for adaptability and permit to change scenarios (Andresen et al. 2005, pp. 70f.). While the first oft theses dimensions identifies the structures that exist

in the information systems themselves the second recognises patterns in the process of intervention which bring about changes in the information system (as a consequence of business process changes).

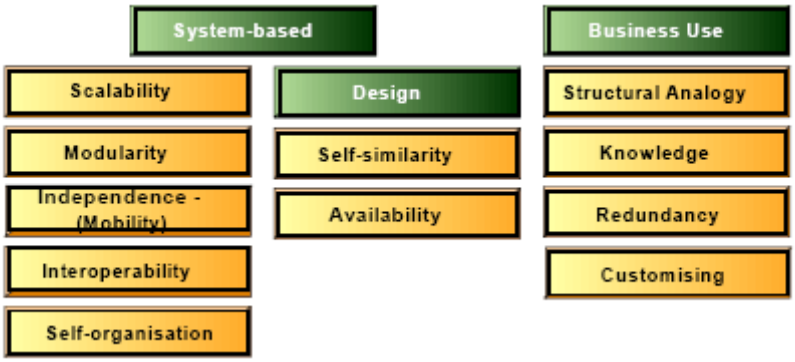

Figure 3. Identified Patterns of Adaptability

System patterns describe the immanent qualities of the information system itself. Independent from surrounding conditions, system patterns show the latent ability of the system to support adaptability. The system is considered a closed system to measure its capacities to manage change. System-based patterns comprise design-related patterns. The sub-category design pattern represents high-level abstractions that describe specific design decisions.

The business dimension characterises the circumstances of usage for an information system. It is outlined that the degree of adaptability, which can be reached by a specific information system, is influenced by decisions referring to the deployment of the system within a business organisation. For this reason the patterns presented below are called business use patterns. The use patterns or the business dimension characterise the circumstances of the usage of an information system. They reflect that enabling factors for adaptability are also related to decisions referring to the deployment of the system. In this area patterns are for instance the capabilities of personnel (person-bound) knowledge or existing guidelines to proper deploy a software system. These patterns define the adaptability of the information system (Wx). The calculation of the index is not detailed in this paper.

2.3 Deriving the IT Strategy

The portfolio-presentation in figure 4 illustrates the result of the two dimensions: adaptability of the information system (Wx) and the turbulence index (Ty), representing the degree of environmental turbulence (low, high) at the x-axis and, the degree of adaptability of the information system (low, high) here defined as domain specific software application (DSSA) at the y-axis. The join results in point values attached to one of the four defined areas of the portfolio; e.g. the example of the ERP system of the cable manufacturer is characterized by small adaptability.

The *neutral area* describes the condition of small environmental turbulences and small prevailing adaptability. The *transfer area* denotes an enterprise, which has a high grade of adaptability in its architecture but facing little environmental turbulences. In the *critical zone* the environmental turbulences predominate, while the information system is hardly adaptable (Ty >> Wx). In the *ideal area*, environmental turbulence and adaptability are maximally distinct. With the collected data the ideal situation is developed from the current state. The arrows illustrate the further development and permit the direction of the IT strategy (1 – 6).

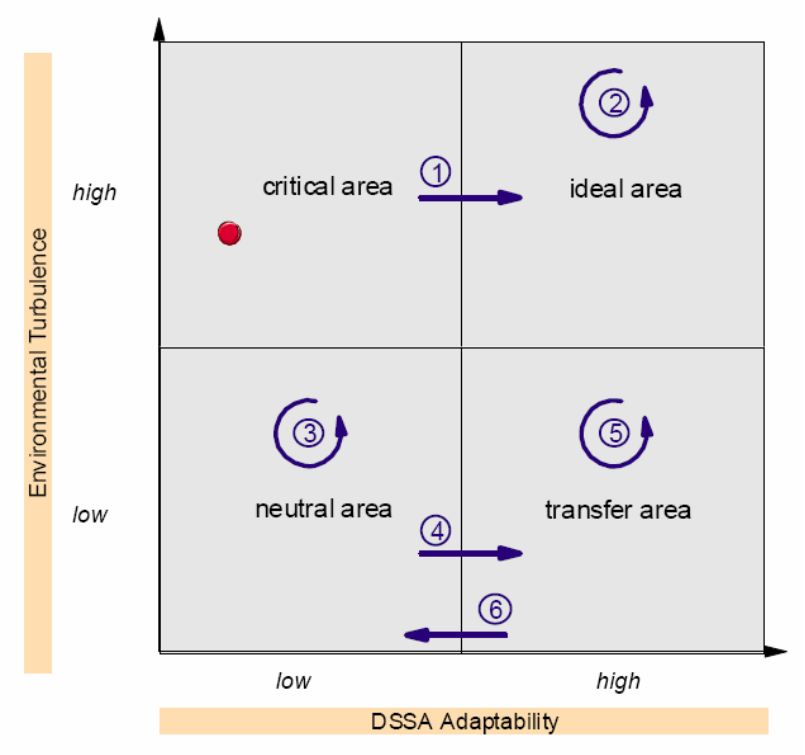

Figure 4. IS assessment and strategies for deployment

1. If the condition of an enterprise is reflected by the critical area the adaptability of the information system architecture must be increased fast, so that the environmental turbulences can be met adequately. If the conversion succeeds the necessary adaptability the enterprise is put into the position to control the market and the surrounding field dynamics. Additionally, the enterprise is to create turbulences in the environment. That corresponds to the transition of the critical to the ideal zone.

2. The enterprise is situated in the ideal zone: The goal is the long term preservation of adaptability. Regular analysis of the situation on the basis of the defined criteria for adaptability prevents an unnoticed deviating from the ideal course and provides the basis for a possible adjustment, if necessary.

3. If enterprises remain sufficiently supported by information systems with small adaptability in a surrounding field with small dynamics, constant advancement under the aspect of cost reduction is the recommended focus of the IT strategy. These characteristics are related to the neutral zone.

4. A careful further development of adaptability linked with an already defined IT strategy can be accompanied by a transition from the neutral area to the transfer one.

5. If the situation is as such that adaptability of the information system over-fulfils the requirements of the dynamic enterprise surrounding field (Wi>> Tj), IT efficiency is to be placed into the foreground of the IT strategy, since the implementation of adaptability is always a cost relevant factor (Heger/ Holzer 2004). From an IT strategic point of view the fathom of cost reducing potential without reducing the grade of adaptability can be an option.

6. If the enterprise is situated in the transfer zone, it is also possible to examine the internal consequences for the core business with a changed information system regarding the decrease of the adaptability. In view of the strategic criteria of risk minimizing an optimization of the adaptability is to be preferred in order to be actively adjusted to changes. The adjustment of the IT to the current turbulence situation corresponds to an evaluated minimum requirement. This is to be evaluated under costs and efficiency criteria.

Hence, the assessment of the adaptability of information systems adds to the definition of IT strategy and target blueprints in order to transform the IT landscape of an enterprise to expected organisational change.

3 ARCHITECTURE MANAGEMENT

3.1 Process of Architecture Development

Architecture design follows a well defined architecture development process which is sketched in figure 4 (compare Meta 2002, pp.5, 57f., TOGAF 2003, Introduction to Architecture Development Method (ADM), Umek/ Tannhäuser 2004, pp. 57f., Dietsch 2005, pp. 634f.).

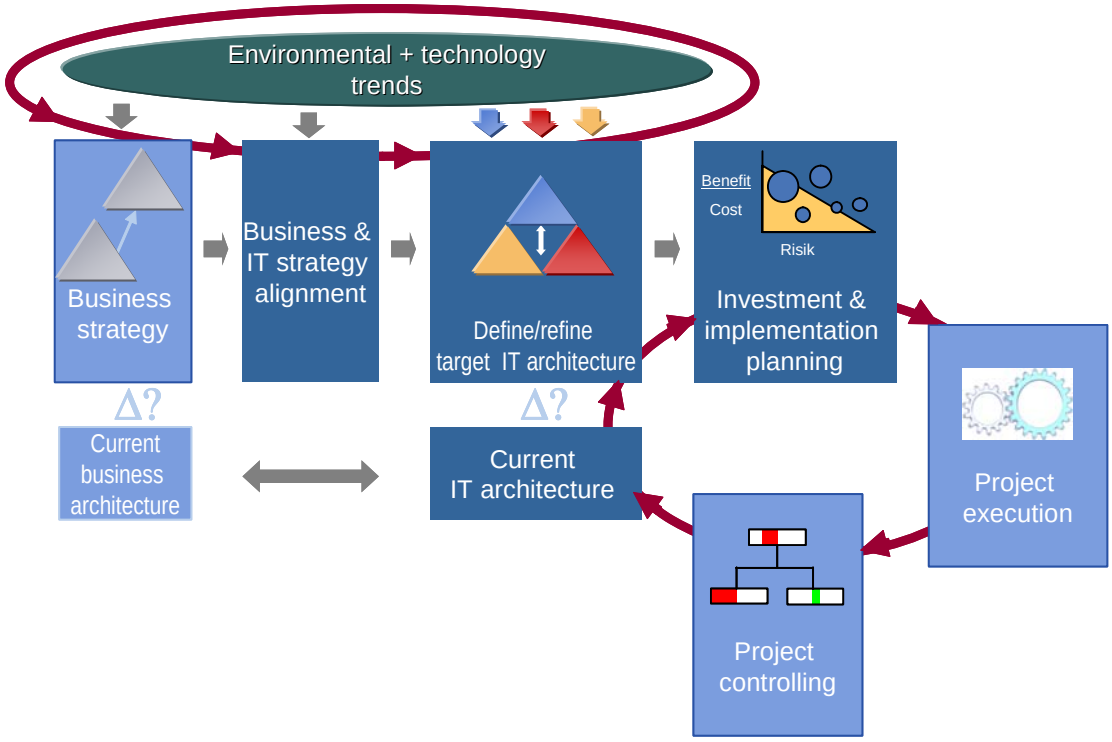

Figure 5. Overview on the architecture development process

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. 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 chapter 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.

Thus, an enterprise architecture includes not only the three domains for the “as is” architecture (baseline architecture) and the target architecture. It also includes a strategic information base with a clear definition of business objectives and strategy. The strategy is needed for the transitional processes in order to implement new technologies in response to the changing business needs. That means the enterprise architecture includes also the process to create, update and manage the evolution of the architecture domains in line with business strategy.

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 I&C 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.

3.2 Architecture Design Techniques and Stakeholders

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. Basically, a system has one or more stakeholders. Each stakeholder typically has interests in, or concerns relative to that system. Concerns are those interests which pertain to the system’s development, its operation or any other aspects that are critical or otherwise important to one or more stakeholders. Concerns include system considerations such as performance, reliability, security, distribution, and ability to evolve. A system exists to fulfil one or more missions in its environment. A mission is a use or operation for which a system is intended by one or more stakeholders to meet some set of objectives.

Having the scope of enterprise architecture and the architecture development process in mind ranging from strategic formulation to implementation it is obvious that a number of people coming from different organizational backgrounds and disciplines are involved. Figure 9 outlines the main stakeholders involved in planning, development, and implementation of enterprise architectures with their basic roles and usage of architecture design techniques (see Dern 2003, pp. 108f., META 2002, pp. 69f., 205f., 333f., TOGAF 2003). In addition to the techniques introduced 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 based on a business/ IT alignment.

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

Stakeholders like CEO/CFO; CIO, IT strategy planer, and program manager involved in the business/ IT strategy and decisions for direction, objectives of architecture and IT program primarily use the methods of business IT alignment, IT impact, portfolio techniques and blueprints. Architecture principles and pattern are partly used.

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

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.

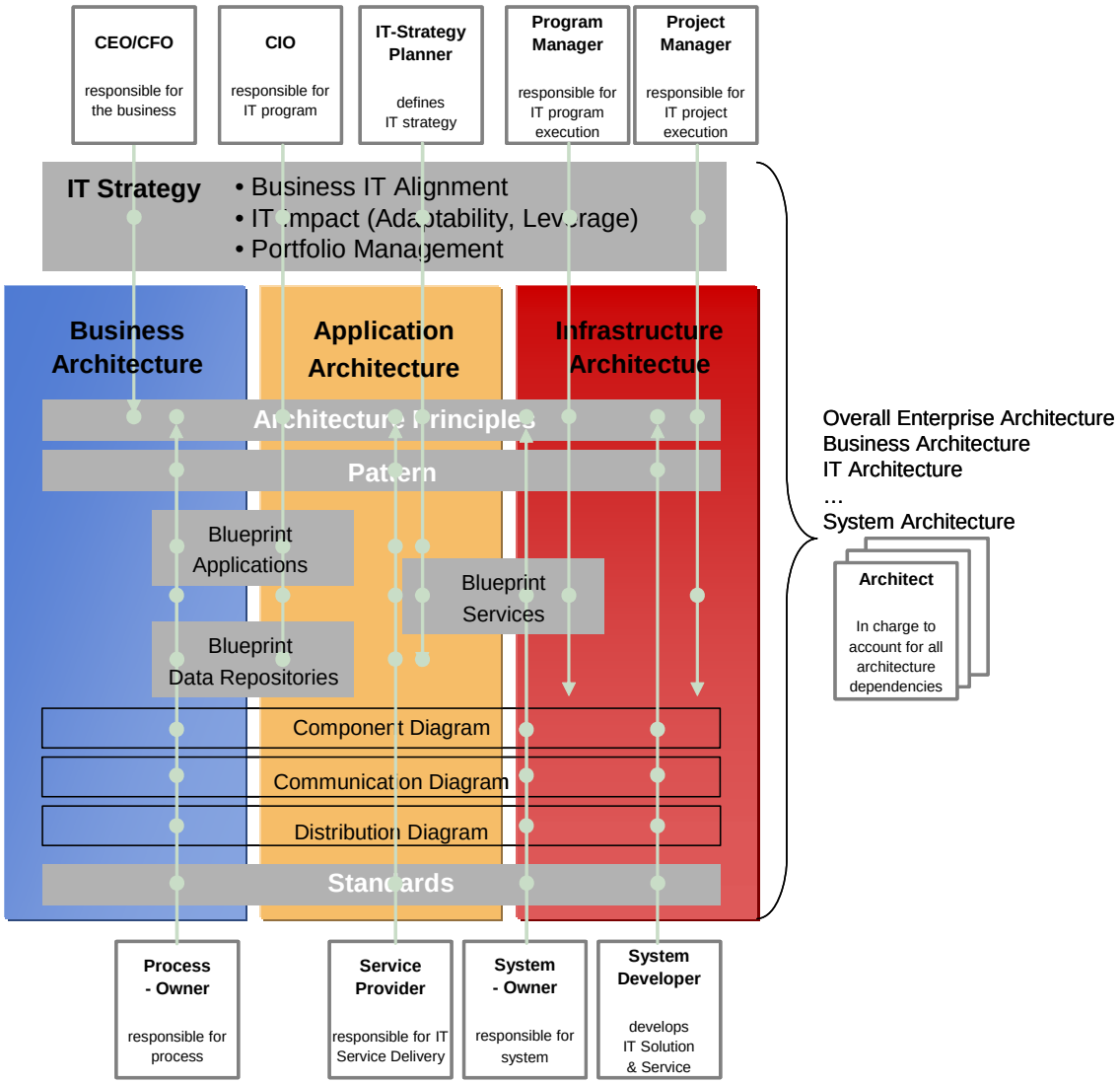

Figure 6. Architecture design techniques and stakeholders

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 and process are fundamental for a business oriented, sustainable development of the enterprise architecture.

The architecture development process and the techniques introduced support the transparency and communication among the business and IT people enhancing the overall business/ IT alignment from strategy definition to operations of information systems. In addition, organisational change is accounted for in aiming at adaptable information systems.

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