The Enterprise Engineering Series

Enterprise Architecture

Creating Value by Informed Governance

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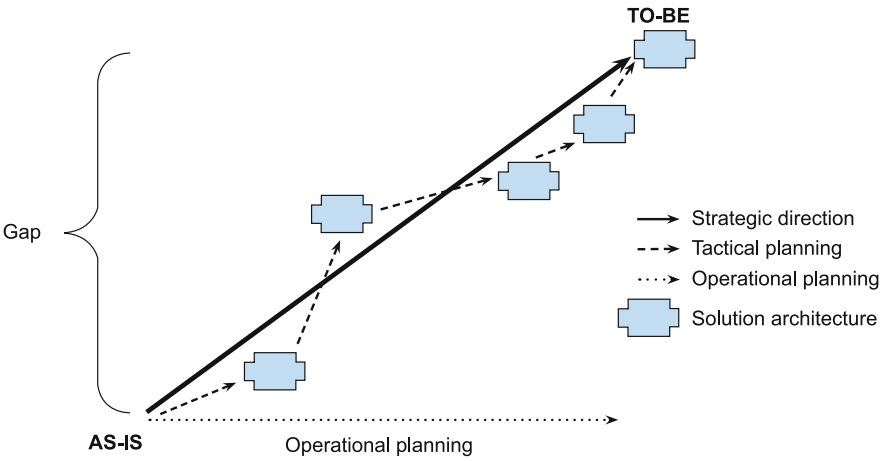

Fig. 3.7 Applications for enterprise architecture

– **Solution architecture**—Use enterprise architecture to create the high level design of an actual step in the enterprise transformation as it will be realized (and implemented) in the context of a specific project.

In Fig. 3.7, we have illustrated these seven application areas. Each of these seven application areas will yield different enterprise architectures, which are clearly interdependent. By ensuring compliance among these architectures, governance, and informed decision-making, from the strategic level to the operational level is enabled.

3.4 Defining Enterprise Architecture

The previous sections will undoubtedly already have shed some light on what we regard as enterprise architecture. In this section, we will make this more specific by providing our own definition of this concept.

3.4.1 Definitions of Enterprise Architecture

Before providing our definition of enterprise architecture, we start with a discussion of some of the existing definitions of IT/information/enterprise architecture:

- The *Institute of Electrical and Electronics Engineers (IEEE)* defines architecture as: "*An architecture is the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution* [60]."

- The *Open Group's Architectural Framework (TOGAF)* defines architecture as: "*Architecture has two meanings depending upon its contextual usage: (1) A formal description of a system, or a detailed plan of the system at component level to guide its implementation; (2) The structure of components, their interrelationships, and the principles and guidelines governing their design and evolution over time* [139]."
- The *Clinger–Cohen Act's* definition of IT architecture is: "*The term "information technology architecture," with respect to an executive agency, means an integrated framework for evolving or maintaining existing information technology and acquiring new information technology to achieve the agency's strategic goals and information resources management goals* [142]."
- The *Netherlands Architecture Forum (NAF)*, defines architecture conceptually as "*a normative restriction of design freedom*" and operationally as "*a set of design principles* [154]." As a background to this definition, NAF writes: "*In general, the design freedom of designers is undesirable large. The idea of architecture is to take advantage of this. Therefore, architecture is defined as normative restriction of design freedom. This idea of consciously applying normative restriction of design freedom is the really new thing. It makes architecture a prescriptive notion; any descriptive interpretation is cogently rejected*."
- The *ArchiMate Foundation* defines enterprise architecture to be "*A coherent whole of principles, methods, and models that are used in the design and realization of an enterprise's organizational structure, business processes, information systems, and infrastructure* [78]."
- The current architecture definition of *Capgemini* is: "*An architecture is a set of principles, rules, standards, and guidelines, expressing and visualizing a vision and implementing concepts, containing a mixture of style, engineering, and construction principles*."
- A recent definition from the *Gartner Group* is: "*Enterprise architecture (EA) is the process of translating business vision and strategy into effective enterprise change by creating, communicating, and improving the key principles and models that describe the enterprise's future state and enable its evolution*."

The variety in these definitions does seem to indicate that the field of enterprise architecture is still in its infancy. At the same time, however, the wide spread attention of enterprise architecture does indicate that enterprises do feel a profound need to steer their development (including their business and IT portfolio), and that they are looking toward enterprise architecture as a means to fill this need.

3.4.2 Perspectives on the Role of Enterprise Architecture

While the above definitions may seem to differ considerably, what all these definitions seem to have in common is a reference to *structure* and *relationships* combined with a reference to a set of governing *principles* that provide *guidance* and *support*

for *directions* and *decisions*. *Enterprise architecture* focuses on shaping and governing the design of the future enterprise using principles to stipulate future direction and models to underpin and visualize future states. In our opinion, there are three important perspectives on the role of an enterprise architecture:

- **A regulation-oriented perspective**—which manifests itself as a prescriptive notion governing the design of an enterprise. When taking this perspective, one will focus on principles, leading to rules, guidelines, and standards, focusing the enterprise's design freedom in the direction of its success.
- **A design-oriented perspective**—which emphasises the comprehensive and cohesive specification of an enterprise in all its facets, as a high level design. This perspective focuses on essential design decisions, as well as its core structures. When taking this perspective, one typically produces models that describe the design of actual systemic artefacts and their interrelations.
- **A patterns-oriented perspective**—which focuses on the use of design patterns. This perspective forms a bridge between the regulative and the design perspectives. To meet the regulations set out in the regulative perspective, during design activities, suitable patterns can be applied.

The regulation and design-oriented perspectives correspond to the earlier mentioned *indicator* and *control* aspects of the dashboard paradigm as depicted in Fig. 3.5, and are complementary to each other in that the regulation-oriented perspective accommodates for the need to steer and direct developments, while the second perspective supports the need to gain insight into an enterprise's design while also providing guidance to designers of enterprise systems.

Even though not many definitions of architecture explicitly refer to the *patterns-oriented* perspective, the role of patterns to capture and reuse design knowledge (such as the quality attributes that will result from using specific patterns) in the creation of architecture (be it for buildings, software, or enterprises) is evident [5, 15, 44, 123].

3.4.3 Definition of Enterprise Architecture

Using these perspectives, we can now define what we regard as enterprise architecture:

> *A coherent set of descriptions, covering a regulations-oriented, design-oriented and patterns-oriented perspective on an enterprise, which provides indicators and controls that enable the informed governance of the enterprise's evolution and success.*

3.4.4 Views in Enterprise Architectures

In practice, an enterprise architecture covers several foci that blend together to form the enterprise architecture. Without attempting to provide an exhaustive list, some typical (example) views are:

- In a *business view*, one would define the integrated structure of the overall business itself (in terms of organization, people and processes, and resources). Business architecture supports business change with a more holistic perspective. This approach is becoming more important with the move toward service-oriented architecture at the business level.
- In an *IT view*, one would define and describe the structure and relationships of IT systems including the way IT supports the enterprise to achieve its business goals.
- A *governance view* would address the full range of governance, from business governance (how to manage overall business processes, both formal and informal) to organizational and systems governance and also IT systems management capabilities.
- A *security view* addresses the full range of security, from business and information security to IT security. It also addresses the required security for organizational and business-related services. It is often linked to governance aspects to address security management.

In Chap. 4, we will discuss several dimensions along which to identify additional views. In the next section, the concept of view will be defined as being one of the key concepts of enterprise architecture.

3.5 Key Concept of Enterprise Architecture

Enterprise architecture can help organizations and their transformation processes in successfully executing their strategy. As such, it acts as an active planning and steering instrument, which can be used in translating strategy to programs and projects, and revolves around four main components: principles, models, views, and frameworks. Organizational transformation processes, embodied in programs and projects, can use the principles, models and views as a means of content based steering in the coherence of the solution. In this section, we will explore the concepts of concerns, principles, models, views, and frameworks.

3.5.1 Stakeholders and Their Concerns

An enterprise has many stakeholders. Future development of an enterprise is likely to impact on the interests of these stakeholders. In this section, we briefly survey some classes of stakeholders and their specific concerns. In this book, we use the definition of stakeholder and concern as provided in [60]. A *stakeholder* is an individual, team, or organization (or classes thereof) with interest in, or concerns relative to, a system (such as an enterprise). *Concerns* are those interests, which pertain to the system's development, its operation or any other aspect that is critical or otherwise important to one or more stakeholders.

In making decisions about an enterprise's future directions, stakeholders want to obtain insight into the impact these directions will have on their concerns, and understand the risks involved in current and future initiatives. Even more, since present day enterprises are complex social systems of interrelated processes, people and technology, stakeholders are keen on finding a way to harness this complexity when judging the impact on their concerns.

As discussed before, each type of stakeholder has its specific need for insight, control, and overview. At the same time, they all want insight into the potential impact on the enterprise resulting from changes in its own strategy or its environment, and consequences of decisions about the enterprise's future directions. They also have the desire to communicate about these changes and impact. Communication will take place at enterprise level, business unit level, department level, and project level depending on the responsibilities of the stakeholder involved in the communication. Below, we briefly zoom in on the interests and concerns of three typical classes of stakeholders, and their needs on enterprise architecture.

3.5.2 Principles

An univocal understanding about what is of fundamental importance for the organization is essential. This is represented by the term "principle." Even though no broadly accepted definition of principle exists yet, principles are generally regarded as constraints on the design space for enterprise engineers [98]. According to TOGAF [139], principles are general rules and guidelines, intended to be enduring and seldom amended, that inform and support the way in which an organization sets about fulfilling its mission. The extensible Architecture Framework (xAF) defines a principle as "a generic (functional or constructional) requirement for a class of systems [154]," where a class of systems is, e.g., all enterprise information systems, so not only for an individual system. According to Capgemini's integrated architecture framework (IAF), a principle is a statement of belief, approach, or intent which directs the formulation of the architecture, and may refer to the current state or a desired future state [30, 45]. In this book, we will primarily follow the xAF definition as it provides an operational way of steering business and/or IT.

According to TOGAF, "*a good set of principles will be founded in the beliefs and values of the organization and expressed in language that the business understands and uses. Principles should be few in number, future oriented, and endorsed, and championed by senior management. They provide a firm foundation for making architecture and planning decisions, framing policies, procedures, and standards, and supporting resolution of contradictory situations* [139]." As discussed in [22], when considering the many different definitions of principles, three typical perspectives on principles can be discerned:

– **Principles as inherent laws**—referring to properties of (classes of) a system that can be observed and validated. Examples are the law of gravity, relativity theory, law of requisite variety, etc.

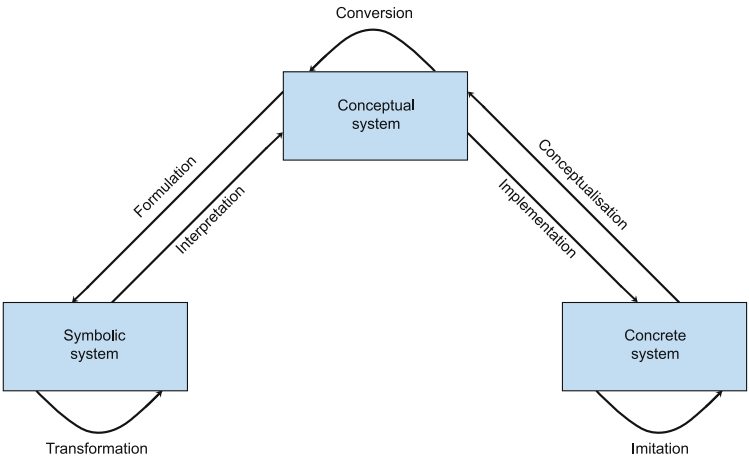

Fig. 3.8 Three types of systems

- **Principles as imposed laws**—referring to properties of (classes of) a system that can be validated. Examples are: traffic laws, societal laws, policies and regulations within organizations, such as *we opt for customer intimacy*, *we comply with privacy laws*, and *business flexibility has precedence over efficiency*. Principles as imposed laws typically address the concerns of stakeholders. Some of these concerns may actually be triggered by an *inherent law* which might have a negative impact on the system/enterprise being engineered.
- **Guidelines**—are properties of (classes of) a system that are specific enough to provide guidance to operational behavior to make it fit within the borders set out by imposed laws, possibly referring to the use of mechanisms. For example: "use your car's cruise control" is an advisable *guideline* to abide by, in an effort to obeying *imposed laws* concerning maximum speeds on roads, using the in-built mechanism of the car's cruise control.

In line with the definition of enterprise architecture used in this book, we will primarily use the last two perspectives on principles.

3.5.3 Models

In general, models are a purposeful abstraction of reality. More specifically, a model is defined as "any subject using a system *A* that is neither directly nor indirectly interacting with a system *B*, to obtain information about the system *B*, is using *A* as a model for *B* [8]." In colloquial use in the context of enterprise engineering, the term model is equated to some graphical diagram. This colloquialism can be explained as most models used in software development, business process (re)engineering, etc., are graphical models. Models, however, do not necessarily have to be graphical.

As depicted in Fig. 3.8, in general, three categories of systems can be distinguished: concrete systems, symbolic systems, and conceptual systems [35], also leading to three main classes of models. A concrete model of a concrete system is called an *imitation* (e.g., a scale model of a car). A conceptual model of a concrete system is called a *conceptualization* (e.g., a process model as the conceptualization of processes). A concrete model of a conceptual system is called an *implementation* (e.g., a process as the implementation of a process model). A conceptual model of a conceptual system is called a *conversion* (e.g., the algebraic concept of a circle ($x^2 + y^2 = r^2$) is a conversion of the geometry of its concept). A symbolic model of a conceptual system is called a *formulation*, and is expressed in some formal language. A conceptual model of a symbolic system is called an *interpretation* and is the reverse of a *formulation*. A symbolic model of a symbolic system is called a *transformation* (e.g., the transformation from Morse code to Roman notation of letters).

In enterprise architecting, a multitude of graphical and nongraphical models are needed. The set of required models spans over multiple dimensions of focus, goals, and purpose. Some examples are:

- differing levels of realization: from conceptual via logical to physical;
- differing aspects of transformation: from contextual (*why*) via design (*where to*) to the actual transformations (*how*);
- different aspects of a enterprises: from goals via services, products and processes to IT;
- differing levels of aggregation: from enterprise level to the level of specific (partial) processes or applications.

Even more, models referring to one specific version/alternative of an enterprise, need to be coherent, also requiring coherence between models over the above dimensions. A core driver of the ArchiMate project [78] was also to increase the coherence between different aspects and models used in an enterprise architecture. In [78], several examples are shown which illustrate the need for coherence between different models used in an enterprise architecture.

3.5.4 Views

The complexity of the execution of an enterprise's strategy is likely to be immense because many processes, departments, and information systems are involved. When using enterprise architecture as a planning and steering instrument, then this instrument should reflect this complexity (the law of requisite variety [15]). As a result, it is almost undoable to make one single univocal and comprehensive set of models that can be used for all people concerned, therefore, several views are needed which focus on specific stakeholders and their concerns [78]. In Sect. 4.3, we will discuss the most common types of stakeholders involved in an architecture project. Stakeholders are important and their cooperation is necessary for a successful project,

because they are the providers of resources, most of them are influencers, some even decision-makers, and they have information about objectives and constraints. Therefore, the architectural descriptions should answer their concerns.

Different views based upon the stakeholders concerns are an important communication means to obtain the cooperation of the stakeholders. A view is a representation of a whole system from the perspective of a related set of concerns [60]. This puts the notion of a view close to the notion of a model. We actually treat a model as being a special kind of view:

1. a model is a purposeful abstraction of reality that cannot be formally derived from an*other* model without changing the way in which the model represents the domain;
2. a view is a purposeful abstraction of reality that is derived formally from one or more models without changing the way in which the model represents the domain.

Therefore, each model is a view, but not each view is a model. As a background to these definitions, we refer to [129]; Stachowiak distinguishes between three different "*model features*":

1. The *mapping feature*, concerned with the fact that a model is based on an original (the modeled domain).
2. The *reduction feature*, which deals with the fact that a model reflects a relevant selection of an original's properties.
3. The *pragmatic feature*, which is concerned with the usability of the model as a placeholder for the original with respect to some purpose.

Creating a model means creating/adjusting the *mapping feature* of a specific model. In creating views, one makes changes to the reduction and pragmatic features, without changing the mapping feature. Changing the latter would lead to another model.

3.5.5 Frameworks

The (example) dimensions for models as discussed above, apply to views as well. Even more, in the case of views one typically feels the urge to introduce views that are tuned to the interests and cognitive abilities of stakeholders as well as the communication goal at hand [107, 108].

To provide architects with some structure to select views, architecture frameworks have been introduced. These frameworks intend to aid architects by providing an ontology, which uses different abstraction levels to map all kinds of information needed. Architecture frameworks position architecture results and enable diverse communication (stakeholders, detail). Often tools and best practices are included in the framework to support the work needed.