Enterprise Architecture:

Enabling Integration, Agility and Change

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Abstract

Three core imperatives are essential for modern businesses and organizations: seamless integration of customer and operational processes, agility, and the ability to change. These imperatives are thus relevant in view of successfully executing strategic choices, but all too often not satisfied.

Businesses and organizations can be viewed as complex adaptive socio-technical systems. Two fundamentally different perspectives on systems play a role: the functional (black-box) perspective and the constructional (white-box) perspective. Management and governance of businesses and organizations regard the functional, black-box perspective, which is inherently ill-suited for addressing the imperatives mentioned. Rather, establishing system integration, agility and change requires a focus on the system's *design*, hence entails the constructional perspective. Both perspectives are relevant.

The concept of *architecture* plays a fundamental role for operationalizing the constructional perspective. Next to the more familiar notion of *technology* architecture, the concepts of *business* and *organizational* architecture are formally introduced and elucidated. In view of the important role of information in customer and operational processes, the notion of *information* architecture will be additionally discussed, specifically the relationships with other architectures. Various domains within these architectures will be highlighted, whereby the importance of coherence and consistency is stressed, especially in view of the ability to change. Collectively, the four architectures are labeled *Enterprise Architecture.* Finally, enterprise architecture will be positioned as a crucial means for linking strategy development and execution.

The functional and constructional perspective

Function and construction

A *system* may be defined as an identifiable bounded set of functionally and/or methodically related elements or principles with a certain operational purpose. Within this definition, a plethora of systems can be mentioned: a payment system, an accounting system, a transport

system or a communication system, to name but a few. More specifically, socio-technical "systems" of human endeavor, like businesses and organizations are the focus of this paper.

Realizing artifacts (systems) always involves two different perspectives: the *functional* and *constructional* perspective [Dietz 1996]. Within the functional perspective the central question regards *what* the system is required to deliver in terms of the system's behavior, performance and interface characteristics, as well as regards the system's operational conditions such as pertinent to reliability, availability, resilience, effectiveness and efficiency. The functional perspective can be labeled as the "black box" perspective: knowledge about the system's design and internal operation is not required. The constructional perspective on the other hand regards the question of *how* the system is to be designed and built. Here, knowledge about the system's internal operation is essential. Hence, we might speak of the "white box" perspective [o.c.].

The distinction between both perspectives becomes vividly clear when observing the difference mentioned earlier between *managing* a system and *changing* a system. Change without knowledge about the system's operation and design seems no prudent approach and is often disastrous. It seems clear that this insight similarly holds for systems of human endeavor, such as businesses and organizations. Business and organizational change thus necessitates a *constructional* perspective. Implementing strategic choices inevitably entails change. As Collis and Montgomery observe, "an outstanding corporate strategy is not a random collection of individual building blocks but a carefully *constructed* system of interdependent parts" [in Kaplan and Norton 2001]. This observation likewise indicates that the white box (constructional) perspective needs to be applied to other domains than merely the technology domain. This notion will be further explored blow. Figure 1 schematically depicts aforementioned distinction.

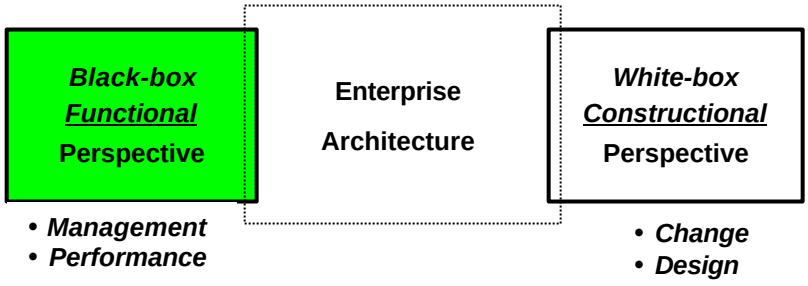

Figure 1. Two distinct system perspectives.

One might argue that the functional and constructional perspectives are incommensurable since they entail fundamentally different concepts and languages pertinent to the same system. Concepts used within the functional perceptive are for example: customer and employee satisfaction or retention, response times, return on capital employed, or efficiency.

Hence, concepts that regard the system's *performance*. On the other hand, within the constructional perspective concepts such as operating channels, resources deployment, process orientation, culture or management practices play a role. These are concepts that are relevant in view of the system's *design*.

Nonetheless despite an apparent incommensurability between the two perspectives, some bridging concept is required that enables operationalizing the constructional perspective through design guidelines that can be linked to, and justified or reasoned from the functional perspective. In other words, the bridging concept thus provides an important communication vehicle about high-level constructional aspects. We feel the required concept is that of *enterprise architecture*, which we will further elucidate below.

Defining architecture

Historically, the notion of architecture was probably first introduced by the Roman architect Vitruvius who lived around 100 years BC and wrote ten books about architecture: "De Architectura Libri Decem" [1998]. These books contained a plethora of principles for properly designing squares and buildings, identified under labels such as "symmetria", "ordinatio", "proportio", and "harmonia". Unfortunately, despite the historic view on architecture as design principles, many other definitions of architecture currently exist. Some examples are: a top-down description of the structure of systems; a family of guidelines (rules, concepts, principles, patterns, standards) for design; a formal description of a system organized in a way that supports reasoning about the structural properties of the system; a blueprint of design; the fundamental organization of a system embodied by its components, their relationships to each other and the environment, and the principles guiding its design and evolution.

Two basic approaches can be noticed regarding these definitions: one sees architecture as a *descriptive* concept that factually describes the characteristics of existing artifacts, whereas the other sees architecture as a *prescriptive* concept that defines how artifacts should be realized. In the latter sense, architecture limits design freedom [Dietz 1998]. We will use the concept of architecture in a prescriptive manner, viewed as a consistent set of design principles and standards that *guide* design. Below this notion will be further elucidated.

The importance of architecture

There are multiple important reasons, argued in this paper, that necessitate extending the notion of "design" and associated "design principles" also beyond the realm of technical systems, hence to other domains than the technology domain only. In particular, we will argue that businesses and organizations – seen as "systems" of human endeavor – need to be included in an integrated design perspective next to technology that supports and enables those systems. Complementary to the technology architecture, also the concepts of business

architecture, organizational and information architecture will be formally introduced in order to enable the constructional perspective on businesses and organizations. Reasons for introducing these new concepts are three-fold.

The first reason has to do with the ability to realize integrated human and technology systems operation. It seems evident that enterprise integration has more facets than just technology. Obviously, having an integrated telephone network is not a sufficient condition for intelligible communication between remote sources, while the introduction of technology for local employee decision making seems pointless in a context where decision making is seen as a management prerogative. Making technology work thus requires a wider perspective than technology only, whereby contextual aspects are included in the design perspective such that the context and technology are optimally matched and integrated. Many failed introductions of technology and related systems prove the importance of this notion [Scott Morton 1991, Galliers and Baets 1998].

The notion of integration will become increasingly important. Appreciably, the more extended a "system" needs to operate seamlessly, the more architecture is essential. For example, effective execution of e-business, which calls for integration of multiple customer interfaces as well as front and back office processes, but also the seamless operation of a network of businesses and suppliers, all require an integrated (mutually consistent) business, organizational and technology design [Moss Kanter 2001]. This requirement necessitates an integrated design perspective and design principles that safeguard and enable integration. Comparably, also success or failures in mergers and acquisitions has been shown to depend on integration capabilities [Woolridge and Hayden 2002]. Strategic notions paint the desired future and serve as a common context for change. However, this context only addresses *what* is to be desired, not *how* it is accomplished. Recalling the perspective on strategy mentioned earlier, the wider design perspective is similarly stressed by Collis and Montgomery stating that strategy needs to be "a carefully constructed system of interdependent parts" [in Kaplan and Norton 2001]. Clearly, the notions of *construction* and *interdependence* call for design principles. Again, integration is key, since "in a great corporate strategy all elements (resources, business and organization) are aligned with one another" [o.c.]. In view of these observations, the first purpose of architecture therefore regards *integration*.

Understandably, implementation – which consequently entails business, organizational, and technology change – subsequently follows design. Often change is of major concern and amounts to business and organizational transformation. Noticeably, a survey among more than 500 CEO's identified the transformation to a new business model and the successful integration of new technology into the organization as the top-two challenges [Pohlmann 2001]. Clearly, apart from the integration aspect, these concerns raise the question about

successful change. Comparably, one study reported that the ability to execute a strategy – hence realize successful change – turned out to be more important than the quality of the strategy itself [Kaplan and Norton 2001]. As emphasized before, change must be addressed from the constructional perspective, which entails design principles. Moreover, as will be argued later, change efforts are only successful under consistency and coherence of concepts used, which in turn is reflected by coherent and consistent design principles. In the words of Fritz, architecture avoids "structural conflict" that otherwise would be manifest in conflicting concepts [1996]. According to the "congruence theorem", the higher the degree of fit – or congruence among the various components – the more effective the enterprise becomes [Nadler and Tushman 1997]. The second important purpose of architecture thus regards safeguarding and enabling *change*.

Increasing business and societal dynamics further imply that both the necessity and frequency of responses to these dynamics – such as pertinent to new products and services – also increases. Consequently, the response time in answering the increased dynamics should decrease. In other words, there is an increasing need for business and organizational agility. Contrary to this need, existing business and organizational arrangements often rather exemplify inert characteristics – inherent in the design – that limit prompt actions. Hence, the third important purpose of architecture is providing *agility*.

In summary, design principles and standards – collectively identified as architecture – should be defined such that *integration*, successful *change*, and *agility* is arranged and enabled.

Enterprise architecture

In its customary meaning, the term "enterprise" refers to a (commercial) business organization. More generally however, this term can be used for intentional and systematic purposeful activities. As will be elucidated and illustrated below, the design of those activities need to be addressed from the four core perspectives mentioned, each having their associated design principles, hence the four different architecture domains identified in the above.

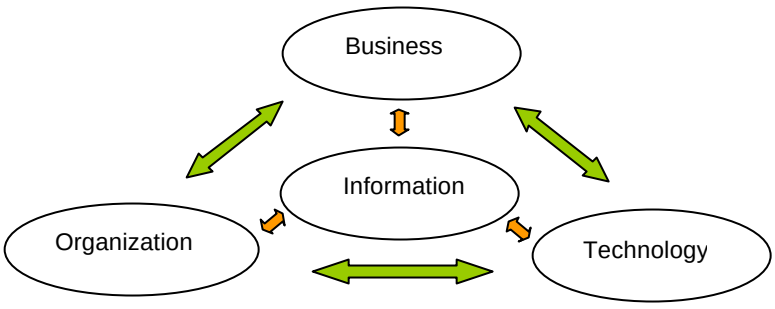

Figure 2. Domains of the Enterprise Architecture.

Collectively the design principles are identified as *enterprise architecture*. Figure 2 graphically shows the four domains of the enterprise architecture. In view of the focus of this paper, the business, organizational and information architecture will be discussed.

One might observe that the notion of principles for organizational design is no novelty. We might refer to Taylor's principles of "scientific management" [1912], Fayol's fourteen principles of management [1916], Weber's administrative principles of the bureaucratic organization [1924], or the principles of human resources management advocated by the human relations movement [McGregor 1960, Likert 1965]. Arguably, these approaches were fragmented and addressed only part of the organizational realm. In light of the observations given earlier, a methodology is required that captures the enterprise as a system in all its relevant dimensions and complexity pertinent to the four areas shown. The underlying conviction is that no single aspect or capability can provide sustainable competitive advantage. Rather, integration of various aspects is crucial, whereby the enterprise architecture acts an integrating force [Malhotra 1996].

Moreover, strategy development does not have the characteristics of a planning, but rather of a learning process. Hence, has emerging and nomadic characteristics, whereby a clear foreseeable future remains an illusion [Mintzberg 1994, Stacey 1996]. Evidently – as argued earlier – this calls for the ability to change and adapt. A crucial aspect of enterprise architecture is therefore that its competence is not so much based on the ability to foresee the future, but to *enable* it [Stevenson 1995]. Enterprise architecture should thus aid in executing planned as well as emerging change.

Business architecture

The concept

This perspective addresses how a particular area of purposeful and gainful activities is to be exploited, explored and developed. Within a commercial context, this perspective regards for example the design principles pertinent to a chosen area of commercial endeavor, such as regarding revenue generation or the channels to be used for delivering products and services to customers. These aspects will be further explored below. Appreciably, for non-profit or governmental undertakings design principles are likewise relevant. For example, the Internal Revenue Service might contemplate about how the area of tax collection is to be exploited and explored.

Further, purposeful and gainful activities are ideally based on an explicit mission and strategy. The mission is viewed as the more timeless expression of purpose and reason for existence of the entity engaged in purposeful activities, hence the mission has to do with "sense making" and imbuing activities with "meaning".

In order to differentiate our current perspective from the overall enterprise perspective, we will use the term “business” – also generally viewed as purposeful activities – in relation with exploiting, exploring and developing a particular field of (commercial) endeavor. With reference to the strategic intentions and mission, the *business architecture* can be defined as *a logically consistent set of principles and standards that guides how a particular field of (commercial) endeavor will be exploited and explored.* Hence, business architecture guides *business engineering*.

Noticeably, the term *business model* is often mentioned in the literature. As with architecture, also the term “model” can have different meanings. A model can mean a conceptual abstraction and representation of a complex reality. Also, the term model might refer to an example for imitation or emulation, or a pattern for others to follow. In these latter cases the model provides implicit guidance for actions, hence is seen from a *prescriptive* perspective, in contrast with viewing the term model as a representation, thus in a *descriptive* sense. The same distinction plays a role regarding the term “business model”. Some authors define it as “an organizational form whereby value is created for stakeholders through combining material and immaterial assets in a given way” [Jagersma et al. 2001]. Noticeably, a descriptive view is used. In a prescriptive perspective sense the business model refers to how a particular field of commercial endeavor is to be exploited. For example, various authors have identified core principles of the e-business model, based on the focus on relationships, and making every activity a customer driven activity [Kalakota and Robinson 1999, Vervest and Dunn 2000]. Others suggest that the business model ultimately expresses the core (revenue generating) principles on which the organizational ability to grow and survive is based. Sometimes therefore, the business model is identified as a “profit model” [Strikwerda 2001]. As with business architecture, the term business model can thus be used in a prescriptive sense, but has in our view a more narrow scope than business architecture. The latter term is thus preferred.

The business architecture framework

Formulating design principles implies the definition of domains for which principles need to be defined. Understandably, the definition of business architecture domains involves some subjective choices: domains deemed relevant. A framework, or conceptual structure, for identifying and representing these domains is useful for practically operationalizing the business architecture concept. A possible framework is presented in figure 3. The various domains in this framework justify considerable attention, which exceeds the scope of the present paper. Hence, we will only briefly elucidate the essentials of the domains.

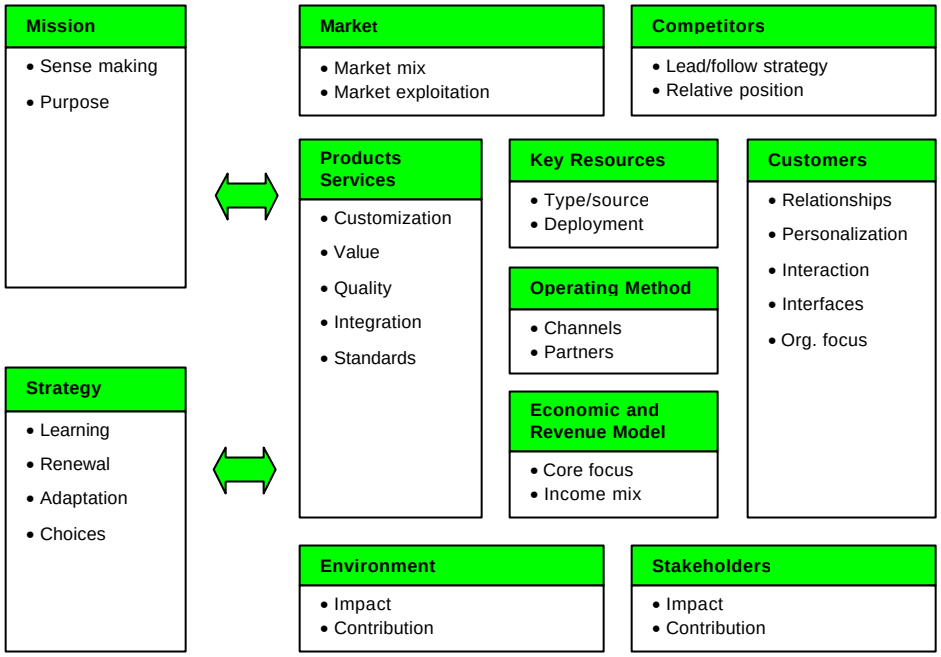

Figure 3. The business architecture framework.

On the left side of the framework the mission and strategy are positioned. The mission regards the organizational purpose for existence and enables overall sense making of business and organizational activities. Strategy has to do with organizational learning, which enables renewal and adaptation [Mintzberg 1994, Mintzberg et al. 1998]. On the right side a number of domains are depicted for which principles need to be defined. Within the center part of the framework, three domains are shown that according to Treacy and Wiersma define areas for strategic market differentiation [1995]. Said differentiation entails choices regarding product leadership (products and services domain), operational excellence (operating method domain) and customer intimacy (customers domain). Evidently, strategies for market differentiation in these areas entail various associated design principles, reflected in the business architecture. As shown, the business architecture involves more domains than those just mentioned. All domains will be briefly discussed, and a few examples of possible principles will be given.

Products and services

This domain expresses principles about the way products and services should be designed, also in view of the aspect of market differentiation mentioned in the above. Examples are: (1) products and services should be designed such that they can be customized, (2) components of products and services must be standardized.

Market

How the market should be exploited and explored is reflected in design principles such as: (1) marketing should move from mass marketing to one-to-one marketing, (2) at least x% of market share must come from recently (< 5 year) introduced products and services. Also principles pertinent to market differentiation are relevant for this domain.

Competitors

Closely related to the market domain is the domain regarding principles defining the relative position against competitors. Possible principles are: (1) commercial activities are based on the smart follower principle, (2) peer group benchmarking must be actively used.

Environment

The purposeful activities will inherently have an environmental impact or contribution in a broad sense. Hence, principles must be formulated that articulate the way activities have to be executed in view of the environment. Some examples are: (1) development and operation of products and services should have the minimally possible environmental impact, (2) product and service delivery should never compromise safety.

Stakeholders

Comparable to the environmental domain is the stakeholder domain, representing those that are affected by the purposeful activities, such as society, employees and shareholders. Examples of principles in this domain are: (1) commercial activities should add balanced value for stakeholders, (2) all stakeholders must be actively represented.

Customers

Evidently, customers – broadly defined as the recipients of the products and services – are the primary reason for executing the purposeful activities. Principles in this domain guide how customer relationships and interactions are to be arranged. Hence, one might define principles like: (1) all customers must be individually known, (2) relationships with customers must be customer manageable.

Economic and revenue model

From a profit-generating viewpoint, this domain expresses the central financial business focus. Principles define how financial gain is obtained. For example, offering core products and services for free (e.g. newspaper or Internet services), while gaining income through complementary services (e.g. advertising) shows basic principles of how a field of (commercial) purposeful activities is exploited. Likewise, a business engaged in mass production to answer mass demand operates under different principles than a business seeking to gain revenue by focusing on lifetime customer value and customer relationships.

Examples of principles are: (1) revenue model must be based on lifetime customer value, (2) x% of revenue should come from complementary products and services.

Operating method

How products and services are delivered to customers is defined in this domain. Essential aspects are the channels used, and the possible use of partners. Principles might read like: (1) products and services are delivered through direct sales only, (2) all customer channels must enable an interactive customer interface and customer relationship management capabilities.

Key resources

Finally, the key resources domain expresses principles about human and technology resources used in the deployment of products and services. Issues such as the human-centered versus the industrial view on service delivery are manifest through related design principles. Examples are: (1) human creativity, initiative and commitment must be considered as the core of product and service delivery (quality, service, productivity), (2) technology must be used such that customers are optimally supported, hence customer productivity and comfort is enhanced.

As can be appreciated, the principles of the business architecture should be mutually coherent and consistent. For example, a business architecture that expresses growth principles through innovative products and services is inconsistent if the underling economic principles induce a short-term, production focus, leaving virtually no room for innovative developments. The need for a coherent and consistent business architecture will be further argued below.

Organizational architecture

The concept

As elucidated and illustrated, the business architecture expressed principles that guide how a particular field of (commercial) endeavor is *exploited* and *explored*. Having defined this, there are still degrees of freedom regarding the question how the purposeful activities are to be *organized*. Evidently, said freedom exists regarding the arrangement of (operational) processes, their supporting means, governance structures, the use of human resources, and so on. As an example: car production can be arranged through a traditional production line arrangement or through more autonomously operating building teams.

For the purpose of our discussion, we define organizing as the intentional, structured arrangement or assembly of means to produce the desired outcome of purposeful activities. Organizing thus implies design principles, hence necessitates *organizational architecture*. In view of the above, organizational architecture can be defined as *a logically consistent set of*

principles and standards that guides how the purposeful activities within a particular field of (commercial) endeavor are actually organized. In other words, the organizational architecture guides *organizational engineering*.

The organizational architecture framework

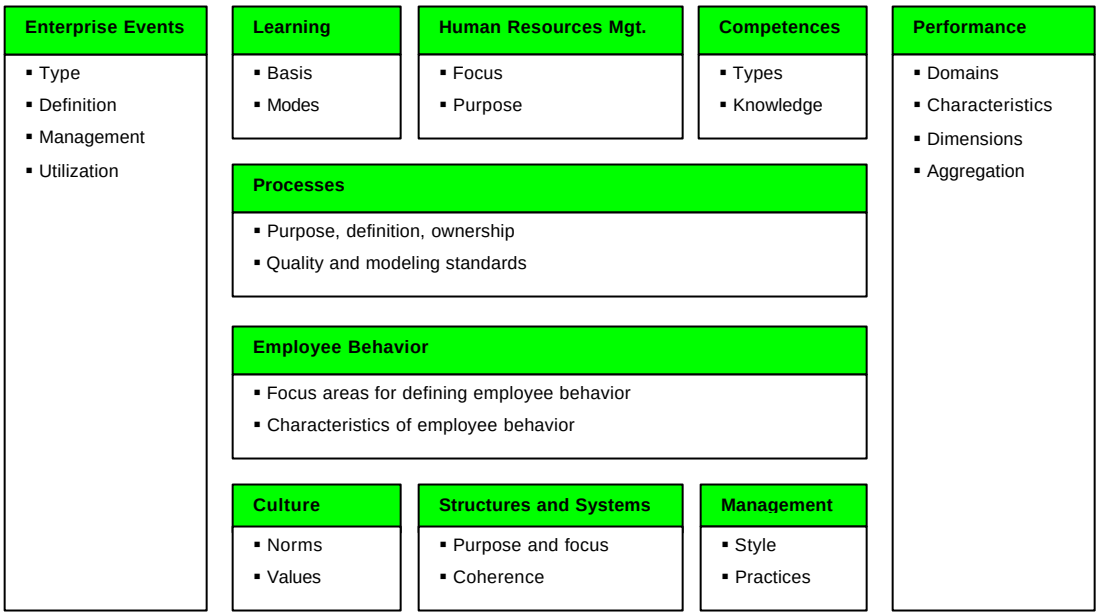

Figure 4. Organizational Architecture framework.

As before, domains for which design principles are deemed necessary have to be identified. A possible organizational architecture framework is presented in figure 4. Its logic is based on the notion that enterprise events, portrayed at the left-hand side of the framework, lead to organizational responses which ultimately are characterized by certain levels of performance, as shown on the right-hand side. In between, a number of essential organizational domains are depicted. Each domain shown warrants considerable attention. Within the latitude of this paper however, the domains are only briefly discussed. Some associated design principles will be given. Evidently, the design principles must reflect fundamental convictions about organizing.

Enterprise events

An enterprise event can be defined as an external or internal trigger that necessitates the enterprise to respond. Put differently, such event triggers the execution of processes and/or employee actions, thereby changing the state of the enterprise. Given the broad use of the term business, the literature also speaks of business events, rather than enterprise events. Instances of events are: the receipt of a customer order or complaint, an employee transfer, a planning change, or a part shortage to name but a few. Hence, there is a plethora of business and organizational event types and instances of those types. The ones that regard basic processes are evidently of primary importance. Examples of related design principles

are: (1) all enterprise events must be explicitly and uniformly defined across the enterprise, (2) event messages must use the corporate syntax and semantics.

Performance

Various areas, parameters and dimensions need to be selected in order to provide indicators for business and organizational performance. Understandably, the indicators should be consistent with, and reflect the enterprise purpose and the principles of the business architecture as illustrated in the above. Principles in this domain might be: (1) operational performance indicators must be explicitly linked to enterprise processes, (2) performance must be expressed in a balanced manner, addressing customers, employees, operations and finance.

Processes

The formal link between business and organizational events and subsequent performance is arranged through processes. The importance of processes can hardly be overstated [Burlton 2001, Eckes 2001, Smith et al. 2001]. Performance in general, and specifically operational excellence, rests on the proper arrangement and execution of processes. It goes without saying that processes must reflect the formal embodiment of enterprise purpose. Said evident imperative is nonetheless often violated. Proper design principles are therefore key. Examples are: (1) processes must be independent of specific vertical (hierarchical) arrangements, (2) process components must be designed for re-use.

Employee behavior

Positioning employee behavior within the organizational architecture framework expresses the conviction that employees are the crucial core for business and organizational success. There is a vast amount of literature corroborating this conviction. Essentially, the importance of employee involvement rests on the non-mechanistic character of businesses and organizations at every level. Performance, improvement, renewal, innovation and adaptation all necessitate involvement of employees in specific ways. These specific ways need to be made explicit through principles such as: (1) behavior of employees should express the desire to achieve, (2) employee behavior should express high levels of participation.

Employee behavior is determined by the behavioral context [Hoogervorst 1998, Hoogervorst et al. 1999]. Rather than focusing on employee behavior directly, the arrangement of desired behavior thus implies designing the behavioral context such that said behavior is evoked and enabled. As Ghoshal and Bartlett observe, “rather than focusing on changing individual behaviors, the more important challenge is to change that internal environment – what we call the behavioral context – that in turn influences people’s behavior” [1997]. Elsewhere we have extensively argued that the behavioral context can be described by the organizational

culture, management practices, and the organizational structures and systems [Hoogervorst 1998]. These three domains will be briefly introduced below. Aside, we stress that the three elements of the behavioral context are highly interrelated and should therefore be treated from an integrated perspective [o.c.] The organizational architecture aids in operationalizing the needed integrated perspective.

Further, in view of the observations regarding employee involvement and the capabilities for innovation, adaptation and renewal, three additional organizational architecture domains are important: learning, competences and human resources management. Also these domains will be illustrated in a few words.

Organizational culture

Culture is viewed as shared norms and values that serve as a guidance for behavior [Deal and Kennedy 1982, Schein 1985, Hofstede 1991]. Also within the organizational context, culture is an important element of the behavioral context. Actively managing culture in the desired fashion is thus important. From the perspective of organizational design, norms and values need to be incorporated, such as: (1) a customer problem is our problem, (2) treating people properly should prevail over following regulations.

Management practices

Many perspectives on management and its primary purpose exist [Drucker 1985, Kotter 1988, Bennis 1989, Mintzberg 1989]. Evidently, management practices affect employee behavior in ways contingent upon the perspective taken. In view of the importance of employee behavior, defining desired management practices is thus crucial. Examples are: (1) management must enable employee self-efficacy, (2) management must show consistency in thinking and doing (walk the talk).

Structures and systems

Within the overall organizational system, a wide variety of structures and systems can be identified, such as a hierarchical structure, an accounting system, a reward structure, or a management information system, to name a few. Overall, structures and systems represent the embedded “system of rule” [Rumelt 1995], or in the words of Selznick, are the “institutional embodiment of purpose” [in Burns 1979]. As such, structures and systems are an essential element in the behavioral context. Despite the variety of structures and systems, common underlying design principles can, and must be defined, such that structures and systems are mutually consistent and also consistent with the other elements of the behavioral context. The following examples serve as illustrations: (1) technology systems must be designed such that employees are up-skilled and optimally supported, (2) the effectiveness and efficiency of local structures and systems must not degrade the overall business and organizational purpose, effectiveness and efficiency.

Learning

Ultimately, learning has to do with the ability to perform better. This notion is not only relevant at the individual level, but also at the enterprise level. Learning is considered a critical competence for enterprise continuity and growth, and is both a manifestation as well as a prerequisite for (strategic) change [Argyris and Schön 1978]. Hence, proper conditions for enterprise learning need to be designed. Examples of associated principles are: (1) customer, employee and operational information must be captured at all levels and interfaces for the purpose of continuous improvement, (2) employees are considered as key enablers for business and organizational learning.

Competences

An organizational competence can be viewed as a cluster of skills, attitudes, explicit and tacit knowledge, and technology for a specific purposeful activity. Enterprise performance, survival and growth ultimately hinge on effectively arranging and deploying competences. As Hamel and Prahalad observe, "core competencies are the gateways to future opportunities" [1994]. Evidently, the other domains of the organizational architecture framework are constituting elements of organizational competences. Again architecture is key, since the integration of skills and technologies "is at the hallmark of a core competence" [o.c.]. With reference to the effective arrangement of competences, design principles apply, such as: (1) core competences must be explicitly defined in their constituting elements, (2) explicit and implicit (tacit) knowledge and skills regarding core competences must be identified.

Human resources management

The crucial position of employee behavior within this organizational architecture framework consequently calls for a human resources management domain, which defines how HRM is to be arranged. Two fundamental perspectives on human resources management can be given: one that more instrumentally sees human resources management as the consequence of the chosen strategy, and one that conversely sees human resources management as a discipline in and of itself that enables strategic choices [Hoogervorst et al. 2002]. Ultimately, the perspective chosen determines design principles, such as: (1) human resources management must focus on employee self-efficacy and empowerment, (2) human resources management must be based on McGregor's Theory Y anthropological outlook [1960].

Information Architecture

The concept

The digital revolution exemplifies Alvin Toffler's *third wave*: from initially an *agricultural* era, to the *industrial* era, and thirdly to the *information* era. One might say that work is no longer merely 'automated' but '*informated*' [Zuboff 1989]. Information becomes a key business and

organizational resource and grows in volume very fast. According to Drucker, information is data endowed with relevance and purpose [in Davenport and Prusak 1998]. Clearly, meaning and purpose are thus not aspects of the technology domain, but key aspects in the *business* and *organizational* domains.

In view of our notion about architecture, we propose the following definition: *Information Architecture is a logically consistent set of principles and standards that guide how information is to be managed*. The management of information has a wide scope and includes various aspects and activities, which we will briefly elucidate below, based on the information architecture framework.

The information architecture framework

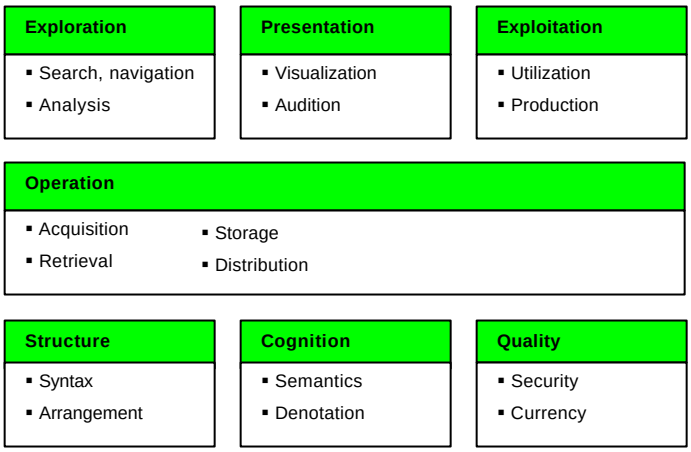

Figure 5. Information architecture framework.

The lower part of the framework shows three domains that have to do with preconditions enabling meaningful use of information: its basic structure (syntax), its meaning (semantics) and its trustworthiness (quality). The middle layer represents operational aspects of information management. Finally, the three domains of the upper part can be seen as areas that address the value of information. Evidently, these domains closely relate to the business and organizational architecture frameworks discussed before. For example, pertinent to the exploitation of information three core aspects are relevant: *reach*, *density* and *velocity* [Buchanan 2002]. These aspects regard the distribution of information (for whom?), the amount of information (how much?), and the speed of information distribution (how fast?). Answers to these questions are driven by the domains – and their associated principles – of the business and organizational architecture. In other words, information architecture principles must follow from, or should be able to be linked with business and organizational architecture principles. Thus, the domains of both the business and organizational architecture framework should be used as starting points for defining information architecture principles. Without the former principles, the latter principles seem to be without foundation.

Taking the "customer" domain of the business architecture as a starting point, an information architecture principle might respectively read: *information about a customer's lifetime value must be available at every customer interface*. Similarly, the performance domain in the organizational architecture framework could have an associated information architecture principle like: *general and specific revenue information must be available to all local commercial directors within eight hours.*

Clearly, domains of information architecture have strong mutual relationships with the technology architecture, since information management ultimately rests on the enabling technology. Also the relationships with the business and organizational architectures have a mutual character. Not only in view of the examples given in the above, but also conversely, since information architecture principles define limitations (e.g. pertinent to security) or opportunities pertinent to the business and organizational areas.

Linking strategy and execution: the need for an integrated, coherent change effort

The topic of business and organizational change is an inherent element of various strategic initiatives, and basically regards the ability to execute those initiatives. For example "the creation of an e-business design is inextricably linked to the management of change" [Kalakota and Robinson 1999]. Implementation of e-business initiatives is complex and requires a focus on programs and processes to ensure enterprise-wide alignment [Overby 2001]. Similarly regarding CRM, failures were reported due to "stovepipe" approaches, uncoordinated projects, and lack of enterprise-wide understanding and change [Kirby 2001, Marcus 2001]. Likewise, integrated organizational change is viewed essential when attempting to implement the six-sigma philosophy [Eckes 2001]. Finally, as indicated in the above, the introduction of (information) technology should match with the organizational context in which technology operates. Thus, technology introduction entails business and organizational change, but in itself does not automatically bring change [Turner 1998]. As failed technology introductions show, looking at technology alone is insufficient to improve organizational performance [Osterman 1991]. As mentioned at the beginning of this paper, the successful integration of new technology into the organization is one of the top-two challenges mentioned in a survey among more than 500 CEO's [Pohlmann 2001]. Again, this challenge can only be successfully addressed through integrated change.

Apart from the different drivers for organizational change, the common underlying theme that is stressed is the need for an integrated approach regarding change. This integrated approach aims to establish coherence and consistency regarding various business and organizational aspects identified in the architecture frameworks. Most likely, organizational change regards employee behavior for a considerable part. Domains within the organizational architecture framework that define the behavioral context are therefore

additionally important since they affect employee behavior. Rather than trying to change employee behavior directly, the change focus should be addressed to the behavioral context [Ghoshal and Bartlett 1997, Hoogervorst 1998].

Multiple examples of failed change programs prove the importance of mutual consistency between the architecture domains [Miles et al. 1984, Beer et al. 1990, Kaufman 1992, Kotter 1995]. A change process is therefore only successful under consistency and continuity of concepts [Doz and Thanheiser 1993]. Research clearly linked organizational inertia to segmentation and incoherence, whereas the capacity to change relates to coherence and integration [Pettigrew 1998]. Others have provided similar evidence. One study about change programs in 33 organizations showed only 5 to be coherent and consistent [Huizing and Bouwman 1996]. The latter provided significantly better results. As might be appreciated, the more radical the change, the more consistency and coherence is required. Put differently, the more radical the change, the higher the price for inconsistency and incoherence [p.c.]. Hence, the ability to establish integrated change programs is viewed as an essential organizational competence. Clearly, this ability is also expressed through the formulation of an integrated business strategy.

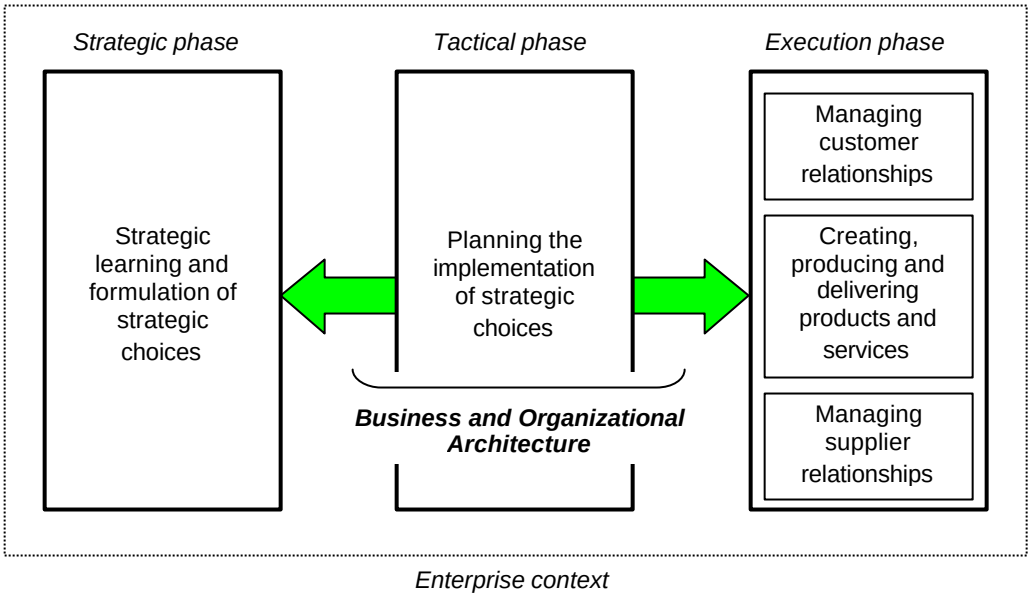

Figure 6. Linking strategy and execution through architecture.

These views again corroborate that establishing coherence and consistency of all enterprise aspects – in order to successfully execute change – requires a constructional perspective on the four domains of the enterprise system. Unlike the functional (management and governance) perspective on these systems, the constructional perspective deals with business, organizational and technology *design*, including the informational requirements. Understandably, the competence to establish such integrated design is essential for linking strategy and execution, and constitutes a considerable competitive advantage.

As argued before, the enterprise architecture is a key element regarding this competence, since it formally links strategy and execution through design principles, as schematically shown in figure 6. In a general sense, this figure shows the main enterprise activity areas. Actually implementing strategic choices, and subsequently producing and delivering products and services is carried out in the execution domain. As emphasized earlier, the business, organization, information and technology designs and subsequent implementations must be addressed in an integrated and comprehensive manner. The key point is therefore that explicit design principles and standards guide these activities: the enterprise architecture as the integrating force.

Summary

The importance of extending the notion of formal design to other systems than technology systems has been argued, specifically regarding systems of human endeavor, identified as businesses and organizations. Within the principal distinction between the functional and constructional perspective, the notion of formal design has been operationalized through the concept of architecture, also important in view of bridging the two perspectives. Three architectures were discussed in detail: the business, organizational and information architecture, which respectively express principles regarding how a particular area of human endeavor is exploited and organized, and information is managed. Examples of architecture frameworks were presented. Overall, three architecture goals were emphasized: integration, agility and the ability to change. In view of the increased business and organizational extension and dynamics, these three aspects are becoming more and more important. Enterprises should thus pay considerable attention to their enterprise architecture.

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