This paper has been published as:
Aier, S.: The Role of Organizational Culture for Grounding, Management, Guidance and Effectiveness of Enterprise Architecture Principles, in: Information Systems And E-Business Management, Volume 12, Issue 1 (2014), pp. 43-70, The final publication is available at link.springer.com: http://dx.doi.org/10.1007/s10257-012-0206-8

The Role of Organizational Culture for Grounding, Management, Guidance and Effectiveness of Enterprise Architecture Principles

Stephan Aier

Institute of Information Management, University of St. Gallen,

Müller-Friedberg-Strasse 8, 9000 St. Gallen, Switzerland

e-mail: stephan.aier@unisg.ch

URL: www.iwi.unisg.ch

Abstract. Enterprise architecture management (EAM) has become a widely acknowledged approach for guiding the continuous change of increasingly complex organizations. While methods and models for describing and analyzing enterprise architectures (EA) have been extensively discussed, principles guiding an EA's design and evolution are hardly covered in existing research. The paper at hand therefore analyzes the mechanisms of EA principles (EAP), that is EAP grounding, EAP management, and EAP guidance and their effects on EA consistency and EAM utility. Specifically we aim at understanding the role of organizational culture for the mechanisms and effects of EAP. Based on empirical data we find that all relations describing EAP mechanisms and their effects are significantly moderated by organizational culture. Based on our findings we give recommendations on how to deal with selected design decisions when introducing and developing EA principles in an organization.

Keywords: enterprise architecture, design principles, organizational culture, competing values model

1 Introduction

Enterprise architecture management (EAM) is often discussed as an effective means for managing the considerable degree of complexity, corporate information systems (IS) environments have reached today. Among others, EAM's goals of achieving and maintaining IS efficiency and effectiveness are often highlighted (Schmidt and Buxmann 2011, Boucharas et al. 2010, Foorthuis et al. 2010, Tamm et al. 2011). One of the most

often cited publication for defining architecture is that of the IEEE standard 1471-2000 (IEEE 2000) and its adaptation to Enterprise Architecture (EA) by The Open Group (2009). Architecture is defined there as (1) "[t]he fundamental organization of a system embodied in its components, their relationships to each other, and to the environment", and as (2) "the principles guiding its design and evolution" (IEEE 2000). In the field of EA, 'system' is then substantiated as an enterprise that is "any collection of organizations that has a common set of goals" e.g. a company or government agency (The Open Group 2009). The (1) *fundamental organization* of a system is often represented by models of its as-is state or the to-be state of a system. For these purposes, meta-models, methods, and frameworks have been developed and extensively discussed in literature (Schönherr 2009, Schelp and Winter 2009, Mykhashchuk et al. 2011). However, (2) *activities*, *rules*, and particularly *principles* guiding an EA's design and evolution from an as-is state into a to-be state are often neglected and thus are hardly covered in literature. Stelzer's (2010) review of EA literature conducted in the year 2009 identifies only six publications that specifically address EA design principles.[1]

In practice, many organizations' EA departments formulate EAPs and still a number of these organizations review project proposals for their compliance with these EAPs.[2] However, there is little known about how EAPs can be effectively anchored in organizations. From our practical experience and the analysis of case studies there is reason to believe, that there is no one best way of how to define, manage and apply EAPs in organizations. Instead we believe that the way organizations effectively deal with EAPs is influenced by the organization's culture.[3] This is because the introduction of EAPs restricts the design freedom of an organization's members (Dietz 2007) on a broad spectrum of design decisions covering the entire "business-to-IT" stack (Winter and Fischer 2007). It is known from institutional theory that such constraints may result in significant resistance to the underlying principles and rules (Oliver 1991, Scott 2001, Aier and Weiss 2012). Specifically culture is known as a significant source of organizational inertia

[1] Exceptions to this generalized observation and additions since Stelzer's study performed in 2009 are (Stelzer 2010, Proper and Greefhorst 2010, Greefhorst and Proper 2011, Aier et al. 2011a) as far as EA *rules* and *principles* are concerned as well as (Buckl et al. 2009, Aier and Gleichauf 2010) as far as *activities* guiding an architecture's design and evolution from an as-is state into a to-be state are concerned.

[2] Cf. for instance the Open Group's architecture compliance review method proposed in TOGAF 9 (The Open Group 2009).

[3] This does not mean that organizational culture is the only influence on how organizations effectively deal with EAPs but it might be an import one and as we will show it might be efficient to analyze the impact of such highly aggregated constructs.

(Cameron and Freeman 1991, Schein 1997) in the IS domain (Cooper 1994) and therefore an important aspect in order to understand how organizations deal with EAPs.

Taking this discussion on a more general level we can state that although research and practice have delivered a number of EA models, methods, frameworks (Mykhashchuk et al. 2011), and also have reliably confirmed EAM success factor models (Schmidt and Buxmann 2011), it still is challenging for practitioners to introduce and sustainably anchor an EAM function in their organization (Tamm et al. 2011). During the last ten years the author has been actively involved in what could best be described as action design research projects (Sein et al. 2011) aiming at the development and use of methods for EA modeling, EA meta modeling, EA planning, the definition of EA principles, and the development of EA software tools. Based on this research project experience it became obvious, that different organizations being in different situations require different approaches to make these artifacts effective. There are some research contributions available applying the concept of situational method engineering (Ralyté et al. 2007) to the field of EAM (Bucher et al. 2006, Ylimäki 2006, Aier et al. 2008, Aier et al. 2011b) or more specifically to identify contingencies that are relevant to EAM method design (Leppänen et al. 2007, van Steenbergen 2011). However, similar to existing research on contingencies of IS governance (Brown and Grant 2005) there are difficulties in identifying relevant dimensions of contingencies as a prerequisite to analyze their impact on EAM method design.

In the paper at hand we therefore propose to look at more aggregated constructs in order to describe the context of EAM method application. In line with van Steenbergen (2011) we propose to look at organizational culture as such a highly aggregated construct, describing fundamental values and beliefs of organizations which might be useful for implementing EAM—or more specifically—for implementing EAPs. This paper builds on two propositions:

(P1) *The effect of EAPs on the goals of EAM depends on the combination of EAP grounding, management, and guidance.*

(P2) *The relations of EAP grounding, management, guidance, and its effects are influenced by organizational culture.*

The purpose of this paper therefore is twofold. Firstly, we want to analyze how EAPs' application is affected by their grounding and management as well as how EAPs' application affects the goal achievement of EAM. Secondly, we want to understand how grounding, management, application, and impact of EAPs interact with organizational culture. The understanding of the relationship between organizational culture and the way EAPs

are grounded, managed, and applied then provides the basis for culture-sensitive methods for the introduction and development of EAPs.

The paper at hand proceeds as follows: In the next section we give the theoretical background and discuss related work in the areas of EAP, IS governance and organizational culture. In section 3 we develop our research model and discuss the research methodology. We present the results in section 4 and critically discuss these in section 5. The paper ends with a conclusion.

2 Theoretical Background

In this section we review the related work on EAPs, IS governance and organizational culture and will thus lay the foundations for our research model.

2.1 EA Design Principles

Most authors agree that EA targets a *holistic scope* and therefore provides a broad and aggregate view of the "Business-to-IT" stack of an entire organization covering strategic aspects, organizational structure, business processes, software and data, as well as IT infrastructure (Winter and Fischer 2007, Jonkers et al. 2006, Lankhorst 2005). EAPs are—besides EA planning—an important component of EAM guiding the evolution or transformation of an organization (The Open Group 2009).

While documentation of EA (represented by models) is well covered in academic and practitioners' approaches, EAP are covered much less so far. Stelzer (2010) conducted a broad and rigorous literature review on EAP in the year 2009. He selected relevant literature by applying Weber and Watson's (2002) guidelines. As a result of his analysis Stelzer identified eleven articles on EAP out of which six articles deal with EA *design* principles. The other articles refer to EA *representation* principles which are out of scope of the paper at hand. The characteristic elements of the six remaining articles' conception of an EAP are summarized in table 1.

Tab. 1 EA design principles according to (Aier et al. 2011a) based on (Stelzer 2010).

Reference	Method	Principle definition
Richardson, (1990)	case study	"Principles are an organization's basic philosophies that guide the development of the architecture. … Principles provide guidelines and rationales for the constant examination and re-evaluation of technology plans." (p. 389)
Armour, (1999)	conceptual	"… simple, direct statements of how an enterprise wants to use IT. These statements establish a context for architecture design decisions by translating business criteria into language and specifications that technology managers can understand and use. Architecture principles put boundaries around decisions about system architecture." (p. 38)
Hoogervorst, (2004)	conceptual	no explicit definition, "collectively the design principles are identified as enterprise architecture" (p. 217)
Chen, (2004)	conceptual	"Architecting principles are rules to use when elaborating enterprise architectures." (p. 1214)
Wilkonson, (2006)	case study	no explicit definition
Lindström, (2006)	case study	"Architectural principles define the underlying general rules and guidelines for the use and deployment of all IT resources and assets across the enterprise …" (p. 2)

Fischer et al. (2010) have verified Stelzer's literature review and found it to hold very well. Only recently Greefenhorst and Proper (2011) have added a substantial work on EAPs which is in line with previous publications as far as the conception of EAPs is concerned. Aier et al. (2011a) have analyzed the different notions of EA principle and have derived a consolidated understanding (figure 1).

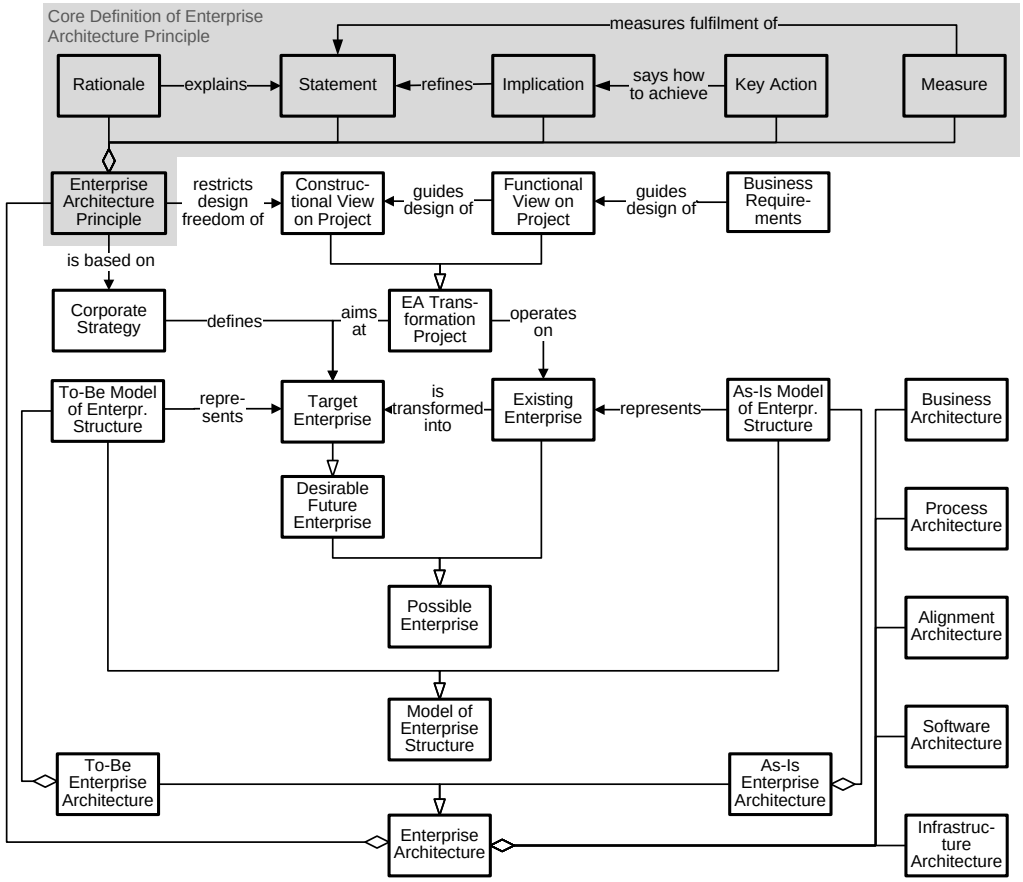

Fig. 1 EAP meta model (Aier et al. 2011a)

They differentiate between a core definition (highlighted in gray) and an extended definition of EA principle. The core definition focuses on the EAP itself including its components, while the extended definition describes an EAP in its environment. In the article at hand we follow the EAP definition of Aier et al. (2011a) and define an EAP as a restriction of design freedom for projects transforming EA from an as-is state into a to-be state. An EAP should be based on corporate strategy. It does not include statements on particular business requirements but on the way these requirements are implemented (*constructional view*) (Dietz 2007, Hoogervorst 2004, Hoogervorst 2009).

An EAP itself is comprised of a *statement* giving a short description of what the principle addresses (Lindström 2006, Hoogervorst 2004, Hoogervorst 2009, Greefhorst and Proper 2011). A *rationale* explains how the principle is meant to work (Richardson et al. 1990, Greefhorst and Proper 2011). An *implication* refines the statement and illustrates the impact the principle has on an organization (Richardson et al. 1990, Greefhorst and Proper 2011) and the *key actions* guide the EAP's implementation (Hoogervorst 2004, Hoogervorst 2009, Richardson et al. 1990). A *measure* is important in order to evaluate an EAP's efficacy, thus the fulfillment of the statement, and finally to support the process of managing (introducing, evaluating, changing, and revoking) EAPs (Lindström 2006, Greefhorst and Proper 2011).

Although for instance Lindström (2006) addresses the need to manage (introduce, evaluate, change, and revoke) EA principles she and others do not elaborate on how to perform this management. Aier et al. (2011a) present a case study in their paper for evaluating their EAP definition. They motivate their choice of cases by the different organizational cultures and thus the differences in managing EAPs in the respective organizations.

2.2 Governance in IS Research

A related and relevant area in IS research is that of (IS/IT) governance and thus the question of how IT decision making is positioned in organizations. It is relevant in the given context because the grounding and management of EAPs deal with the two questions that are among others analogically relevant in IT governance (Weill 2004): (1) Who has the right to decide on EAPs and (2) who has input rights for EAPs?

Adopting the structuring by Brown and Grant (2005) there are two almost consecutive streams of research in the field of IT governance. The first stream of research dealt with the forms of IT governance, e.g. centralized, decentralized, hybrid/distributed forms of IT governance (e.g. Thompson and Bates 1957, Ein-Dor and Segev 1978, Olson and Chervany 1980). The second stream deals with the analysis of individual and multiple contingencies for governance frameworks (e.g. Olson and Chervany 1980, Ein-Dor and Segev 1982, Henderson and Venkatraman 1993, Brown 1997, Brown and Magill 1994, Brown and Magill 1998, Sambamurthy and Zmud 1999). Recent updates on IT governance research especially addressing a practitioners audience have been provided by Weill and Ross (Weill 2004, Weill and Ross 2004, Weill and Ross 2005).

The latter research stream has analyzed several contingencies like industry, firm size, business strategy etc. and their relation to the respective forms of governance. Brown and Magill (1994) analyzed ten interacting antecedents: corporate vision, corporate strategy, overall firm structure, culture (business unit autonomy), strategic IT role, senior management of IT, satisfaction with management of technology, satisfaction with use of technology, strategic grid of current/future applications, locus of control for system approval/priority. Based on their analysis Brown and Magill have proposed contingency patterns and have described the patterns' relationships to IT governance structures.

Although aspects of culture and their relationship to IT governance have been analyzed (e.g. business unit autonomy in Brown and Magill 1994) and organizational culture is commonly referred to as a contingency factor for organizational design (Allaire and Firsirotu 1984, Drazin and Van de Ven 1985, Smircich 1983, Tosi and Slocum 1984), we are not aware of any research specifically analyzing the relationships between IT governance and organizational culture. Brown and Grant (2005) have pointed out that research-

ers may wish to analyze the impact of organizational culture on IT governance design choice.

2.3 Organizational Culture in IS

There is a large number of publications dealing with definitions, conceptualizations, and dimensions of culture and thus with the question of what culture is (Kroeber and Kluckhohn 1952, Pettigrew 1979, Hofstede 1998, Sackmann 1992, Detert et al. 2000, DeLong and Fahey 2000, Leidner and Kayworth 2006). For this article we adopt Schein's formal definition of culture because it integrates many of the various concepts of culture found in literature. Schein defines the culture of a group as "[a] pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid, and therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems" (Schein 1997 12).

For the purpose of understanding and analyzing culture Schein's three-level model of culture (Schein 1997) has proven to be valuable (Denison and Spreitzer 1991, Cooper 1994, Leidner and Kayworth 2006, Iivari and Huisman 2007). On the surface level culture is manifested through visible *artifacts* like organizational structures, technologies, myths, language, rituals etc. (Pettigrew 1979). The problem with artifacts is that while they are observable, it is hard to decipher their underlying cultural meanings.

On the intermediate level, *espoused values* and believes define what is important in a particular culture and thus what ought to be done in an organization. Values are represented as, e.g. strategies, goals, or philosophies. These values are to a certain extend visible and debatable with individuals.

Values finally are a reflection of the *basic underlying assumptions* on the deepest level. These "basic assumptions are at the core of culture and represent the believe systems that individuals have toward human behavior, relationships, reality, and truth" (Leidner and Kayworth 2006) without being aware of them.

It is difficult to study basic assumptions because they are invisible and preconscious. It is also difficult to study artifacts, while being visible, they are not easily decipherable. Therefore, the majority of research aiming at analyzing culture focuses at the respective group's values. This is also the level our paper focuses building on the competing values model (CVM) (Denison and Spreitzer 1991, Quinn and Rohrbaugh 1983) as a theoretical foundation.

CVM has been originally developed to explain differences in the values underlying various organizational effectiveness models (Quinn and Rohrbaugh 1981) and has since been

extended in several directions (Quinn 1984, Quinn and Cameron 1983, Quinn and Hall 1983)—among these to study organizational culture (Quinn and Kimberly 1984). CVM is a very practical and a quantitative model to study organizational culture that is well reported in literature. It has a short and validated measurement instrument (Denison and Spreitzer 1991, Iivari and Huisman 2007). While there are alternative models to study organizational culture, e.g. the model of Cooke and Rousseau (1988) as well as Hofstede et al. (1990), these are far too complex, including more than 100 measurement items, for the purposes of the paper at hand. Other models, e.g. the model of Detert et al. (2000), have primarily been used for qualitative analyses (Jones et al. 2006, van Steenbergen 2011).[4]

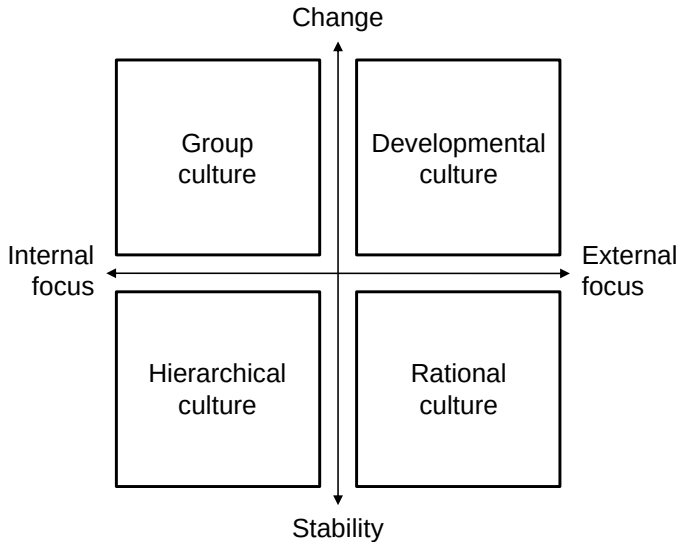

Fig. 2 Competing Values Model

In line with Schein's intermediate level (Schein 1997), CVM focuses on values as core constituents of organizational culture. The competing values are positioned in two dimensions reflecting the competing tensions and conflicts inherent in any human system (Denison and Spreitzer 1991). One dimension is *change* versus *stability* the other dimension is *internal focus* versus *external focus* (figure 2). Change emphasizes flexibility and spontaneity, whereas stability focuses on control, continuity, and order. In the other dimension internal focus means integration and maintenance of the socio-technical system whereas external focus stands for competition and interaction with the organization's environment. The opposite ends of these dimensions form the competing values or the conflicts that may occur within the organization. By focusing on the inherent tensions of an organization, CVM allows for the conceptualization of both paradoxical and linear

[4] Although these models seem not ideal for the purpose and scope of our paper, the reader might be specifically pointed to the work of van Steenbergen (2011) as she analyzes how organizational culture impacts the way the enterprise architecture practice is implemented based on a qualitative empirical study.

phenomena, and for the analysis of both transformation and equilibrium. Based on the resulting two-dimensional matrix four archetypes of organizational culture can be distinguished (Denison and Spreitzer 1991):

Group culture is primarily concerned with human relations. It emphasizes flexibility and focuses on the internal organization. Maintenance of the group is a main purpose and thus belonging, trust, and participation are core values. Leaders in group culture tend to be participative, considerate, and supportive, teamwork is important. *Developmental culture* also emphasizes flexibility and change, but the main focus is on the external environment. Therefore, growth, resource acquisition, creativity, and adaptation to the external environment are important. Leaders tend to be entrepreneurial and idealistic, willing to take risks, and future-oriented. *Rational culture* emphasizes productivity, performance, and goal fulfillment. The purpose of organizations tends to be the pursuit and attainment of well-defined objectives. Leaders tend to be directive, goal orientated, instrumental, and functional, and are constantly providing structure and encouraging productivity. *Hierarchical culture* emphasizes internal efficiency, uniformity, coordination, and evaluation. The focus is on the logic of the internal organization and the emphasis is on stability. The purpose of organizations tends to be the execution of regulations. Leaders tend to be conservative and cautious, paying close attention to technical matters.

The competing values model has several underlying assumptions: The cultures described above are archetypes defined by the model. Organizations do not necessarily reflect only one culture, but a combination of cultural types including paradoxical combinations (Cameron 1986). CVM does not attempt to describe the unique qualities of an organization's culture, but it groups cultures into broad categories based on general characteristics. Recognizing that the specific content of an individual culture will vary widely, CVM assumes that the general dimensions will remain relevant across a wide number of settings (Denison and Spreitzer 1991). CVM thus delivers on our goal to apply highly and purposefully aggregated constructs in order to describe the context of EAM in general and the grounding, management, guidance, and application of EAPs in particular.

3 Research Design

In the introduction we have already stated our two central propositions referring to (P1) the way EAPs are set up and impact EA and referring to (P2) the effects of EAPs' cultural context. In the following sub-section 3.1 we will break these two propositions down to our research model and discuss the research methodology in sub-section 3.2.

3.1 Research Model

Based on the definition of an EAP by Aier et al. (2011a) EAPs as other EA artifacts need to be *grounded* in the norms and values of an organization in order to legitimate the principles in the respective organization (Niemi 2007, Ylimäki 2006, Op ’t Land et al. 2009, Kurpjuweit and Winter 2007, Kurpjuweit and Winter 2009, Lagerström et al. 2009). Principles that are not legitimated in an organization might provoke strategies of *resistance* like *avoidance*, *defiance* or *manipulation* among the stakeholders concerned (Oliver 1991).

(H1.1) The better EA principles are grounded in the norms and values of the organization, the more they will applied.

Since the requirements and goals of an organization might change over time, also EAPs need to be updated, added or deleted. Principles that proved not to be effective need to be changed or deleted (Lindström 2006). If such an EAP management process is missing, ineffective or even counterproductive principles will be ignored as might be EAPs in general (Oliver 1991).

(H1.2) The more actively EA principles are managed, the more they will be applied.

EAPs as rules are one of the classical *structural means of coordination*. They aim at the alignment of possibly conflicting stakeholder goals and activities (Martinez and Jarillo 1989). Eventually EAPs are expected to set architectural standards (Chen and Lillehagen 2004). It can thus be expected that the application of EAPs contributes to *EA consistency* (Boh and Yellin 2007).

(H1.3) The application of EA principles contributes to EA consistency.

The contribution of EAPs to EA consistency, however, is not only dependent from the principles’ application but it is also dependent from the way EAPs are *guided by communication* in an organization (Richardson et al. 1990, Hoogervorst 2004). It is important to create a “shared understanding” against a shared background (Habermas 1984) for an artifact that potentially affects large parts of an organization comprised of stakeholders with possibly heterogeneous goals and backgrounds.

(H1.4) EAP principle guidance contributes to EA consistency.

The degree of EA consistency controls the realization of the actual *utility* promised by EAM like (IS/IT) flexibility and efficiency (Boh and Yellin 2007, Schmidt and Buxmann 2011).

(H1.5) EA consistency will positively influence EAM utility.

There is reason to believe that organizational culture moderates the hypotheses listed above, i.e. organizational culture affects the strength of the relations between the independent variables and the dependent variables in the hypotheses above. In opposition to the original definition of a moderating effect by Baron and Kenny (1986) we do not expect organizational culture to change the direction of effects, i.e. we expect for example EAP management to always positively contribute to EAP application. This means, however, that we are looking for small or medium effects. This hypothesis firstly results from our observations of a number of EA action design research projects where we found that the way EA artifacts were effectively anchored in an organization depends—among other factors—on the common values of the respective organization. Secondly, research on the related field of IS governance also proposes the relevance of organizational culture for finding effective forms of governance (Brown and Grant 2005). And thirdly, there is evidence, that the use of similarly regulative IS artifacts, like systems development methodologies (SDMs), is influenced by organizational culture (Iivari and Huisman 2007).

In the paper at hand we are particularly interested in understanding how to ground, manage, and guide EAPs in different organizational cultures with the goal of making these principles effective. This means that we are not primarily interested in whether or not EAPs are in general more effective in one culture or another, but—from a design point of view—we are interested in understanding how to best spend the oftentimes limited resources for grounding, managing, and guiding EAPs effectively in different organizational cultures. Therefore our further hypotheses are that the relations modeled by (H1.1)–(H1.4) are moderated by organizational culture. While the relation between EA consistency and EAM utility (H1.5) might also be moderated by organizational culture, we do not focus this question in the paper at hand because only EA consistency is a directly dependent variable from an EAP perspective.

(H2.1) Organizational culture moderates the relation between EAP grounding and EAP application (H1.1).

(H2.2) Organizational culture moderates the relation between EAP management and EAP application (H1.2).

(H2.3) Organizational culture moderates the relation between EAP application and EA consistency (H1.3).

(H2.4) Organizational culture moderates the relation between EAP guidance and EA consistency (H1.4).

The resulting research model is illustrated in figure 3.

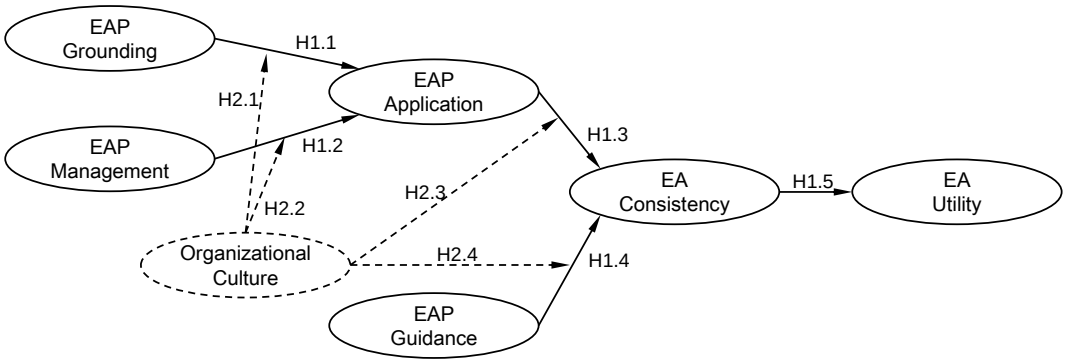

Fig. 3 Research model

3.2 Research Methodology

In order to test our hypotheses we follow a quantitative empirical approach by the means of a questionnaire used in a survey among enterprise architects. Data collected in this survey is then used to test the hypotheses following a partial least squares (PLS) approach to structural equation modeling (SEM).[5] We have chosen PLS-SEM over traditional moderated multiple regression (MMR) or analysis of variance (ANOVA) approaches since the latter are often afflicted with difficulties detecting and accurately estimating actually exiting and often weak moderation effects. This is because these approaches do not account for measurement errors and thus further affect the oftentimes problematic statistical power (Chin et al. 2003).[6] We have chosen a PLS approach over covariance based approaches to SEM like LISREL or AMOS primarily because PLS has only soft distributional assumptions, it is exploratory in nature—as our research is—, and it has modest sample size requirements (Chin 2010).

In order to apply PLS to our research model two additional steps are necessary: (1) We need to specify a measurement model comprised of indicator variables (IVs)—in our case—reflecting the latent variables (LVs) of the hypotheses. (2) We need to choose an appropriate way to model and assess the interaction effects of organizational culture.

3.2.1 Measurement Model

Our measurement model has three components (1) EAP grounding (GRO), EAP management (MAN), EAP guidance (GUI) and EAP application (APP), (2) EA goals, i.e. EA consistency (CON) and EAM utility (UTI), and (c) organizational culture. The measurement model regarding EAPs has been specifically developed for this questionnaire on the

[5] We used the PLS implementation in SmartPLS, version 2.0.M3 (Ringle et al. 2005).

[6] For a critical discussion of this statement and its basic conditions see (Goodhue et al. 2007).

basis of the EAP definition in (Aier et al. 2011a). The number of IVs used for measuring an LV regarding EAPs is between a minimum of 2 and a maximum of 4.

The measurement model for evaluating the achievement of EA goals has been adopted from (Aier et al. 2011b). The original measurement instrument which has been tested in (Aier et al. 2011b) is comprised of 16 items found in mostly practice driven publications (van den Berg and van Steenbergen 2006, Ross 2006, Wagter et al. 2005, Niemann 2006). However, to better understand these 16 items we performed a factor analysis on these items which resulted in two factors we named EA consistency (CON) and EAM utility (UTI). The number of IVs used for measuring EA consistency (CON) is seven and the number of IVs used for measuring EAM utility (UTI) is nine.

The measurement model for describing organizational culture is based on the original CVM questionnaire by Cameron (1985) which is described in (Quinn 1988) and its modifications by (Yeung et al. 1991). Each of the cultural archetypes defined by the CVM is measured by three IVs. Similar to the instrument's application by Iivari and Huisman (2007) we have, however, dropped one item during reliability analysis.

The overview of all IVs and the respective LVs is given in table 2.

3.2.2 Modeling of Moderation Effects

For testing moderation effects in PLS path models there are basically two options, (1) the group comparison approach and (2) the product term approach (Henseler and Fassott 2010). In the group comparison approach we would split the data set into four groups—by applying clustering algorithms on the IVs measuring culture—representing the four cultural archetypes defined by the CVM.[7] We would then estimate the SEM parameters for each group and compare the differences of parameters between groups. While such an approach is popular it is not advisable in our case. This is because the allocation of a case to one cultural group, based on the case's dominant culture, ignores the multidimensionality of CVM and the possibility of even paradoxical combinations of cultural archetypes. In addition to this practical consideration, a summation of the different cultural scales (although to a certain extend assumed by CVM) and the following categorization would mask and then fix measurement error which negatively affects statistical power (Chin et al. 2003).

Given that we have measured each cultural orientation separately employing two or three IVs measured on a 5-point Likert scale per cultural archetype, we apply the product term

[7] We actually did this for better understanding our sample and to make sure that all cultural dimensions are sufficiently present in our sample.

approach here. We illustrate this approach on the example of hypothesis H2.1 in the following. Hypothesis H2.1 states that organizational culture moderates the relation between EAP grounding and EAP application (H1.1).

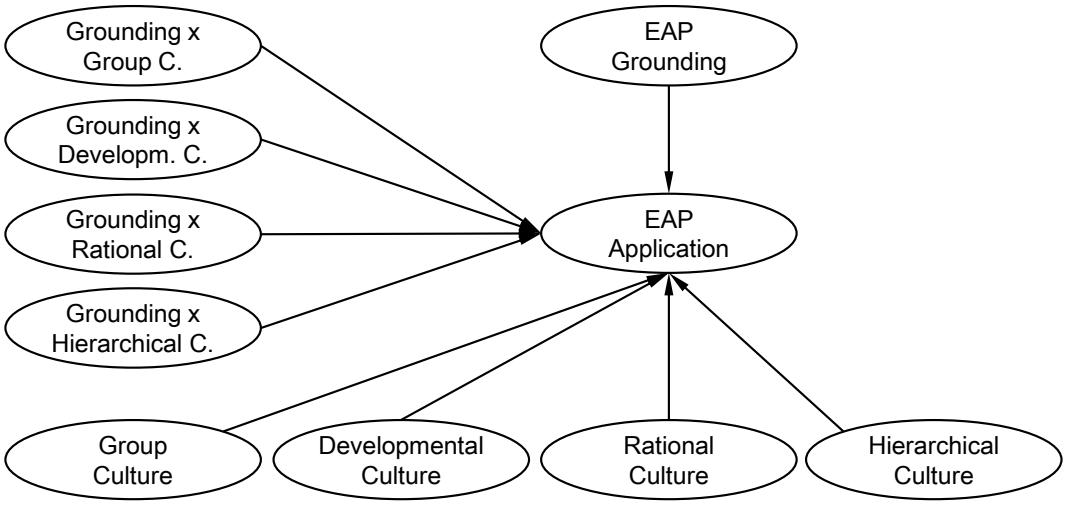

Fig. 4 Product term approach for modeling moderator effects

In figure 4 it can be seen that we model the direct effect of the exogenous variable *EAP Grounding* on the endogenous variable *EAP Application* and the direct effects of the moderator variables (one for each cultural archetype) on the endogenous variable. In order to assess the actual moderation effects we additionally model the interaction terms as products of each exogenous variable with each moderation variable. In figure 4 we omitted the IVs of each LV for reasons of clarity. In fact, the IVs of each indicator term are the products of each IV of the exogenous variable with each IV of each moderation variable (Chin et al. 2003). To avoid problems of multicollinearity, which often arise when modeling moderating effects, we mean-centered all indicator values before multiplication (Henseler and Fassott 2010). We deal with the hypotheses (H2.2)–(H2.4) in the same way.

3.2.3 Data Collection

Data was collected by means of a questionnaire that comprised five sets of questions. The first set was comprised of six items relating to demographics. The second set contained the measurement instrument for the CVM. This set was comprised of 12 items out of which one item was dropped during reliability analysis. The third set was comprised of eight items on the current positioning of EAM in the organization (not reported in this paper). The fourth set was comprised of 19 items regarding EA principles out of which 16 items where included in the initial path model and out of which four items where dropped during reliability analysis. The last set was comprised of 16 items on EA success.

For all items the respondents were asked to evaluate their organization's current implementation level on a 5-point Likert scale ranging from "not at all" (1) through "completely" (5). We pre-tested the questionnaire with practitioners from six of our regular research partner companies. The pre-test resulted in minor adjustments of the wording. Questionnaires from the pre-test are not included in the sample.

We collected the questionnaires on two practitioner events taking place in Switzerland in late 2010 and early 2011. On the first event we collected 70 questionnaires, on the second event we collected 68 questionnaires which corresponds to response rates of 61% and 64%. A total of 138 data sets were collected that did not reveal substantial extent of missing data (10% at maximum). While we cannot claim our sample to be representative, respondents have a strong link to EAM because all of them were participants of events that specifically addressed EA practitioners. We cannot identify the number of organizations respondents come from without sacrificing the respondent's anonymity. By analyzing the conferences' list of participants, we can, however, state that the potential number of multiple questionnaires referring to the same organization is very small (5% at maximum). Study participants came from Switzerland, Germany, and Austria. The survey was administered in German language only.

The majority of respondents (>71%) worked for an IT unit rather than for a business unit. 88% of the respondents were actively involved in an EA function in their organizations. The respondents were primarily representatives of large organizations. More than 40% of the respondents came from very large companies (5000 employees and over), 27% from large companies (1000–4999 employees), 14% from medium large companies (250–999 employees), 17% from medium sized or small companies (249 employees or less). The majority of survey participants were well experienced in the field of EA. 39% of the respondents reported a long EA experience (more than five years), 26% three to five years, 17% two years and 18% one year or less. Survey participants were broadly distributed among industries. The most frequently reported industries in the survey are financial industry (30%), software/IT industry (25%), followed by public services (8%), manufacturing (7%), telecommunication (4%) and others.

4 Results

Initially the model parameters were measured with the complete set of indicators. Based on the results of indicator reliability and construct reliability analyses single items were removed in an iterative process in order to improve the quality of the measurement model. The parameter values of the structural model were not substantially affected during these iterations. We first tested the model without interaction terms, that is including di-

rect effects only to evaluate the quality criteria (Götz et al. 2010) of the basic measurement and structural model. Afterwards we added all combinations of interaction terms in order to evaluate the entire model and to estimate all values necessary to determine the strength of the moderating effects (Henseler and Fassott 2010).

The IVs used for measuring the LVs of the research model, are documented in table 2. All LVs were operationalized in reflective mode. Reflective measurement models—as opposed to formative measurement models—are characterized by the fact that IVs are considered to be manifestations of an LV. The IVs must therefore be sufficiently similar to each other or even refer to the same subject matter (Chin 1998b).

Significance tests were conducted using *t*-statistics applying bootstrapping with 500 resamples of the original sample size.

Tab. 2 Survey items, construct reliability, and convergent validity

		Mean	Standard deviation	Loading	*t*-statistic	CR	AVE
GRO	**EAP Grounding**					0.859	0.605
GRO1	EAP are defined under participation of all stakeholders.	2.55	1.104	0.7682	16.3951		
GRO2	EAP are centrally confirmed by management.	2.76	1.269	0.7594	18.3099		
GRO3	EAP are based on IT strategy.	3.15	1.233	0.7799	18.5150		
GRO4	EAP are based on corporate strategy.	2.76	1.200	0.8029	19.5386		
MAN	**EAP Management**					0.897	0.744
MAN1	A process to handle exceptions from EAPs is defined.	2.55	1.313	0.8483	27.6620		
MAN2	The significance of EAPs is regularly assessed.	2.58	1.106	0.8787	46.9613		
MAN3	The implementation of EAPs is regularly measured.	2.16	1.118	0.8603	32.9656		
APP	**EAP Application**					0.901	0.752
APP1	EAPs are applied to business architecture.	2.27	1.025	0.808	21.5472		
APP2	EAPs are applied to IT architecture.	3.12	1.139	0.885	45.6274		
APP3	EAPs are adhered to.	2.72	1.049	0.906	60.6488		
GUI	**EAP Guidance**					0.923	0.858
GUI1	The rationale of an EAP is explained.	2.72	1.301	0.9012	29.8761		
GUI2	It is explained how an EAP should be applied.	2.64	1.161	0.9506	113.3596		
CON	**EA Consistency**					0.928	0.650
CON1	Redundancy in EA is reduced.	2.89	1.033	0.8035	22.5777		
CON2	Change projects are well coordinated.	2.92	1.001	0.8113	24.0063		
CON3	Information silos are dissolved.	2.97	1.126	0.8219	25.5802		
CON4	Heterogeneity of technologies is reduced.	3.10	1.075	0.7959	22.4195		
CON5	Reuse of platforms, information, and functions is increased.	3.11	1.056	0.8685	36.4146		

		Mean	Standard deviation	Loading	*t*-statistic	CR	AVE
CON6	Standardization of processes is increased.	2.98	1.012	0.7825	25.5006		
CON7	Standardization of applications is increased.	3.10	0.954	0.7556	18.4722		
UTI	**EAM Utility**					0.940	0.635
UTI1	Business units and IT have a mutual understanding.	3.00	0.964	0.7149	12.3652		
UTI2	Business units are satisfied with IT services.	3.03	0.912	0.7586	16.5857		
UTI3	Flexibility to respond to external changes is increased.	2.77	1.017	0.8073	25.9626		
UTI4	Efficiency of responding to customer or market requirements is increased.	2.78	0.947	0.8335	29.6850		
UTI5	There is lowered risk by being prepared for unplanned change.	2.68	1.013	0.7890	26.3292		
UTI6	Costs for run the business are reduced.	2.96	1.095	0.7956	26.4555		
UTI7	Costs for change the business are reduced.	2.70	1.068	0.8588	39.5511		
UTI8	Rate of business innovation is increased.	2.52	1.013	0.7987	24.0113		
UTI9	Rate of IT innovation is increased.	2.63	1.032	0.8078	23.4401		
GRC	**Group Culture**					0.865	0.685
GRC1	The company I work in is a very personal place. It is like an extended family and people seem to share a lot of themselves.	2.96	1.2950	0.884	7.1239		
GRC2	The glue that holds the company I work in together is loyalty and tradition. Commitment to the company I work in runs high.	3.53	1.0195	0.893	16.9703		
GRC3	The company I work in emphasizes human resources. High morale is important.	3.71	0.9714	0.884	16.6955		
DEC	**Developmental Culture**					0.768	0.527
DEC1	The company I work in is a very dynamic and entrepreneurial place. People are willing to stick their necks out and take risks	2.90	1.1586	0.671	5.3706		
DEC2	The glue that holds the company I work in together is commitment to innovation and development. There is an emphasis on being first with products and services.	3.12	1.0944	0.832	10.5726		
DEC3	The company I work in emphasizes growth through acquiring new resources. Acquiring new products/services to meet new challenges is important.	3.07	1.2200	0.662	5.4726		
HIC	**Hierarchical Culture**					0.865	0.681
HIC1	The company I work in is a very formal and structured place. People pay attention to bureaucratic procedures to get things done.	3.18	1.1174	0.813	10.7902		
HIC2	The glue that holds the company I work in together is formal rules and policies. Following rules and maintaining a smoothrunning institution are important.	3.07	1.1687	0.844	16.9055		
HIC3	The company I work in emphasizes permanence and stability. Efficient, smooth operations are important.	3.62	0.9404	0.818	14.7487		

		Mean	Standard deviation	Loading	*t*-statistic	CR	AVE
RAC	**Rational Culture**					0.862	0.758
RAC1	The glue that holds company I work in together is an emphasis on tasks and goal accomplishment. A production and achievement orientation is commonly shared.	3.53	0.9160	0.888	21.9682		
RAC2	The company I work in, emphasizes competitive actions, outcomes and achievement. Accomplishing measurable goals is important.	3.56	1.0395	0.853	20.0091		

Tab. 3 Correlation matrix (with the square root of the AVE on the main diagonal)

	DEC	CON	UTI	APP	GRO	GUI	MAN	GRC	HIC	RAC
DEC	**0.727**									
CON	0.327	**0.806**								
UTI	0.345	0.786	**0.797**							
APP	0.268	0.643	0.575	**0.867**						
GRO	0.347	0.615	0.507	0.785	**0.779**					
GUI	0.141	0.568	0.389	0.618	0.664	**0.926**				
MAN	0.278	0.603	0.557	0.766	0.785	0.670	**0.863**			
GRC	0.375	0.233	0.253	0.338	0.341	0.309	0.300	**0.827**		
HIC	-0.076	0.410	0.367	0.384	0.340	0.434	0.369	0.093	**0.825**	
RAC	0.508	0.467	0.485	0.360	0.395	0.233	0.382	0.263	0.385	**0.870**

The quality the *measurement model* is determined by (1) construct reliability, (2) convergent validity, and (3) discriminant validity (Bagozzi and Yi 1988).

For testing *construct reliability* two parameters are relevant, composite reliability (CR) and average variance extracted (AVE). For a construct to be considered reliable the CR value should be greater than 0.6; AVE should be greater than 0.5 (Bagozzi and Yi 1988). The estimated CR and AVE values are well above these threshold values for all LVs (table 2).

Convergent validity is given when the IV loadings on the respective LVs are sufficiently high and statistically significant. IV loadings in general should be above 0.7 (Götz et al. 2010) and should not differ too much for one respective LV (Chin 2010). Weaker loadings, however, are often observed. In reflective models IVs with loadings smaller than 0.4 should be removed (Hulland 1999). For all but two IVs parameter estimation yields loadings well above the 0.7 threshold value. The t-statistics indicate that all IV loadings are statistically significant at a 0.001 level at least (table 2).

Discriminant validity describes the degree to which the IVs of different constructs are related to each other. It can be assessed by comparing the square root of the LVs' AVE to the constructs' correlations (Götz et al. 2010). The test shows discriminant validity, when

the square roots of the LVs' AVE are significantly larger than any correlation between this LV and the other constructs. Table 3 shows the results of this test for discriminant validity. With one exception, the square root of the LVs' AVE is strictly higher than any inter-construct correlation of the respective LV.

The *structural model* is constituted by the entirety of latent variables and their relationships including all interaction variables considered. The results of the evaluation of the research model are depicted in figure 5. The core model of EAPs and its impact on EA/M is printed in inverted color all other LVs represent organizational culture archetypes and their respective interaction terms.

One important metric for judging the structural model is the endogenous LVs' *determination coefficient* (R^2) which reflects the share of the LV's explained variance (Chin 1998b). There are no general recommendations on acceptable values of R^2. What is acceptable or not depends on the individual study and LV (Chin 1998). 71.2% of the variance in APP (EAP application) is jointly explained by GRO (EAP grounding), MAN (EAP management), all four LVs representing organizational culture (HIC, RAC, GRC, DEC) and the respective interaction terms. This value points to substantial explanatory power (Chin 1998b). The other R^2 values of the research model are encouraging: 58.1% of the variance of CON (EA consistency) is jointly explained by APP (EAP application), GUI (EAP guidance), organizational culture and the respective interaction terms. Finally 61.7% of the variance of UTI (EAM utility) is explained by CON (EA consistency).

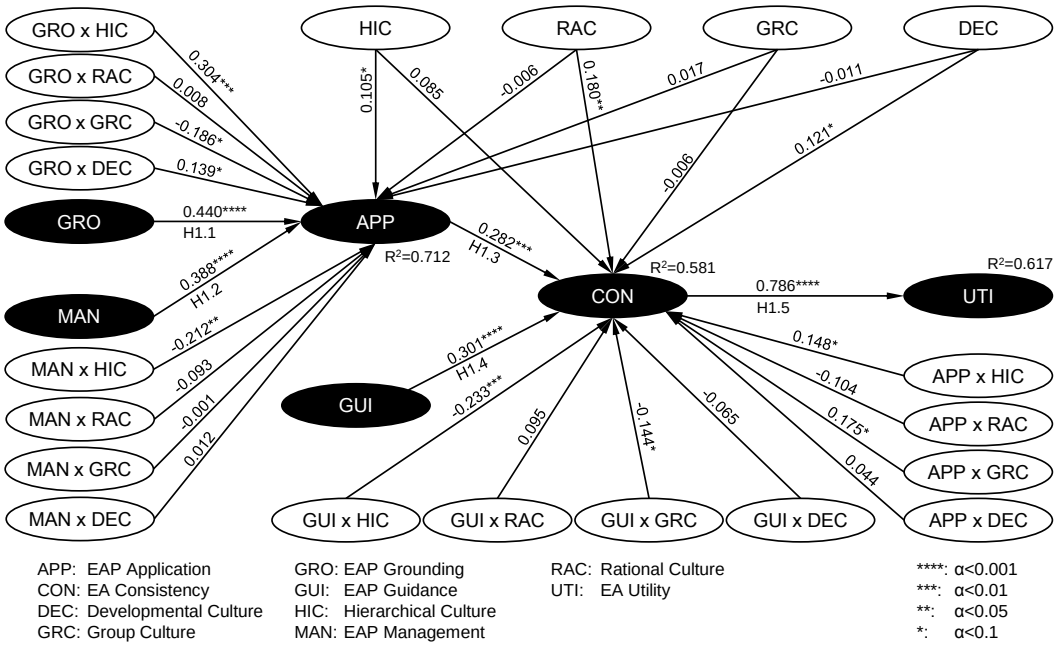

Fig. 5 Research model results

Especially the R^2 value of CON (EA consistency) is remarkable, since we only measured the effects of EAPs and organizational culture and did not account for other EAM ser-

vices like EA transparency (models) or EA planning or any financial constraints for example—all of which can be expected to contribute to EA consistency because they represent (EA) coordination mechanisms (Martinez and Jarillo 1989).

All path coefficients of the (invertedly printed) core model exceed the recommended 0.1 value (Lohmöller 1989) and even the 0.2 value (Chin 1998b) in conformance to the hypothesized directions and are statistically significant at the 0.01 level (H1.3: APP – CON) or even the 0.001 level (all other hypotheses). If we look at the direct effects and the interaction effects of organizational culture, the results are more differentiated. Although we are not particularly interested in the direct effects of organizational culture (cf. section 3.1) it still is worth noting that three of the direct effects (hierarchical culture/HIC on EAP application/APP, rational culture/RAC on EA consistency/CON, and developmental culture/DEV on EAP application/APP) are statistically significant. The other direct effects of organizational culture are not significant and show low path coefficients.[8]

What we are more interested in are the moderating effects of organizational culture represented by the interaction terms and the respective path coefficients. Here we found that all of the analyzed paths (H1.1)–(H1.4) are significantly moderated by at least one cultural orientation. The path coefficients of the interaction terms are on a low level. However, this is perfectly in line with our expectations. We did not expect organizational culture to render for example the effect of EAP management/MAN on EAP application/APP negative but to alter the strength of these effects in a moderate way.

In order to determine the strength of the moderating effects, we calculated the effect size f^2 (Cohen 1988). The f^2 value of all interaction terms on APP (EAP application) is 0.09 which is between a small and medium effect and is larger than what is found in most past IS studies (Chin et al. 2003). The f^2 value of all interaction terms on CON (EA consistency) is 0.10 which also represents a small to medium effect. If we take all LVs that represent organizational culture (direct effects and interaction effects) these values rise to 0.14 (APP) and 0.25 (CON) representing moderate effect sizes (starting at a value of 0.15). However, a low effect size does not imply that the underlying moderator effect is negligible. They can be meaningful when the respective path coefficient changes are meaningful (Chin et al. 2003).

Given these effect sizes it is also important to consider the statistical power of our model and thus its ability to uncover existing but small effects. As a general rule of thumb Chin (1998b) mentions to have ten times the number of observations of the highest number of

[8] It is worth noting though that PLS while consistently overestimating IV loadings consistently underestimates path coefficients of the structural model (Chin et al. 2003).

predictors for a LV. In our model we have LVs (APP, CON) with 14 predictors each resulting in a sample size requirement of about 140 observations which we nearly have reached. However, Chin (1998a) states that simple rules of thumb are often not enough. We therefore calculated the statistical power of the two focal multiple moderated regressions using G*Power version 3.1.3 (Faul et al. 2007) which resulted in a statistical power of 0.82 ($\alpha<0.1$) and 0.73 ($\alpha<0.05$) both for detecting small effect sizes ($f^2=0.1$). The recommended level of statistical power is .80 (Chin 1998a) which, however, is not reached by a significant number of empirical research—especially analyzing moderating effects (Chin et al. 2003).

Finally we tested our model's *predictive validity* by means of the non-parametric Stone-Geisser test applying the blindfolding procedure implemented in SmartPLS. The test shows how well the empirical data can be reconstructed using the model and the PLS parameters (Götz et al. 2010). If the Stone-Geisser test criterion is larger than 0 the model is considered to have predictive validity which holds true for our model (all Q^2 values are larger than 0.37).

5 Discussion

The model evaluation shows that our hypotheses regarding the mechanisms and effects of EAPs hold. It also shows that organizational culture plays a significant role in moderating these mechanisms and effects. In order to make these results exploitable for practice and for design research we will discuss these findings in detail.

The core model (printed invertedly in figure 5) shows that application of and compliance with EAPs (APP) is positively contributed by the principles' grounding (GRO) and management (MAN). While this result may seem trivial, it can often be observed in practice that EA principles—although defined—are not used. The reason for this may be found in two typical patterns. (1) The process of principle definition was performed as some kind of exercise driven by "the" architect or by a small group of architects without anchoring this process in the broader organization. Thus the results of this process, the EA principles, fail to become part of a governance process guiding transformation projects and programs of the respective organization. (2) The definition of EA principles is a one-time effort, performed in a typical project setting. This is a common problem with the creation of different EA artifacts (among them models, tools, and of course principles)—the difficulty of transferring the results of initial artifact creation into continuous operation. In the particular case of EAPs these may be defined and grounded properly, however, without constant evaluation and updates principles may become obsolete, counterproductive, not in line with changed strategy, and thus finally ineffective. The result that principles will

in consequence not be applied is in line with research on institutional theory showing that ineffective pressures affecting an organization will cause avoidance of and resistance to these pressures by the concerned parties (Oliver 1991).

While it is immediately plausible that EAP application (APP) positively contributes to EA consistence (CON)—as this is the main reason for introducing EAPs—it is important to note that EAP application needs to be guided by a constant explanation of a principle's application and a continuous sense making of these restrictions in forms of rationales to make these principles effective.

Finally it is important understand, that EAPs do not directly contribute to the common goals of EAM such as flexibility, efficiency, or innovation but that EAPs (like probably other EAM artifacts too) contribute to these goals indirectly via EA consistency. This is important because it is one step towards measuring EAM success—particularly in practice where this is a common challenge for enterprise architects.

Adding the perspective of organizational culture we differentiate direct effects of the different cultural orientations on EAP application (APP) and EA consistency (CON) on the one hand and moderating effects of these cultural orientations of the relations among EAP mechanisms and effects described in (H1.1)–(H1.4).

It is beyond the scope of this paper to analyze and interpret the effectiveness of EAM in different organizational cultures (for such a discussion cf. van Steenbergen 2011). As a by-product of our study, however, we found that EA consistency (CON) is supported by rational culture (RAC) and developmental culture (DEC) while this is not the case for hierarchical culture (HIC) and group culture (GRC). We also found that hierarchical culture contributes to the application of EAPs. This is in line with similar findings by Iivari and Huisman (2007) who analyzed the use of SDMs in different organizational cultures.

The analysis of the moderating effects of organizational culture is the core of our research. The strongest moderating effects can be found with *hierarchical culture* (HIC). This cultural orientation almost doubles the path coefficient between EAP grounding (GRO) and EAP application (APP). This means that a carefully grounded EAP will almost certainly be applied and observed. Consistently hierarchical culture significantly reduces the importance of EAP management (MAN) for EAP application (APP) by more than 50% and the importance of EAP grounding (GRO) for EA consistency (CON) by almost 75%. An EAP which is applied will contribute above average to EA consistency in hierarchical culture. The basic pattern of these findings is that while hierarchical cultures are certainly amendable to EA principles, it is key for architects to ground principles in the hierarchy itself. If a principle is legitimated by the hierarchy, i.e. its application becomes mandatory, it will almost certainly be effective. This makes clear that in hierar-

chical culture the main effort for introducing EAPs should not be spend on EAP management processes or EAP guidance but on grounding in corporate strategy and hierarchy. This does, however, not mean that for example EAP management is not important, but that under limited resources and time these aspects of EAPs may be added later, without too much loss at the beginning. Iivari and Huisman (2007) who come to comparable conclusions regarding the use of SDMs, however, they also discuss the effects of SDM adoption on hierarchical culture. They point out that hierarchical culture also has drawbacks especially in uncertain and dynamic environments (Burns and Stalker 1961). Therefore organizations that do not want to strengthen such a cultural orientation should be careful with adding too much bureaucracy with the introduction of SDMs and EAPs respectively.

For *group culture* (GRC) the effects are less straightforward. While grounding of EAPs is still important for EAP application its impact is significantly below average and considerably lower than in hierarchical culture. Especially stakeholder involvement during the EAP definition is important. However, the set-up of an EAP management function including EAP exception handling is important in group culture and its effect on EAP application is unimpaired. If an EAP is applied it has the strongest effect on EA consistency among all cultural orientations. Compared to that, the importance of EAP guidance for EA consistency is also reduced. This may be explained by the focus of teamwork, participation, and human relations in group culture: The fact that an EAP is applied already implies that a process of sense making and mutual understanding of architects and groups concerned by EAP has been implemented.

While *rational culture* (RAC) introduces no significant moderation effects, the values of its non-significant path coefficients compared to the coefficients of hierarchical culture und group culture in particular, allow for some interesting conjectures. Especially the shifting of effects on EA consistency from EAP application to EAP guidance is revealing. The impact of rational culture on the relation between EAP application and EA consistency is almost significant but more importantly, it has the opposite direction compared to all other partially significant cultural influences. The same is true but invertedly signed for the relation between EAP guidance and EA consistently. This supports our conjecture that in rational culture concerned parties are usually rather critical towards regulations unless they are well explained. This is in line with the findings of Iivari and Huisman (2007) for the introduction of SDMs. They conclude that in rational culture it is essential to convince concerned parties of the rationale of such regulations and its benefits in the longer run. Although significantly important, it is not sufficient to properly ground EAPs for instance in strategy and hierarchy but to convince every concerned party, otherwise—although applied—EAP may not make an impact. This effect can be explained again by institu-

tional theory where classical tactics of an avoidance strategy due to lacking legitimacy and efficiency are *concealing*, *buffering* or *escaping*. This means that EAPs are applied on paper but not in reality (Oliver 1991).

Developmental culture finally shows similar moderation effects as hierarchical culture—although on a much lower level and less significant. Obviously, the need and possibilities of proper grounding also generate an above average impact on EAP application. The effects of EAP management are, however, not significantly moderated. One explanation could be that in developmental culture, with its strong focus on change and external opportunities, EAPs need to be regularly re-invented instead of just being managed.

Taking this discussion back on a more generic level we showed that organizational culture—although not being the only factor—can be a significant instrument to better understand the effects of EA artifacts in a given organization or a group of organizations. Such an analysis can provide valuable information for practitioners who aim at applying IS artifacts in a specific situation. It can also be valuable for the researcher improving the utility of an artifact or the validity of a design theory, connecting valuable ends with effective means for a higher artifact mutability (Gregor and Jones 2007). It has to be noted though that on the one hand even if CVM provides extremely aggregated constructs it still ads significant complexity to such basic models like the one discussed in this paper. On the other hand because of this compactness of CVM it does not allow to understand the specifics of a given situation but it targets the general cultural dimensions.

Our research of course has limitations. First, our data collection—although it took place in a controlled environment—did not yield a representative sample. Second, since data collection was limited to respondents from German speaking countries, the results' validity might also be limited to this geographical area.[9] In the case of culture as one of the objects of research this may be of particular importance. Third, the reliance on single informants per organization does not account for the possibility of sub-cultures (Smircich 1983). However, the homogeneity of the respondents regarding their role in the respective organizations limits the impact of possible sub-cultures on our findings. Nevertheless, it might be interesting and an opportunity for further research to repeat this survey with respondents having different roles in their organizations. Finally it has to be noted that

[9] Iivari and Huisman (2007) point out that this limitation accounts for most empirical research in top-ranked IS journals which is based on data from one country—the United States. The limited scope on German speaking countries, however, might limit the validity of our core model; it might not seriously limit the findings of this paper regarding the moderating effects. This is because we would expect national culture to also moderate the effects of our core model and we would not expect that national culture moderates the moderation of organizational culture.

some statistical quality criteria and some of our measures show borderline values, specifically statistical power could be higher for identifying further weak effects.

Given these limitations we are still confident that our results provide valuable insight regarding both of our two underlying propositions for this paper.

6 Conclusion

To the best of our knowledge, this article is the first analysis of EA principles mechanisms and their effects on EA success in different organizational cultures. Based on empirical observations from actions design research projects and prior research on organizational culture in IS we developed a research model which hypothesizes the role of organizational culture for grounding, management, guidance and effectiveness of EA principles.

We found that EAP application is positively influenced by EAP grounding and EAP management, that EA consistency in positively influenced by EAP application and EAP guidance, and that finally these EAP mechanisms impact EAM utility via EA consistency. We also found that all relations describing EAP mechanisms and their effects are significantly moderated by organizational culture. More specifically we found how different cultural orientations take effect.

Our research comes down to the point that an organization cannot easily choose its own organizational culture that might be favorable for reaching one goal or another and for applying one respective means or another—although the design of organizational culture is another interesting topic. Instead the question is, how to best cope with a given situation. Based on our empirical findings we give recommendations on how to deal with selected design decisions when introducing and developing EA principles in an organization. These findings and our recommendations might be helpful for the practitioner concerned with introducing or developing EAPs in his or her organization by better recognizing and understanding the dimensions of his or her situation and taking informed action. For the design researcher concerned with EAM our findings may stimulate new approaches to conceptualize the often messy human situation they build their artifacts for (Baskerville et al. 2007). For the action researcher (or action design researcher for that matter) concerned with EAM we might provide a useful instrument to observe and analyze the organizational shaping of their artifacts (Sein et al. 2011).

We concede that this article is just one step towards conceptualizing the situational parameters that influence EAM success. Nonetheless, from our practical experiences we consider this a valuable step given the level of maturity of the core EA artifacts like models, tools, or planning approaches to make these artifacts more effective.

References

Aier, S, Fischer, C, Winter, R (2011a) Construction and Evaluation of a Meta-Model for Enterprise Architecture Design Principles. In: Bernstein, A, Schwabe, G (ed) The 10th International Conference on Wirtschaftsinformatik WI 2.011, Zurich, pp 637–644

Aier, S, Gleichauf, B (2010) Application of Enterprise Models for Engineering Enterprise Transformation. Enterprise Modelling And Information Systems Architectures 5(1):58–75

Aier, S, Gleichauf, B, Winter, R (2011b) Understanding Enterprise Architecture Management Design – An Empirical Analysis. In: Bernstein, A, Schwabe, G (ed) The 10th International Conference on Wirtschaftsinformatik WI 2.011, Zurich, pp 645–654

Aier, S, Riege, C, Winter, R (2008) Classification of Enterprise Architecture Scenarios – An Exploratory Analysis. Enterprise Modelling and Information Systems Architectures 3(1):14–23

Aier, S, Weiss, S (2012) An Institutional Framework for Analyzing Organizational Responses to the Establishment of Architectural Transformation. In: Proceedings of the 20th European Conference on Information Systems, Barcelona

Allaire, Y, Firsirotu, M E (1984) Theories of Organizational Culture. Organization Studies 5(3):193–226

Armour, F J, Kaisler, S H, Liu, S Y (1999) A Big-Picture Look at Enterprise Architectures. IEEE IT Professional 1(1/2):35–42

Bagozzi, R P, Yi, Y (1988) On the Evaluation of Structural Equation Models. Journal of the Academy of Marketing Science 16(1):74–94

Baron, R M, Kenny, D A (1986) The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology 51(1):1173–1182

Baskerville, R L, Pries-Heje, J, Venable, J (2007) Soft Design Science Research: Extending the Boundaries of Evaluation in Design Science Research. In: Proceedings of DESRIST 2007

Boh, W F, Yellin, D (2007) Using Enterprise Architecture Standards in Managing Information Technology. Journal Of Management Information Systems 23(3):163–207

Boucharas, V, van Steenbergen, M, Jansen, S, Brinkkemper, S (2010) The Contribution of Enterprise Architecture to the Achievement of Organizational Goals: Establishing the Enterprise Architecture Benefits Framework. Department of Information and Computing Sciences, Utrecht University. Utrecht

Brown, A E, Grant, G G (2005) Framing the Frameworks: A Review of IT Governance Research. Communications of the Association for Information Systems 15(May):696–712

Brown, C V (1997) Examining the Emergence of Hybrid IS Governance Solutions: Evidence from a Single Case Site. Information Systems Research 8(1):69–94

Brown, C V, Magill, S L (1994) Alignment of the IS Functions with the Enterprise: Toward a Model of Antecedents. MIS Quarterly 18(4):371–403

Brown, C V, Magill, S L (1998) Reconceptualizing the Context-Design Issue for the Information Systems Function. Organization Science 9(2):176–194

Bucher, T, Fischer, R, Kurpjuweit, S, Winter, R (2006) Analysis and Application Scenarios of Enterprise Architecture – An Exploratory Study. In: Society, I C (ed) EDOC Workshop on Trends in Enterprise Architecture Research (TEAR 2006), IEEE Computer Society, Los Alamitos, CA, USA

Buckl, S, Ernst, A M, Matthes, F, Schweda, C M (2009) An Information Model for Landscape Management – Discussing Temporality Aspects. In: Feuerlicht, G, Lamersdorf, W (ed) Service-Oriented Computing – ICSOC 2008 Workshops, Springer, Berlin, pp 363–374

Burns, T, Stalker, G M (1961) The Management of Innovation. Tavistock, London

Cameron, K S (1986) Effectiveness as paradox: Consensus and conflict in conceptions of organizational effectiveness. Management Science 32(5):539–553

Cameron, K S, Freeman, S J (1991) Cultural Congruence, Strength, and Type: Relationships to Effectiveness. Research in Organizational Change and Development 5:23–58

Chen, D, Lillehagen, F (2004) Enterprise Architectures – Review on Concepts, Principles and Approaches. In: Sobolewski, M W, Cha, J (ed) 10th International Conference on Concurrent Engineering (ISPE CE 2004), Tsinghua University Press, Beijing, pp 1211–1216

Chin, W W (1998a) Issues and Opinion on Structural Equation Modeling. MIS Quarterly 22(1):vii–xvi

Chin, W W (1998b) The Partial Least Squares Approach to Structural Equation Modeling. In: Marcoulides, G A (ed) Modern Methods for Business Research, Lawrence Erlbaum Associates, Mahwah, pp 295–336

Chin, W W (2010) How to Write Up and Report PLS Analyses. In: Vinzi, V E, Chin, W W, Henseler, Jet al (ed) Handbook of Partial Least Squares. Concepts, Methods and Applications, Springer, Berlin, Heidelberg, pp 655–690

Chin, W W, Marcolin, B L, Newsted, P R (2003) A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion/Adoption Study. Information System Research 14(2):189–217

Cohen, J (1988) Statistical power analysis for the behavioral sciences. Lawrence Erlbaum, Hillsdale, NJ

Cooke, R A, Rousseau, D M (1988) Behavioral Norms and Expectations: A Quantitative Approach to the Assessment of Organizational Culture. Group & Organization Studies 13(3):245–273

Cooper, R B (1994) The inertial impact of culture on IT implementation. Information & Management 27(1):17–31

DeLong, D W, Fahey, L (2000) Diagnosing Cultural Barriers to Knowledge Management. Academy of Management Executive 14(4):113–127

Denison, D R, Spreitzer, G M (1991) Organizational Culture and Organizational Development: A Competing Values Approach. Research in Organizational Change and Development 5:1–21

Detert, J R, Schroeder, R G, Mauriel, J J (2000) Architecture Principles – The Cornerstones of Enterprise Architecture. Academy Of Management Journal 25(4):850–863

Dietz, J L G (2007) Architecture. Building strategy into design. Academic Service, The Hague

Drazin, R, Van de Ven, A H (1985) Alternative Forms of Fit in Contingency Theory. Administrative Science Quarterly 30(4):514–539

Ein-Dor, P, Segev, E (1978) Organizational Context and the Success of Management Information Systems. Management Science 24(10):1064–1077

Ein-Dor, P, Segev, E (1982) Organizational Context and MIS Structure: Some Emprirical Evidence. MIS Quarterly 6(3):55–68

Faul, F, Erdfelder, E, Lang, A-G, Buchner, A (2007) G*Power 3: A flexible statistical power analysis for the social, behavioral, and biomedical sciences. Behavior Research Methods 39(2):175–191

Fischer, C, Winter, R, Aier, S (2010) What is an Enterprise Architecture Design Principle? Towards a Consolidated Definition. In: Lee, R (ed) Computer and Information Science 2010, Springer, Berlin, Heidelberg, pp 193–205

Foorthuis, R, van Steenbergen, M, Mushkudiani, N, Bruls, W, Brinkkemper, S, and Bos, R (2010) On course, but not there yet: Enterprise architecture conformance and benefits in systems development. In: ICIS 2010 Proceedings. Paper 110.

Goodhue, D L, Lewis, W, Thompson, R (2007) Statistical Power in Analyzing Interaction Effects: Questioning the Advantage of PLS with Product Indicators. Information System Research 18(2):211–227

Götz, O, Liehr-Gobbers, K, Krafft, M (2010) Evaluation of Structural Equation Models Using the Partial Least Squares (PLS) Approach. In: Vinzi, V E, Chin, W W, Henseler, Jet al (ed) andbook of Partial Least Squares: Concepts, Methods and Applications, Springer, Heidelberg, pp 691–711

Greefhorst, D, Proper, E (2011) Architecture Principles – The Cornerstones of Enterprise Architecture. Springer, Berlin, Heidelberg

Gregor, S, Jones, D (2007) The Anatomy of a Design Theory. Journal of the Association for Information Systems 8(5):312–335

Habermas, J (1984) The theory of communicative action: Reason and the rationalization of society. Beacon, Boston

Henderson, J C, Venkatraman, N (1993) Strategic alignment: Leveraging information technology for transforming organizations. IBM Systems Journal 32(1):4–16

Henseler, J, Fassott, G (2010) Testing Moderating Effects in PLS Path Models: An Illustration of Available Procedures. In: Esposito Vinzi, V, Chin, W W, Henseler, Jet al (ed) Handbook of Partial Least Squares: Concepts, Methods and Applications, Springer, Heidelberg, pp 713–735

Hofstede, G (1998) Identifying Organizational Subcultures: An Empirical Approach. Journal of Management Studies 35(1):1–12

Hofstede, G, Neuijen, B, Ohayv, D D, Sanders, G (1990) Measuring Organizational Cultures: A Qualitative and Quantitative Study Across Twenty Cases. Administrative Science Quarterly 35(2):286–316

Hoogervorst, J A P (2004) Enterprise Architecture: Enabling Integration, Agility and Change. International Journal of Cooperative Information Systems 13(3):213–233

Hoogervorst, J A P (2009) Enterprise Governance and Enterprise Engineering. Springer, Berlin

Hulland, J (1999) Use of Partial Least Squares (PLS) in Strategic Management Research: A Review of Four Recent Studies. Strategic Management Journal 20(2):195–204

Iivari, J, Huisman, M (2007) The Relationship between Organizational Culture and the Deployment of Systems Development Methodologies. MIS Quarterly 31(1):35–58

Jones, M C, Cline, M, Ryan, S (2006) Exploring knowledge sharing in ERP implementation: an organizational culture framework. Decision Support Systems 41(2):411–434

Jonkers, H, Lankhorst, M M, Doest, H W L, Arbab, F, Bosma, H, Wieringa, R J (2006) Enterprise architecture: Management tool and blueprint for the organisation. Information Systems Frontiers 8:63–66

Kroeber, A L, Kluckhohn, C (1952) Culture: A Critical Review of Concepts and Definitions. The Museum, Cambridge, MA

Kurpjuweit, S, Winter, R (2007) Viewpoint-based Meta Model Engineering. In: Reichert, M, Strecker, S, Turowski, K (ed) Enterprise Modelling and Information Systems Architectures - Concepts and Applications, Proceedings of the 2nd Int'l Workshop EMISA 2007, Gesellschaft für Informatik, Köllen, Bonn, pp 143–161

Kurpjuweit, S, Winter, R (2009) Concern-oriented Business Architecture Engineering. In: Shin, D (ed) Applied Computing 2009 - The 24th Annual ACM Symposium on Applied Computing, ACM, pp 265–272

Lagerström, R, Saat, J, Franke, U, Aier, S, Ekstedt, M (2009) Enterprise Meta Modeling Methods – Combining a Stakeholder-Oriented and a Causality-Based Approach. In: Halpin, T, Krogstie, J, Nurcan, Set al (ed) Enterprise, Business-Process and Information Systems Modeling, Proceedings of the 10th International Workshop BPMDS and 14th International Conference EMMSAD at CAiSE 2009, Springer, Berlin, pp 381–393

Lankhorst, M (2005) Enterprise Architecture at Work: Modelling, Communication and Analysis. Springer, Berlin et al.

Leidner, D E, Kayworth, T (2006) A Review of Culture in Information Systems Research: Toward a Theory of Information Technology Culture Conflict. MIS Quarterly 30(2):357–399

Leppänen, M, Valtonen, K, Pulkkinen, M (2007) Towards a Contingency Framework for Engineering an Enterprise Architecture Planning Method. In: Proceedings of 30th Information Systems Research Seminar in Scandinavia (IRIS 2007)

Lindström, Å (2006) On the Syntax and Semantics of Architectural Principles. In: Sprague, R H, Jr. (ed) 39th Annual Hawaii International Conference on Systems Sciences, IEEE Computer Society, Los Alamitos, CA, USA

Lohmöller, J-B (1989) Latent Variable Path Modeling with Partial Least Squares. Physica, Heidelberg

Martinez, J I, Jarillo, J C (1989) The Evolution of Research on Coordination Mechanisms in Multinational Corporations. Journal of International Business Studies 20(3):489–514

Mykhashchuk, M, Buckl, S, Dierl, T, Schweda, C M (2011) Charting the Landscape of Enterprise Architecture Management. In: Bernstein, A, Schwabe, G (ed) Proceedings of the 10th International Conference on Wirtschaftsinformatik WI 2.011, Zurich, pp 570–577

Niemann, K D (2006) From Enterprise Architecture to IT Governance. Elements of Effective IT Management. Vieweg, Wiesbaden

Niemi, E (2007) Enterprise Architecture Stakeholders – A holistic view. In: 13th Americas Conference on Information Systems (AMCIS 2007), Keystone, CO

Oliver, C (1991) Strategic Responses to Institutional Processes. Academy Of Management Review 16(1):145–179

Olson, M H, Chervany, N L (1980) The Relationship Between Organizational Characteristics and the Structure of the Information Services Function. MIS Quarterly 4(2):57–68

Op ’t Land, M, Proper, E, Waage, M, Cloo, J, Steghuis, C (2009) Enterprise Architecture – Creating Value by Informed Governance. Springer, Berlin

Pettigrew, A M (1979) On Studying Organizational Cultures. Administrative Science Quarterly 24(4):570–581

Proper, E, Greefhorst, D (2010) The Roles of Principles in Enterprise Architecture. In: Proper, E, Lankhorst, M M, Schönherr, Met al (ed) 5th International Workshop on Trends in Enterprise Architecture Research (TEAR 2010), Springer, Berlin, Heidelberg, pp 57-70

Quinn, R E (1984) Applying the competing values approach to leadership. In: Hunt, J G, Stewart, R, Schriesheim, C Aet al (ed) Managerial work and leadership: International perspectives, Pergamon, New York, pp 10–27

Quinn, R E (1988) Beyond rational management. Jossey-Bass, San Francisco

Quinn, R E, Cameron, K S (1983) Organizational life cycles and shifting criteria of effectiveness: Some preliminary evidence. Management Science 29(1):33–51

Quinn, R E, Hall, R H (1983) Environments, organizations, and policymakers: Toward an integrative framework. In: Hall, R H, Quinn, R E (ed) Organizational theory and public policy, Sage, Beverly Hills, CA, pp 281–298

Quinn, R E, Kimberly, J R (1984) Paradox, planning, and perseverance: Guidelines for managerial practice. In: Kimberly, J R, Quinn, R E (ed) Managing organizational Transitions, Richard D. Irwin, Homewood, IL, pp 295–313

Quinn, R E, Rohrbaugh, J (1981) A competing values approach to organizational effectiveness. Public Productivity Review 5(2):122–140

Quinn, R E, Rohrbaugh, J (1983) A Spatial Model of Effectiveness Criteria: Towards a Competing Values Approach to Organizational Analysis. Management Science 29(3):363–377

Ralyté, J, Brinkkemper, S, Henderson-Sellers, B (ed), Proceedings of the IFIP WG8.1 Working Conference on Situational Method Engineering – Fundamentals and Experiences (ME07), Springer, Boston

Richardson, G L, Jackson, B M, Dickson, G W (1990) A Principle-Based Enterprise Architecture: Lessons From Texaco and Star Enterprise. MIS Quarterly: Management Information Systems 14(4):285–403

Ringle, C, Wende, S, Will, A (2005) SmartPLS 2.0 (beta). University of Hamburg. Hamburg

Ross, J W (2006) Enterprise Architecture: Driving Business Benefits from IT. Massachusetts Intitute of Technology, Center for Information Systems Research (CISR). 359.

Sackmann, S A (1992) Culture and Subcultures: An Analysis of Organizational Knowledge. Administrative Science Quarterly 37(1):140–161

Sambamurthy, V, Zmud, R W (1999) Arrangements for Information Technology Governance: A Theory of Multiple Contingencies. MIS Quarterly 23(2):261–290

Schein, E H (1997) Organizational Culture and Leadership. Jossey-Bass Publishers, San Francisco

Schelp, J, Winter, R (2009) Language Communities in Enterprise Architecture Research. In: Vaishanvi, V, Baskerville, R (ed) Diversity in Design Science – 4th Conference on Design Science Research in Information Systems and Technologies (DESRIST2009), ACM, Philadelphia, PA, USA, pp 1–10

Schmidt, C, Buxmann, P (2011) Outcomes and success factors of enterprise IT architecture management: empirical insight from the international financial services industry. European Journal Of Information Systems 20(2):168–185

Schönherr, M (2009) Towards a Common Terminology in the Discipline of Enterprise Architecture. In: Feuerlicht, G, Lamersdorf, W (ed) Service-Oriented Computing – ICSOC 2008 Workshops, Springer, Sydney, pp 400–413

Scott, W R (2001) Institutions and Organizations. Sage Publications, London

Sein, M, Henfridsson, O, Purao, S, Rossi, M, Lindgren, R (2011) Action Design Research. MIS Quarterly 35(1):37–56

Smircich, L (1983) Concepts of Culture and Organizational Analysis. Administrative Science Quarterly 28(3):339–358

Stelzer, D (2010) Enterprise Architecture Principles: Literature Review and Research Directions. In: Dan, A, Gittler, F, Toumani, F (ed) Service-Oriented Computing. ICSOC/ServiceWave 2009 International Workshops, Stockholm, Sweden, November 23-27, 2009, Revised Selected Papers, Springer, Berlin, pp 12–21

Tamm, T, Seddon, P B, Shanks, G, Reynolds, P (2011) How Does Enterprise Architecture Add Value to Organisations? Communications of the Association for Information Systems 28:141–168

The Open Group (2009) TOGAF Version 9 – The Open Group Architecture Framework (TOGAF). The Open Group,

Thompson, J D, Bates, F L (1957) Technology, Organization, and Administration. Administrative Science Quarterly 2(3):325–343

Tosi, H L, Jr., Slocum, J W, Jr. (1984) Contingency Theory: Some Suggested Directions. Journal Of Management 10(1):9–26

van den Berg, M, van Steenbergen, M (2006) Building an Enterprise Architecture Practice: Tools, Tips, Best Practices, Ready-to-Use Insights. Springer, Berlin

van Steenbergen, M (2011) Maturity and Effectiveness of Enterprise Architecture. Dissertation, Utrecht University. Utrecht

Wagter, R, van den Berg, M, Luijpers, J, van Steenbergen, M (2005) Dynamic Enterprise Architecture: How to Make It Work. John Wiley & Sons, Hoboken, New Jersey

Webster, J, Watson, R T (2002) Analyzing the Past to prepare for the Future: Writing a Literature Review. MIS Quarterly 26(2):13–23

Weill, P (2004) Don't Just Lead, Govern: How Top-Performing Firms Govern IT. MIS Quarterly Executive 3(1):1–17

Weill, P, Ross, J W (2004) IT Governance – How Top Performers Manage IT. Harvard Business School Press, Boston

Weill, P, Ross, J W (2005) A Matrixed Approach to Designing IT Governance. MIT Sloan Management Review 46(2):25–34

Wilkinson, M (2006) Designing an "Adaptive" Enterprise Architecture. BT Technology Journal 24(4):81–92

Winter, R, Fischer, R (2007) Essential Layers, Artifacts, and Dependencies of Enterprise Architecture. Journal of Enterprise Architecture 3(2):7–18

Yeung, A K O, Brockbank, J W, Ulrich, D O (1991) Organizational Culture and Human Resource Practices: An Empirical Assessment. Research in Organizational Change and Development 5:59–82

Ylimäki, T (2006) Potential Critical Success Factors for Enterprise Architecture. Journal of Enterprise Architecture 2(4):29–40