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EMPIRICAL RESEARCH

An empirical analysis of the factors and measures of Enterprise Architecture Management success

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Abstract

Enterprise Architecture Management (EAM) is discussed in academia and industry as a vehicle to guide IT implementations, alignment, compliance assessment, or technology management. Still, a lack of knowledge prevails about how EAM can be successfully used, and how positive impact can be realized from EAM. To determine these factors, we identify *EAM success factors* and *measures* through literature reviews and exploratory interviews and propose a theoretical model that explains key factors and measures of EAM success. We test our model with data collected from a cross-sectional survey of 133 EAM practitioners. The results confirm the existence of an impact of four distinct EAM success factors, 'EAM product quality', 'EAM infrastructure quality', 'EAM service delivery quality', and 'EAM organizational anchoring', and two important EAM success measures, 'intentions to use EAM' and 'Organizational and Project Benefits' in a confirmatory analysis of the model. We found the construct 'EAM organizational anchoring' to be a core focal concept that mediated the effect of success factors such as 'EAM infrastructure quality' and 'EAM service quality' on the success measures. We also found that 'EAM satisfaction' was irrelevant to determining or measuring success. We discuss implications for theory and EAM practice.
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Introduction

To deal with the complexity of their corporate IT environments, many organizations employ enterprise architectures (EAs). These contain structured and aligned collections of plans for the integrated representation of the business and information technology landscape of the enterprise, in its past, current, and future states (Niemann, 2006). Enterprise Architecture Management (EAM) describes the management activities conducted in an organization to install, maintain and purposefully develop an organization's EA (Aier *et al*, 2011). It captures all those processes, methods, tools, and responsibilities necessary to deal with the different architectural layers of an EA when attempting to build a holistic and integrated view of the enterprise (The Open Group, 2009).

Large organizations across all industries employ EAM toward various ends, for instance, as a management tool to guide IT implementations (Ross *et al*, 2009), business-IT alignment (Henderson & Venkatraman, 1999), compliance assessment (Foorthuis *et al*, 2012), technology management (Boh & Yellin, 2007), and corporate strategic management (Simon *et al*, 2014). A survey of enterprise architects showed that EAM goals can range from fostering innovation to improving standardization, interoperability, and business-IT alignment (Winter *et al*, 2010), and other studies have found that organizations make substantial investments in their EAM programs (Morganwalp & Sage, 2004). A recent survey indicated that CIOs consider the management of their EA one of their most pressing concerns and the most time-consuming activity (Luftman & Zadeh, 2011).

Although EAM has gained popularity as a management instrument in business and IT over the last decade (e.g., Salmans & Kappelmann, 2010), adoption issues prevail (Simon *et al*, 2014). Many organizations still behold EAM as an abstract concept that demands significant investment, but whose benefits have not yet been proven (Rodrigues & Amaral, 2010). Indeed, several organizations consider their EAM programs to be a failure because they have not been able to justify their investments in EAM (Morganwalp & Sage, 2004).

For these reasons, there is an interest to examine both the outcomes of EAM in organizations as well as the principles that lead to effective EAM. That is, there is an interest in ascertaining which benefits accrue from EAM (e.g., Boucharas *et al*, 2010a; Tamm *et al*, 2011; Simon *et al*, 2014) and which critical factors relate to success of EAM (Schmidt & Buxmann, 2011; Weiss *et al*, 2013). However, while EA-related issues have been examined in the literature since the late 1980s (Simon *et al*, 2013), substantive theoretical and empirical contributions have largely been absent until recently (Tamm *et al*, 2011). Boh & Yellin (2007) examined the use of EA standards in the management of IT infrastructures across business units. Schmidt & Buxmann (2011) examined the achievement of IT benefits such as flexibility and efficiency through EAM implementation, and recently Weiss *et al* (2013) examined how EAM institutionalization mechanisms affected firm-level benefits achieved through EAM.

Notwithstanding these research efforts, the existing view on both EAM success factors and success measures remains incomplete and fragmented. Notably, examinations of *EAM success measures* have so far largely focused on IT-level benefits (Boh & Yellin, 2007; Schmidt & Buxmann, 2011) but not yet, for instance, on project levels. Existing studies of *EAM success factors* have largely studied EAM adoption during implementation (Schmidt & Buxmann, 2011) or institutionalization (Weiss *et al*, 2013) phases but not yet, for instance, on post-implementation stages of EAM use.

We seek to complement and extend the existing works by developing knowledge about EAM success factors at a post-implementation stage and by focusing not on IT but rather project- and organizational-level benefits. Our goal is to add to the existing literature by developing and empirically testing a comprehensive EAM success factor model that encompasses, explains, and measures the realization of success measures such as continued use, satisfaction, and business- and IT-centric EAM benefits on an organizational and project level.

This paper offers three central contributions. First, we present a theoretically developed and empirically validated model of success factors and measures of EAM. Our model assists organizations in anticipating and assessing both the critical factors as well as the relevant metrics for successful EAM. Second, in the process we provide a rigorously developed and tested measurement instrument that allows organizations and researchers alike to rigorously measure success metrics such as project and organizational benefits, which could, for instance, be leveraged in future research on benefit realization from EAM (e.g., Boucharas *et al*, 2010a). Third, foreshadowing our ensuing discussion, we extend the emerging literature on EAM by providing an empirically developed understanding of the role of organizational anchoring as a critical EAM success factor (e.g., Aier, 2014).

In the next section, we discuss the relevant background. The section after that describes the approach taken to develop and operationalize a conceptual model. The following section discusses the design of research method and measurement instrument. The empirical evaluation of our proposed model is described in terms of measurement model analysis in the subsequent section and structural model analysis in the following section. In the section after that we examine the data from the viewpoints of different EAM stakeholders. Then we provide a discussion of findings and contribution. The following section outlines the implications of this research. Finally, we elaborate on the limitations of this study and conclude with a review of contributions.

Research background

Enterprise Architecture Management

Our work concerns the management of EAs, that is, the management activities conducted in an organization to install, maintain, and purposefully develop an organization's EA (Aier *et al*, 2011). EAs define the inherent structure of the … *main components of [an] organization, its information systems, the ways in which these components work together […] to achieve defined business objectives, and the way in which the information systems support the business processes of the organization* (Kaisler *et al*, 2005). They are common design vehicles used by organizations in contexts such as IT implementations (Ross *et al*, 2009), business-IT alignment (Winter *et al*, 2010; Luftman & Zadeh, 2011), compliance assessment (Foorthuis *et al*, 2012), or technology management (Boh & Yellin, 2007).

Common aims of EAM in organizations are to link business strategy formulation and the actual implementation of these strategies in an organization's processes and IT systems. By means of such aims, EAM is argued to be instrumental for governing an organization's continuous improvement process by first constituting the interface between business strategy and its implementation, and second supporting the development of solution architectures

(Tamm *et al*, 2011). EAM builds on a comprehensive set of concepts and tools for the holistic management of an organization's operating platform (Ross *et al*, 2009), which can be structured in three different areas:

- *EAM products* contain the documentation of the EA and related decision making. Four different EAM products can be distinguished that differ with respect to their time-reference:

  (1) the 'as-is architecture', which describes the currently implemented operational environment;
  (2) the 'to-be architecture', which describes the desired future target state;
  (3) the roadmap, which describes the transformation path from the as-is to the to-be architecture (Smolander *et al*, 2008); and
  (4) EA principles, which provide guidelines and rationales for the development and re-evaluation of the EA (Richardson *et al*, 1990).

- *EAM infrastructure* describes the formal foundation on which EAM operates. It includes governance aspects such as the formal mandate of EAM, the extent of centralization of EAM-related decision making, and the formally defined governance mechanisms for EAM-related decision making. Further, it covers available supporting instruments such as EAM frameworks, software tools, and reference architectures. And finally, it covers the available resources such as people skills and financial resources.
- *EAM services* are the collection of activities and support that is offered by EAM to the organization or to transformation projects. It includes services related to general communication with all EAM stakeholders, the support and advice of the management in EAM-related topics, and the active support of transformation initiatives and other projects.

On basis of this conceptualization, we observe that stakeholders can have two perspectives on EAM: they can be *contributing*, for instance by being involved in creating EA products, by participating in meetings related to EAM governance, or providing mandate and general support, or they can be *benefiting*, for example, by consuming EAM services and using EA products. *EAM Benefits* thus describe the positive impacts that flow from EAM use to individuals, groups, projects, or organizations.

In this research, we focus on how stakeholders achieve positive impacts from EAM by using EAM products and services provided via the EAM infrastructure. In this line, *intended EAM use*, defined as the degree to which stakeholders intend to continue to engage with EAM by using EAM products and services via the EAM infrastructure in the future for either contributions or benefits, describes a relevant success metric for EAM in terms of whether or not relevant stakeholders plan to continuously engage and employ EAM for their purposes. This is even more important since usage purposes may encompass a wide range of EAM application contexts, such as its use as a means to facilitate enterprise transformation but also its use for purposes such as organizational analysis of inconsistencies, redundancies, and potential synergies, or as a tool to examine alignment or governance issues (Op't Land *et al*, 2009).

Table 1 provides a summary of the relevant conceptual foundations for our study.

Empirical studies on EAM

While much of the historical EAM research has been conceptual (e.g, Boucharas *et al*, 2010b) or design-oriented in nature (e.g, Aier & Winter, 2009), recent years have seen a strong increase in interest in managerial topics in EAM (Winter *et al*, 2014). With the renewed focus in EA management, the share of empirical studies on EAM has also increased. Table 2 summarizes key empirical contributions to EAM research, and positions the study reported in this paper against the background of related empirical studies.

Several observations can be made in reference to the summary of related work in Table 2. First, we note that in recent years several key contributions have been made to establish an empirical body of knowledge on EAM across several phases of its lifecycle from design (Bruls *et al*, 2010; Aier, 2014) to implementation (Schmidt & Buxmann, 2011; Löhe & Legner, 2014) and institutionalization (Weiss *et al*, 2013) phases of EAM adoption. We now add to this literature by focusing on *post-implementation use* of EAM, thereby also extending the knowledge around applications of EAM in use (Simon *et al*, 2014). Second, we note that knowledge has increasingly accumulated about value (Tamm *et al*, 2011), outcomes (Boh & Yellin, 2007), and benefits (Weiss *et al*, 2013) as success measures of EAM in organizations. A large share of these assessments has either focused on the realization and type of IT-level benefits such as achievements of flexibility and efficiency (Schmidt & Buxmann, 2011) or the reduction of heterogeneity and replication of IT infrastructure (Boh & Yellin, 2007), or on a firm-level general assessment of benefits such as process standardization, coordination of change, and strategy realization (e.g., Foorthuis *et al*, 2010; Weiss *et al*, 2013). We add to this an understanding and differentiation of *project and organizational benefits* that accrue from EAM use.

Conceptual basis

The focus of our research is to investigate the factors and measures of successful EAM practices that are active in an organization (albeit potentially at different levels and in different formats). Thus, our research takes place in the post-adoption phase (Jasperson *et al*, 2005) after EAM has been installed, and it examines the use of EAM and the consequences that stem from its use, rather than the determinants or consequences that stem from a decision to adopt EAM.

A suitable framework that identifies different dimensions of success factors as well as dimensions of success

Table 1 Overview of key concept definitions

Concept	*Definition*	*Relevant literature*	*Relevance to this study*
Enterprise architecture (EA)	The inherent structures of the main components of an organization, its information systems, the ways in which these components work together to achieve defined business objectives, and the way in which the information systems support the business processes of the organization	Kaisler *et al* (2005)	Representation artifact, the *practices* around which are the *core phenomena* of interest in our study
Enterprise Architecture Management (EAM)	The management activities conducted in an organization to install, maintain and purposefully develop an organization's EA	Aier *et al* (2011)	The *management practices* (viz., the installation, maintenance, development and use of a coherent set of architecture principles, models, services, and governance structures) is the *unit of analysis* in our paper
Intended EAM use	The extent to which EAM stakeholders intend to *continue to engage* in EAM	Adapted from definitions of continued usage intentions in Bhattacherjee (2001); Recker (2010)	Key *success metrics* of EAM and key component in our theory
Benefits	EAM stakeholders' perceptions of the extent to which EAM yields positive *organizational* and *project* impacts	Foorthuis *et al* (2010)	
EAM success factors	Relevant EAM products, infrastructure or service concepts that are critical to attaining EAM goals	Adapted from Schmidt & Buxmann (2011)	Set of *potential success factors* relevant to describing the impact of EAM

Table 2 Relationship of current study to related works

Reference	*Summary of contributions*	*Focus*	*Research method*	*Stakeholder perspective*	*Examined outcomes*
Boh & Yellin (2007)	Identification of four key governance mechanisms for EA standards management	Use of EA standards	Survey	Chief architects	*IT infrastructure management* (heterogeneity, replication, application, integration)
Bruls *et al* (2010)	Formulation of prescriptive criteria to create and refine domain architectures	Design of EAs	Multiple case study	EA designers	—
Schmidt & Buxmann (2011)	Evaluation of success factors and outcomes from EAM implementations	Implementation of EAM	Survey	EAM providers (e.g., chief architects, heads of IT function)	*IT benefits* (flexibility and efficiency)
Weiss *et al* (2013)	Evaluation of the factors that influence the institutionalization of EAM	Institutionalization of EAM	Survey	Members of the EAM function	*Organizational benefits*
Aier (2014)	Evaluation of the role of organizational culture for the mechanisms and effects of EA principles	EA design principles	Survey	Members of the EAM function	*Utility* of EAs
Simon *et al* (2014)	Development of a comprehensive business architecture framework	EA applications for corporate strategic management	Qualitative interviews	Strategy directorate (e.g., head of corporate strategy)	*Applicability* of EAs
Löhe & Legner (2014)	Development of a design theory for EAM implementation	Implementation of EAM	Multiple case study	Various roles involved in EAM setup and implementation	—
This study	*Evaluation of success factors and measures of EAM use*	*Post-implementation use of EAM*	*Survey*	*EAM end users*	*Organizational and project benefits*

measures of an information system is DeLone and McLean's (1992, 2003) IS success model (DMSM). This model identifies six dimensions that influence the success of an information system in terms of the impact that stems from system use. It incorporates the findings from decades of empirical and theoretical research on IS success and is widely applied and borrowed in other studies. Petter *et al* (2008; 2012; 2013) provide excellent overviews.

The DMSM model suggests six key success dimensions that relate to factors and measures of successful information system use (DeLone & McLean, 1992, 2003):

- *Information quality* as a success factor measures the output of an information system. Typical characteristics measured in this dimension include, among others, accuracy, completeness, consistency, relevance, and timeliness.
- *System quality* as a success factor measures the desirable characteristics of the information processing system. Typical characteristics include, for example, data quality, ease-of-use, flexibility, functionality, importance, integration, portability, and reliability.
- *Service quality* as a success factor measures the IS function's support for the users of the system. Typical characteristics of this dimension measure, for example, technical competence, responsiveness, reliability, and empathy.
- *Use* as a success measure refers to the intended and actual usage of the system and is typically analyzed, for example, based on the characteristics dependency, frequency of use, number of accesses, time of use, and usage pattern.
- *User satisfaction* as a success measure refers to how satisfied the user is with using the information, the system, and the related services. This dimension is typically measured based on the user's delightedness, satisfaction, and contentedness with respect to the system of interest.
- *Net benefits* as a success measure refer to positive contribution to individuals, groups, organizations, and/or society. This dimension is typically characterized by measures such as job performance, decision-making performance, improved productivity, increased sales, and quality of work environment.

Decades of theoretical and empirical work have provided two implications of particular importance to our research: first, the application of the DMSM model as a conceptual framework is applicable not only to a wide range of technological systems (Petter *et al*, 2013), but also management domains and contexts, such as process modeling (Bandara & Rosemann, 2005), e-commerce management (DeLone & McLean, 2004), or knowledge management (Kulkarni *et al*, 2007). This suggests not only widespread acceptance of the model (Petter *et al*, 2008) but also that its main ideas and concepts can transition from the narrow information system use context to broader conceptions of systems and system-related behaviors in other management contexts, if characterization of the constructs involved as well as the relationships between them are appropriately transitioned as well (Kulkarni *et al*, 2007). These findings suggest that success factors and measures of EAM, often described as a fundamental 'management information system' for the enterprise (Simon *et al*, 2014), can also be conceptualized on the basis of the DMSM.

Second, the practical application of the conceptual framework depends highly on the analysis context and the appropriate measurement of the six relevant dimensions (DeLone & McLean, 2003; Petter *et al*, 2008, 2013). For example, an information system managed by a vendor requires service quality measures for the vendor rather than for the internal IS department (Petter & McLean, 2009). Similarly, the benefits accrued from the use of EAM will largely differ from benefits that can be obtained from, say, enterprise resource planning systems. This context sensitivity suggests that the DMSM framework, on basis of the results of prior work, will serve well as a *sensitizing device*. As such, it serves as a theoretical lens to view the world in a certain way (Klein & Myers, 1999) in order to provide us with a set of dimensions relevant to understanding success factors and measures of EAM. However, this does not reduce the need to operationalize and instantiate the broad categories in the context of EAM. As an example, to examine the system quality of EAM we need to develop an understanding (a) what is the system in EAM and (b) what are relevant quality metrics of the EAM system. We will report on our research to develop a substantive model of EAM success factors and measures in the section that follows.

In doing so, we wish to highlight that we are by no means the first to suggest or explore the application of the DMSM model to EAM. For instance, Kluge *et al* (2006) and Niemi & Pekkola (2009) build on the DMSM to propose models for EAM value realization. Both models are aimed at explaining and supporting greater overall EAM acceptance. These two proposed models of EAM value realization include, among others, the DMSM concepts 'service quality' and 'use' as mediating variables. Yet, comprehensive validations of these models remain outstanding.

Research model

To develop a success factors and measures model for EAM on the basis of the dimensions of the DMSM as a framework, we employed a two-phased research design following MacKenzie & House (1978), starting with an explorative phase in which we developed a substantive conceptual EAM success factor model through review of the literature and exploratory empirical work, and a confirmatory phase in which the model is operationalized and tested through quantitative research.

To develop our research model, we performed two key research tasks. First, we conducted a comprehensive literature review, in which we identified success factors as well as reports of success measures and benefits from EAM. From approximately 600 extracted publications we identified a set of 48 relevant peer-reviewed publications, which we examined using the data analysis tool NVivo (Bandara, 2006). The detailed review is available in (Lange, 2012). In summary, we identified 211 EAM success factors and measures, which we coded through content analysis into the broad success factor categories EAM products, EAM services, EAM infrastructure, and EAM cultural aspects, and the broad success measure categories EAM use, EAM satisfaction, and EAM benefits. The analysis of success factors and measures was completed by two of the authors as follows: The first researcher coded the success factors and measures including the initial topic structure. Then, a second researcher re-coded the success factors and measures against the created structure. With this approach, we could identify only a few discrepancies. To resolve these discrepancies, we discussed and recoded the topics, thereby iteratively reaching consensus in our coding.

Second, we then examined and revised the identified categories of success factors and measures from the literature through semi-structured interviews with a set of eleven EAM experts. Details about this stage of the research process are provided in Lange *et al* (2012). The interviewed experts covered senior managers in organizations (mostly 'Head of Enterprise Architecture' or equivalent) as well as experienced consultants to complement the experiences from the enterprises. The protocol was developed perusing open questions such as previous experiences in engaging with EAM as well as structured questions to explore experienced success factors and measures alongside the identified dimensions.

These expert interviews, in essence, confirmed the emerging conceptualization. All experts agreed that the proposed dimensions were relevant and complete as compared with their experiences. They also attested to the practical relevance of the suggested model. However, as discussed below, we also found that an additional dimension was relevant to understand EAM success, which captured informal, 'softer' conditions under which EAM operates. And indeed, Bean (2010) and Magalhaes *et al* (2007) argue that these cultural and social aspects are fundamental elements of EAM that, however, are often neglected in studies and models. As we describe below, we will refer to this dimension of factors that we initially coded as 'cultural aspects', based on the revised findings from the interviews, as the 'organizational anchoring' of EAM in an organization.

On the basis of the categories of success factors and measures identified in the literature together with the identification of relevant concepts from the expert interviews, we perused the structure provided by the DMSM as a variance model to position and integrate the identified dimensions into operationalizable constructs of an EAM success factor model. Figure 1 shows our view of that model, the components of which are described in the following.

EAM products are the outcomes that store the information required for EAM and the related decision making about EA. They include, for instance, the as-is architecture or roadmap. The *EAM product quality* therefore is supposedly a strong influence on the overall EAM success. In terms of the DMSM, the EAM product quality dimension can be related to the information quality construct.

The EAM infrastructure refers to the required foundational structures for EAM, such as the assignment of accountability, an appropriate governance scheme, or EAM tool support. The *EAM infrastructure quality* therefore determines the extent to which the formal conditions under which EAM is executed are appropriate. In this sense, it can be regarded as an instantiation of the system quality dimension in the original DMSM.

EAM services are provided to all relevant EA stakeholders. *EAM service delivery quality* is therefore concerned

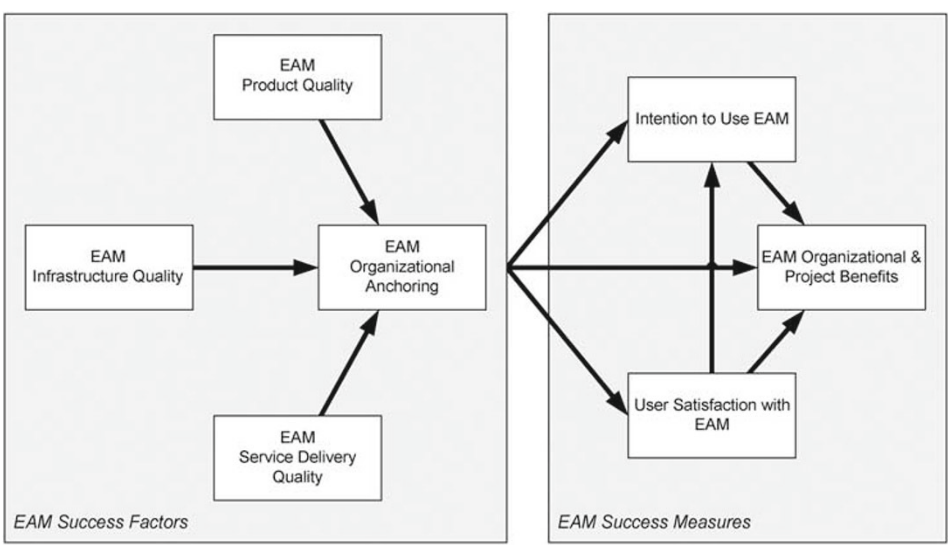

Figure 1 The *a-priori* EAM success factor model.

with the quality of the services provided, which include EAM and value communication, compliance validation, and decision-making. In terms of the DMSM, this dimension relates to the original service quality dimension.

To explore the success measures of EAM, we adapted the original DMSM success dimensions intended use, satisfaction, and net benefits, faithfully to the EAM context to capture intended continued engagement with EAM as *intention to use*, satisfaction with EAM use (*user satisfaction*), and net benefits stemming from EAM use on an organizational and project level (*organizational and project benefits*). Our focus on organizational and project benefits as opposed to, say, individual or function-specific benefits, such as IT-benefits, stemmed from our goal to complement and extend rather than revisit the existing understanding of IT-level benefits from EAM (Boh & Yellin, 2007; Schmidt & Buxmann, 2011).

A key extension to the DMSM in the substantive context of EAM is the introduction of the additional success factor *EAM organizational anchoring*. In general, anchors are reference points that entities can draw upon when choosing a behavior or making a decision (Tversky & Kahneman, 1974). Organizational anchors describe those characteristics and conditions in an organization that work collectively to enable, drive, and influence an organization's performance (Eversole & Barr, 2003). In analogy, we thus define organizational anchoring of EAM as the characteristics and conditions through which EAM is embedded in the organization to enable, drive, and influence an organization's performance.

We included this dimension on the basis of two key arguments. First, we learned from our expert interviews that this dimension is crucial for EAM success as experienced by practitioners (Lange *et al*, 2012). Second, this additional dimension also addresses the criticism that cultural and people aspects are underrepresented in the DMSM (Ballantine *et al*, 1996; Seddon, 1997; Petter *et al*, 2013) and that cultural characteristics of an organization can be a significant source of inertia in how organizations deal with EAs (Aier, 2014). This additional dimension allows us to consider additional socio-organizational, individual, and cultural aspects that we identified as relevant to the success of EAM through our literature review. In contrast to the EAM infrastructure quality, which is concerned with the formal conditions, this dimension is concerned with the informal and cultural (i.e., the 'softer') conditions in which EAM is grounded in an organization (Weiss & Winter, 2012; Aier, 2014).

Having defined the relevant concept dimensions of the EAM success factor model, we then proceeded to identify relevant sub-constructs for each dimension on basis of the literature review and expert interview findings, and then relevant measurement items for each construct. For example, for the success factor EAM product quality, we identified the relevant construct dimensions As-Is Architecture (the documentation of the current implementation of business processes, IT systems, and infrastructures), To-Be Architecture (the documentation of business processes, IT systems, and infrastructures in a desired state), Roadmap (the schedule of transformation steps to evolve into the to-be architecture), and EA principles (guidelines and rationales for the development and re-evaluation of the EA). Evaluating the quality of an As-Is Architecture, for instance, involves measuring *timeliness, completeness*, and *level of detail* of information provided about the architecture (see Supplementary Appendix A). Details about the identification process for all constructs and items is available in Lange (2012). Table 3 provides a summary of the identified construct dimensions for the identified EAM success factors and outcome metrics. Detailed definitions of all measurement items for each construct are provided in Supplementary Appendix A.

Research method

Measurement

We decided to examine our research model through a cross-sectional survey, which is the most common method in studies on basis of the DMSM model (Petter *et al*, 2008).

In developing a measurement instrument and designing the survey, we followed the process suggested by MacKenzie *et al* (2011). First, using the process described in the section 'Research model', we defined for each construct a conceptual definition, which aimed at thoroughly specifying the construct's conceptual domain and its conceptual theme. As summarized in Table 3, we identified for each success factor and measure a set of sub-constructs that detailed the conceptual definition of each factor and measure. Second, in operationalizing the constructs through measurement items, we followed Bagozzi & Phillips's (1982) recommendations for (a) gathering and adopting existing measurement items, or, if not available, (b) generating and revising measurement items that appropriately capture each construct.

Regarding (a), measurement items for the constructs use and satisfaction were adopted from existing measurements for intended continued use of systems (Bhattacherjee, 2001) and methods (Recker, 2010), and satisfaction with system use (Premkumar & Bhattacherjee, 2008), respectively. We operationalized EAM use as the intention to continue EAM use because access to actual usage of a management approach or method is virtually unattainable and continuance intentions have been shown to be valid predictors of actual usage behaviors (Venkatesh *et al*, 2011, 2012).

Regarding (b), we created measurement items for each construct dimension for all success factors (EAM product quality, EAM service delivery quality, EAM infrastructure quality, EAM organizational anchoring) and the EAM success measure 'EAM organizational and project benefits' on basis of the results of our conceptual model development process summarized in Table 3, ensuring that each indicator derived from the literature and the expert interviews was mapped to a measurement item. All item definitions are provided in Supplementary Appendix A.

Table 3 Operationalization of identified EAM success factors and success measures

EAM success factors			*EAM success measures*		
Construct	*ID*	*Construct dimensions*	*Construct*	*ID*	*Construct dimensions*
EAM Product Quality	PQ1	As-Is Architecture	EAM Organizational and Project Benefits	OB1	Organizational efficiency
	PQ2	To-Be Architecture		OB2	Organizational effectiveness
	PQ3	Roadmap		OB3	Organizational flexibility
	PQ4	EA Principles		PB1	Project efficiency benefits
EAM Infrastructure Quality	IQ1	EAM mandate		PB2	Project effectiveness benefits
	IQ2	Decision-making centralization		PB3	Project flexibility benefits
	IQ3	EAM governance formalization	Intention to Use EAM	Use1	Usage intention
	IQ4	EAM framework availability		Use2	Usage expectation
	IQ5	EAM tool support availability		Use3	Usage preference
	IQ6	EAM reference architecture availability		Use4	Usage decision
	IQ7	EAM principle establishment	User Satisfaction with EAM	Sat1	Contentedness with use
	IQ8	EAM skills availability		Sat2	Satisfaction with use
	IQ9	EAM resources availability		Sat3	Delightedness with use
EAM Service Delivery Quality	SQ1	EAM communication			
	SQ2	EAM management support			
	SQ3	EAM project support			
EAM Organizational Anchoring	OA1	EAM top management commitment			
	OA2	EAM awareness			
	OA3	EAM understanding			

We evaluated all candidate measurement items for content validity subsequently by using Hinkin & Tracey's (1999) panel rating approach using ANOVA (analysis of variance) to assess item differences. We conducted this assessment with eight post-graduate students who attended a course in EA. The *F*-statistics were significant between 7.2 and 38.1 and well above the critical *F* of 1.76. Content validity was further demonstrated, because the mean for the measurement item on the hypothesized construct was always higher than on other constructs (Yao *et al*, 2008).

Next, we implemented the measurement items using the Survey Monkey platform. The content and face validity of this survey was examined in a pre-test with 15 experts. These experts were selected with the aim to cover different levels of expertise to ensure an understanding of the formulation of the measurement items by a diverse population of interest (Anderson & Gerbing, 1981). We talked to five experts who were familiar with the model development from previous discussions, a further five experts who did not know the model but had expert knowledge in the area of EA, and five experts who had no specific knowledge of EA but were familiar with the information systems domain in general.

The web-based survey instrument then underwent a pilot test with 10 senior EAM practitioners representative of the target survey population. On the basis of this feedback, we made minor changes to the instrument and made the final survey available between August 2011 and February 2012.

Survey administration and data inspection

We targeted EAM stakeholders that contribute to or benefit from EAM. We therefore distributed the survey via the professional social network LinkedIn and its German equivalent XING to 42 relevant EAM user groups. We further invited 800 EAM stakeholders personally via mail and sent invitations to over 53 EAM forums such as the Association of Enterprise Architects. These invitations engaged 747 people to access the survey. Thereof, 311 participants (41.6%) started the survey, and 133 (42.8%) completed it.

As the survey was distributed to unconfined groups, an immediate response rate cannot be calculated. Therefore, we conducted a power analysis using the G*Power 3 software (Faul *et al*, 2007). Given the parameters of the survey design as discussed above, and with type-1 error probabilities set to $\alpha<0.05$, a sample size of $N=111$ was required to reach sufficient statistical power ($1-\beta$ error probability >0.95) for effect sizes of $f^2>0.30$ (moderate to large, see Cohen, 1988). This suggested our sample size is adequate.

We examined the data for possible non-response bias but did not find significant differences between the demographics of those who filled in the survey completely and those who stopped in between, nor between early and late respondents. The 133 complete responses come mainly from organizations in Europe (51.9%) and North America (24.1%). The major share of the participants works in the financial and insurance industry (24.1%), and in information, communication, entertainment, and recreation, respectively (25.6%). This relative dominance on these two industries is in line with previous studies (e.g., Foorthuis *et al*, 2010). Figure 2 summarizes the distribution of respondents by continent and industry.

Next, in addition to examining organizational demographics, we also examined the respondents' role in their respective organization. Since EAM is concerned with the 'restriction of design freedom' (Op't Land *et al*, 2009) regarding how an organization is set up, participants on different levels of the organization might perceive EAM and its success differently depending on whether they have advantages or disadvantages from these restrictions. As visualized in Figure 3, survey participants were distributed both between operational and executive positions as well as between IT and business positions, with the relative distributions on the surface being similar to the distribution of IT and business roles in general. This indicates that our sample sufficiently covered the range of different EAM stakeholders argued in the literature (Kluge *et al*, 2006), and also suggests that we had data available both from those respondents who benefit and those who do not benefit. Still, realizing that our sample comprised respondents from different organizational stakeholders, we explore the experience of EAM benefit realization from different stakeholder viewpoints in the section 'Stakeholder analysis' below.

As a final test, we assessed the data for normality by using a sample moment test of skewness and kurtosis statistics. This analysis confirmed that relevant thresholds (skewness<2 and kurtosis<7) were not exceeded (Stevens, 2001).

Measurement model analysis

To analyze the data, we used structural equation modeling (SEM) with the partial least squares (PLS) technique. PLS is

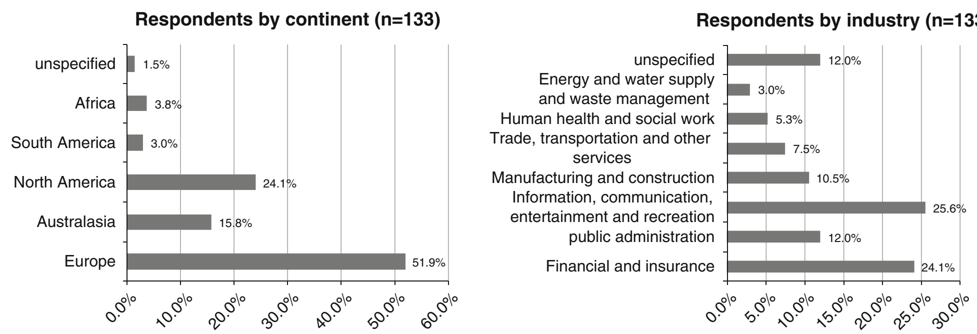

Figure 2 Overview of survey participant demographics.

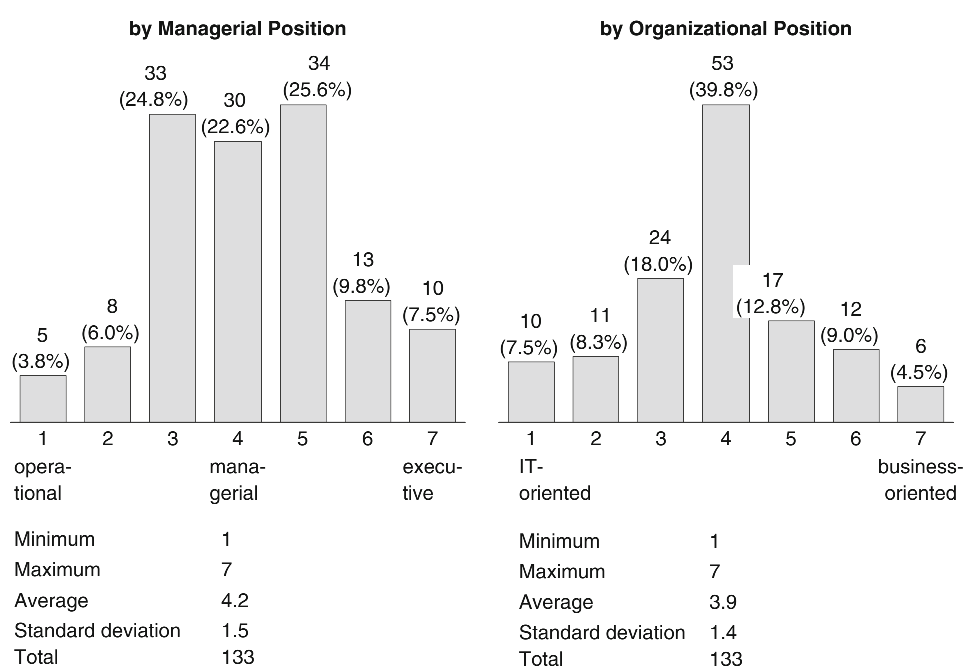

Figure 3 Overview of survey participants' orientation.

an appropriate method in this research to test our model as it is well suited for exploratory research endeavors and theory development such as our research (Marcoulides & Saunders, 2006). It is specifically appropriate for complex models with both formative and reflective indicators as was the case in our study (Chin, 1998; Hair *et al*, 2012). To conduct the PLS analysis, we used the WarpPLS 2.0 software with a configuration to conduct a maximum of 300 iterations and stopped when the sum of the outer weights' changes between two iterations was less than 10^{-5} (Kock, 2011).

First we evaluate the convergent validity, discriminant validity, and the consistency reliability first for all reflectively defined (see Table 4) and then for all formatively defined measurement items (see Table 5), because these two types require different kind of analyses and interpretations (MacKenzie *et al*, 2011). Detailed results from our analysis are reported in Supplementary Appendix B as referenced in Tables 4 and 5.

On the basis of these test results, we found that three constructs and seven measurement items were problematic. These are summarized in Table 6. Below, we discuss how we addressed these problems.

The reflective construct 'Intentions to Use EAM' did not exhibit expected reliability levels at the construct level, largely because measurement item 'Use4' did not display the necessary convergent validity. A likely reason is that the item Use4 measures the extent to which usage decisions were mandated, which often is found to be distinct from intentions (e.g., Brown *et al*, 2002). Therefore, we decided to remove the item 'Use4' from the construct. The remaining three items are still appropriate for use in measuring the 'Intentions to Use' construct (e.g., Bhattacherjee, 2001; Recker, 2010). Removing the measurement item 'Use4' improves the Cronbach's α coefficient from 0.79 to 0.87, in turn satisfying requirements for reliability and convergent validity (see Table 6).

The formative indicators 'PQ1e', 'PQ2e', and 'PQ3e' represent the as-is, to-be, and roadmap for the attribute 'available elsewhere' for EAM products. We added these measurement items during the construct definition process because they are also commonly measured in the context of the original DMSM. However, this measurement item was not identified in the literature review for our *a priori* model or during the expert interviews for the revised *a priori* model (Lange *et al*, 2012). It appears that the redundant availability of EAM information does not influence the success of EAM. Hence, we argue that these items can be removed without compromising the definition of the formative constructs. Removing these items also

Table 4 Overview of analysis for the outer model of reflective constructs

Test	*Threshold*	*Value range*	*Reference*	*Relevant literature*
Convergent validity				
Item loadings	0.6	0.61–0.98; except for Use4 (0.57)	Table B1	Fornell & Larcker (1981)
Construct composite reliability	0.8	0.87–0.97	Table B1	
Average variance extracted (AVE)	0.5	0.53–0.90	Table B1	
Discriminant validity				
Construct-level discriminant validity	Construct correlations exceed square roots of AVE	At least 0.3 difference	Table B2	Fornell & Larcker (1981)
Measurement-level discriminant validity	Loadings exceed cross-loadings	At least 0.3 difference	Table B3	Straub *et al* (2004)
consistency reliability				
Cronbach's α	0.8	0.94–0.96; except for Use (0.79)	Table B1	Cronbach & Meehl (1955)

Table 5 Overview of analysis for the outer model of formative constructs

Test	*Threshold*	*Value Range*	*Reference*	*Relevant literature*
Adequacy coefficient (R^2_a)	0.5	0.52–0.94	Table B1	Edwards (2001)
Path weights	0.5	Problematic: PQ1e, PQ2e, PQ3e, IQ2c, IQ3d, and IQ3e	Tables B4 and B5	Bollen & Lennox (1991); Centefelli & Bassellier (2009)
Indicator loadings	-	Problematic: PQ1e, PQ2e, PQ3e, IQ2c, IQ3d, and IQ3e	Tables B4 and B5	Centefelli & Bassellier (2009); MacKenzie *et al* (2011)
Variance inflation factor	10	1.09–4.36	Table B4 and B5	Mathieson *et al* (2001)

Table 6 Overview of identified issues with measurement items

Construct	Measure	Type of measure	Identified issue
Int. to Use	N/A	Reflective	Reliability: Cronbach's α 0.79 (below 0.8 threshold)
	Use4	Reflective	Convergent validity: Loading 0.57 (below 0.6 threshold)
PQ1	PQ1e	Formative	Construct validity: Loadings and weights low
PQ2	N/A	Formative	Discriminant validity: Square root AVE<construct correlations
	PQ2e	Formative	Construct validity: Loadings and weights low
PQ3	N/A	Formative	Discriminant validity: Square root AVE<construct correlations
	PQ3e	Formative	Construct validity: Loadings and weights low
IQ2	IQ2a	Formative	Construct validity: Loadings and weights low
	IQ2c	Formative	Construct validity: Loadings and weights low
IQ3	PQ3d	Formative	Construct validity: Loadings and weights low
	PQ3e	Formative	Construct validity: Loadings and weights low

resolves the issue with the discriminant validity of the constructs ‘PQ2’ and ‘PQ3’.

Similarly, the other two problematic indicators ‘IQ3d’ and ‘IQ3e’, which are concerned with ignoring or waiving EA principles, did not seem to have an impact. EA principles should conceptually have an impact, be it positive or negative, on EAM success in an organization because these are by definition key criteria that are used to evaluate the EA. However, our data could not confirm this relationship and indeed the results suggest that ignoring or waiving EA principles may indeed not be part of a measure of EA principles *per se* but rather of the actions or management decisions that are made in respect to such principles. Still, this interpretation is speculative and hence further analysis is required. A hypothesis for validation could be that, although EA principles are the guidelines to examine and re-evaluate an EA, temporarily waiving them might be sometimes required but may not impact success or indeed benefit realization in the long term. In conclusion, for this study, we argue that removing these items does not compromise the definition of the ‘IQ3’ construct.

Finally, the formative measurement items ‘IQ2a’, which indicates the centrality of capital budgets, and ‘IQ2c, which indicates the centrality of process improvement decisions, exhibited low factor loadings and weights. However, from the offset we believed that these aspects are important to the definition of the construct ‘extent of centralization’ and thus we first decided to retain but also closely observe these measures in the analyses that followed. MacKenzie *et al* (2011) argue that measurements should be retained if the construct definition will be compromised otherwise. Only if the variance inflation factors (VIF) is below 10, the loadings and weights are insignificant, and the construct definition will not be compromised should the measurement item be removed (MacKenzie *et al*, 2011). Otherwise, the measurement item should be further explored in the subsequent analysis (Centefelli & Bassellier, 2009). In our case, the measurement items ‘IQ2a’ and ‘IQ2c’ had VIF below 3. Because this is a much lower and more conservative threshold than, for example, the one recommended by Petter *et al* (2007), and because we indeed believe that the construct definition would be compromised, we opted to retain these measurement items at first. However, as we detail in the detailed model estimations and comparisons in Supplementary Appendix C, in the end the first order construct IQ2 was dropped due to measurement issues and a seven-item second order construct ’EAM infrastructure quality’ was retained (see also the relevant statistics in Supplementary Appendix B).

Structural model analysis

Having tested the reliability and validity of our measurement model and having eliminated problematic items, we proceeded to test the validity and explanatory power of the structural model. Because we already developed an *a priori* model, we employed confirmatory factor analysis (CFA) to assess the model fit (Straub *et al*, 2004). CFA requires one or more putative models proposing different sets of latent variables that may account for the covariance of a set of observed variables. We performed the analysis also with the WarpPLS 2.0 software (Kock, 2011).

Relaxing the assumption that there is only one model that fits the data and testing different variants prevents interpretational confounding (Evermann & Tate, 2011). Therefore, we explored multiple conceptualizations of EAM success factor and measures, based on findings from our literature review and expert interviews. Details about the conduct and results from the assessment of three different possible conceptual models are provided in Supplementary Appendix C.

Figure 4 shows the results of the structural model identified as the most appropriate conceptualization of EAM success. Six hypotheses in this model are significant, indicating the general viability of the suggested model as a means of explaining the EAM success factors and measures. On average, the model explained 50% of the variance in intentions to use EAM and 58% of the variance in EAM organizational and project benefits as the ultimate dependent variable in our model.

In our model, three constructs have a direct, significant impact on EAM organizational and project benefits. These constructs are ‘Intentions to use EAM’ ($\beta=0.27$), ‘EAM product quality’ ($\beta=0.22$), and ‘EAM cultural anchoring’

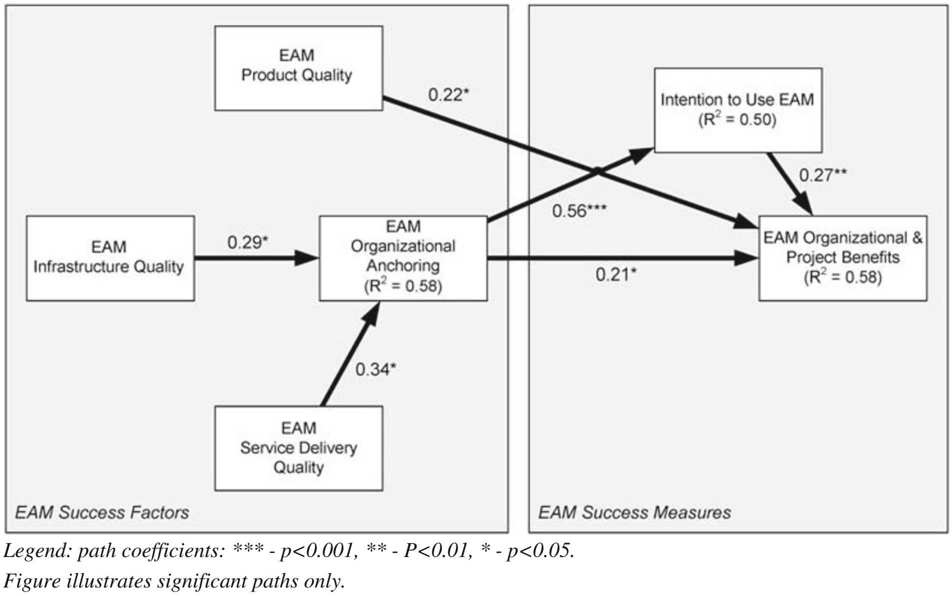

Figure 4 Validated model of EAM success factors and measures.
Notes: path coefficients: *** $P<0.001$, ** $P<0.01$, * $P<0.05$. Figure illustrates significant paths only.

Table 7 **Statistics for post-hoc analysis of perceived EAM benefits by stakeholder groups**

	Managerial positioning					*Organizational positioning*				
	Mean mana-gerial	*Mean opera-tional*	*Delta*	*F-value*	*P-value*	*Mean business*	*Mean IT*	*Delta*	*F-value*	*P-value*
OB1	0.05	−0.04	0.09	2.76	0.07	0.05	−0.09	0.14	0.58	0.45
OB2	0.07	−0.07	0.14	5.20	**0.01**	−0.01	0.03	−0.04	0.05	0.82
OB3	0.07	−0.07	0.14	4.18	**0.02**	−0.01	0.01	−0.02	0.01	0.92
PB1	0.18	−0.29	0.47	6.67	**0.002**	0.03	−0.06	0.10	0.29	0.59
PB2	0.16	−0.25	0.41	5.08	**0.01**	0.02	−0.03	0.05	0.07	0.78
PB3	0.18	−0.30	0.48	5.94	**0.003**	0.10	−0.18	0.28	2.37	0.12

($\beta=0.21$). The determinant of 'Intentions to use EAM' was 'EAM organizational anchoring', which fully mediated the influence of 'EAM infrastructure quality' ($\beta=0.29$) and 'EAM service delivery quality' ($\beta=0.34$) on 'Intentions to use EAM' ($\beta=0.56$) as well as 'EAM organizational and project benefits'.

Stakeholder analysis

Having analyzed EAM success factors and measures *in general*, we now examine differences in the perceptions of EAM success *by different EAM stakeholder groups*. As indicated in Figure 3, we gathered data on whether participants were in a managerial or an operational role, and whether they were working on the IT side or the business side of the business.

Perusing this data, we split respondents into a managerial *vs* operational group and into a business *vs* IT group, using a median split. On basis of this data, we then compared the variance in the total factors scores for the ultimate dependent variable in our research model, 'EAM organizational and project benefits', by means of a post-hoc MANOVA analysis. Results from these tests are summarized in Table 7.

The data in Table 7 presents some interesting insights into the differences to which organizational and project benefits from EAM use are perceived by different types of stakeholders. With respect to the managerial positioning of respondents, we found only non-significant differences in the perceived manifestation of some organizational benefits (OB1), which measured the improvement of an organizations efficiency resulting from EAM. However, perceptions of the remaining organizational benefits (OB2 and OB3) and the project-related benefits (PB1, PB2, and PB3) were significantly different between managerial- and operational-level respondents. In all these cases, managerial respondents evaluated operational and project benefits higher than their operational counterparts. This might indicate that depending on the position in the organization different sets of EAM benefits are emphasized as they are differently relevant to the position. For example, since EAM is concerned with the 'restriction of design freedom' (Dietz, 2007), it may be possible that the design restrictions pertain mostly to operational-level stakeholders, which may explain why these stakeholders do not take as positive a view on EAM benefits as their managerial counterparts.

Interestingly, the data in Table 7 indicates that business and IT stakeholders share largely congruent views on perceived EAM organizational and project benefits. This finding may suggest that indeed EAM is a suitable mechanism for business-IT alignment (Henderson & Venkatraman, 1999) as it literally 'bridges the views' and yields perceptions of benefits that are largely comparable across both groups.

In sum, our *post-hoc* analysis provides some support for the external validity of our success factor model. More interestingly, it also suggests that benefits (as one key measure of EAM success) appear to be perceived differently by some different stakeholder groups, an observation also made by Foorthuis *et al* (2010). This would suggest that whether and how benefits are realized by EAM stakeholders may vary depending on the type or position of stakeholder. This has implications for future research on EAM success and benefit realization from EAM, which we explore in the Section 'Implications' below.

Discussion

Our structural model analysis showed that six hypotheses embodied in our research model were supported by the data. EAM project and organizational benefits are dependent on EAM product quality, intentions to use EAM, and EAM organizational anchoring. The effects of organizational anchoring on EAM benefit realization were partially mediated by EAM use, as was expected. Intentions to use EAM, as the second key EAM success measure, were dependent on EAM organizational anchoring. Organizational anchoring, in turn, depended on EAM infrastructure quality and EAM service delivery quality. These results yield a number of significant findings that advance our understanding of how EAM can be successful for organizations. We explore these, in turn.

EAM organizational anchoring

A key tenet of our model and analysis is the central importance of EAM organizational anchoring in the establishment of EAM success. This success factor was found to strongly influence 'intentions to use EAM' ($\beta = 0.56$) and was also a key mediator for the two constructs 'EAM infrastructure quality' and 'EAM service delivery quality' on the variable 'EAM organizational and project benefits' ($\beta = 0.21$). Because the two constructs 'EAM infrastructure quality' and 'EAM service delivery quality' do not have a significant impact either directly on the 'EAM organizational and project benefits' or indirectly on 'intentions to use EAM', organizational anchoring appears to be central to the role of the EAM infrastructure and EAM service delivery in achieving EAM success.

Because strategic planning is fairly similar to EAM and indeed EAM is argued to be a key tool for strategic management of organization (Simon *et al*, 2014), we note that these findings share some similarities with those of Cleland & King (1974). These authors conclude from their research on strategic planning that the success of long-term planning is more sensitive to organizational anchoring than to the techniques employed. These findings are consistent with the findings of this research. The employed structures and techniques, which in our model are captured through 'EAM infrastructure quality', influenced EAM organizational anchoring but showed no direct effect on the success measures. Thus, the techniques employed in the domain of EAM are also subordinate to the organizational anchoring, which in turn influenced the EAM success measures.

Our findings are also consistent with Zink (2009). He presented a qualitative EAM study that highlights 'EAM understanding' and 'EAM leadership involvement' as central enablers of EAM success. In addition, organizational research findings show the central role of organizational anchoring in the realization of performance benefits (Lee & Yu, 2004) and indeed it clarifies anchoring as a mechanism to understand the role of culture and grounding in EAM (Weiss & Winter, 2012; Aier, 2014).

Intentions to use EAM

The role of the construct 'intentions to use EAM' is similar to that of the construct 'EAM organizational anchoring' in that both are central mediators in explaining the ultimate dependent variable, 'EAM organizational and project benefits'. One interpretation of this finding is that an organization may understand, plan, and manage an EA, but EAM only yields benefits if the organization actually implements the planned architecture and intends to continuously engage with EAM. Thus, the continued usage intentions are a necessary precondition for any benefits to accrue from EAM. The data confirms that perceptions or organizational and project benefits are elevated when respondents intended to continue to engage with EAM, thus suggesting future use plans and increased usage to be a key driver to increase the perceived value of EAM. This finding is also a confirmation of Schmidt & Buxmann (2011), who concluded that EAM stakeholder participation, which is one manifestation of continued use, is fundamental to the realization of (IT-specific) benefits from EAM. Consistent with their findings we found that increased willingness to engage more with EAM will lead to elevated beliefs that more benefits can be realized from EAM use.

EAM product quality

A key role emerged for the construct 'EAM product quality'. The analysis of our research model showed that this construct is the only success factor, aside from 'EAM organizational anchoring', that has a direct positive effect on 'EAM organizational and project benefits' – but not on intentions to use EAM. Our interpretation of these results is that EAM products, being communication vehicles that create transparency by providing information about the current and future architecture and the transformation roadmap, appear to plausibly yield immediate benefits. This is likely because organizational IT or business projects can use EAM products immediately for their project activities and hence reap benefits on the project-level such as an acceleration of project setup times, easier scoping, and efficient communication. Our data further suggests that the use of EAM products does not even require a deeper understanding of EAM (i.e., the quality of its infrastructure or its service delivery), or a strong organizational anchoring, to unfold the related EAM benefits.

Again we find that our results are congruent with earlier studies. Schmidt & Buxmann (2011), for instance, already found that EAM product quality has a positive, direct impact on the accrual of IT-specific benefits, albeit with a slightly lower impact size. They conclude that the relatively low impact could be due to the fact that EAM products primarily create informational transparency rather than impacting technology evolution in a regulatory manner. The authors further conclude that the impact is relatively low because firms that focus on EAM products alone do not substantially improve with respect to their EAM goals. Our findings would now suggest that indeed EAM products yield benefits on an organizational level that outweigh IT-specific benefits that can be accrued. This is an important extension to the findings by Schmidt & Buxmann (2011) because it (a) clarifies the role of EAM products in facilitating benefits outside of the IT unit, and (b) demonstrates that EAM products may have value for projects and entire organizations over and above any IT value or achievements (such as integration of efficiency gains).

EAM infrastructure quality and EAM service delivery quality

The next two EAM success factors, 'EAM infrastructure quality' and 'EAM service delivery quality' have no direct impact on the examined EAM success measures. Instead, they appear to be important determinants of 'EAM organizational anchoring', the focal construct in our success factor model. Importantly, unlike EAM products, infrastructure and service quality appear not to have an immediate role on benefits perceived from EAM. The findings suggest that without an understanding and an awareness of EAM, that is, an appropriate EAM organizational anchoring and actual use, neither the EAM infrastructure nor EAM service delivery will yield immediate benefits at the organizational or project level, and neither will they lead to continuous engagement with EAM. In contrast, EAM products can be employed on a project level without a deeper understanding of EAM. For example, EAM tool support could improve the efficiency of EAM processes but would not yield immediate organizational benefits on its own, nor could it be used on a project level without a deeper understanding of EAM. Therefore, 'EAM infrastructure quality' and 'EAM service delivery quality' appear to be hygiene factors that support a deep anchoring, which in turn will deliver EAM success in terms of continued engagement and the delivery of benefits. This interpretation suggests that quality of EAM infrastructure and service delivery need to be in place for EAM to operate, and their characteristics shape the EAM organizational anchoring, but their existence alone is not sufficient to ensure EAM benefits if they do neither contribute to organizational anchoring nor increased willingness to continue let alone extend EAM use.

Satisfaction

Finally, our data analysis suggested that satisfaction with EAM use does not contribute to the explanatory power of our model of EAM success factors and measures. Therefore, we can conclude that the 'EAM Satisfaction' construct, as hypothesized in the revised *a priori* model, does not seem to be a significant mediator for continued engagement with EAM or for the achievement of organizational and project benefits.

In a way, these results confirm logical sensemaking: Individual satisfaction with any management instrument in itself can hardly be an instrument to evaluate the success of such an instrument; and neither can individual satisfaction be a relevant precondition to the organizational willingness to continue managing this particular way, nor achieving value from such management (in the sense of realizing benefits from it). We further note that our findings are similar to those from other disciplines in which the DMSM has been used (e.g., Teo & Wong, 1998; Gable *et al*, 2008; Sedera & Gable, 2010). For example, Gable *et al* (2008) removed the satisfaction construct from their model to analyze information system impact because it added only insignificant explanatory power. They argue that pure satisfaction items do not reflect a distinct dimension of success but are rather just additional measures of overall success. Our results clarify that if the system being examined is a managerial rather than a technological instrument, then indeed individual satisfaction from its use yields no relevant success for the organization, whereas satisfaction with technological system use may in fact yield success, for instance, in terms of continued usage (Wixom & Todd, 2005) or performance on basis of that system (McGill *et al*, 2003).

Limitations

We see at least three potential sources of limitations that bound our interpretations and conclusions: the use of perceptual measures, the restricted survey sample, and the employed data analysis strategy.

The measurement instrument has been implemented using perceptual measures. The legitimacy of perceptual measures as a proxy for objective measures is still a matter for discussion in measuring success because it is possible that interviewees exaggerate their views and because the difficulty of evaluating organizational performance makes it difficult to accurately assess even value or benefits perceptions (Tallon *et al*, 2000).

However, because research indicates that there is a strong correlation between perceived firm-level performance and the results obtained using traditional objective measures (Venkatraman & Ramanujam, 1987) and because pragmatically the obtainment of objective success measures for intangible systems such as EAM in a cross-sectional study can be virtually unattainable, we acknowledge the associated potential for response bias and urge the reader to consider the data source when interpreting our findings. Still, perceptional data is an agreed way of measuring both success factors and measures (Bandara *et al*, 2005; Petter *et al*, 2008) and, especially in the emerging field of empirical EAM research, are an accepted way of measuring both factors determining and measuring success of EAM in organizations (Schmidt & Buxmann, 2011; Weiss *et al*, 2013; Aier, 2014).

The sample from our survey research also has some limitations. The preferred random sampling strategy for survey research could not be used because of the limited information available about the overall population of EAM stakeholders. This limitation may have restricted the generalizability and robustness of the results. However, by transparently discussing the resulting statistics and comparing them with those presented in earlier research, we tried to describe and validate the representativeness of the sample as extensively as possible. We also sourced our data exclusively through online EAM communities and key network contacts, which in turn suggests our population to consist of appropriate respondents and key informants.

Further, for our data analysis we chose PLS because of its appropriateness complex research models including formative and reflective multi-level constructs (Chin, 1998; Hair *et al*, 2012). Yet, the relative merits and weaknesses of PLS are still being debated (Ringle *et al*, 2012). For instance, using a PLS approach instead of a covariance-based SEM approach may inflate the indicator loadings and weights (Diamantopoulos, 2011). This potential inflation needs to be considered when interpreting the results, and we invite other researchers to examine the data with other approaches, such as covariance-based methods.

Finally, we noted a number of measurement issues that emerged from our data analysis. Notably, the measurements for the first-order construct 'decision-making centralization' (IQ2) had to be dropped. As this measurement item did not show stable statistical properties, this either indicates that the centrality of the decision-making in the context of EAM has no impact on the outcomes or might indicate that the measurement items in our model did not properly measure the intended construct. Although some studies show that, for example, centralized architecture data has a positive impact on benefits (Aier *et al*, 2011), this needs to be addressed by future research in detail investigating how different decision-making setups influence EAM success. Overall, our research adds to the emerging inventory of validated EAM-specific measurement instruments (Schmidt & Buxmann, 2011; Weiss *et al*, 2013; Aier, 2014).

Implications

For future research on EAM

Our empirical analysis of critical success factors and measures have implications for (a) EAM success factor research, (b) our understanding of EAM in practice, and (c) IS success research. We explore these, in turn.

First, regarding the emerging empirical understanding of EAM (see Table 2), our empirical analysis yielded a first conceptual model of critical success factors and measures of EAM on an *organizational* and *project* level. We used cross-sectional data from global EAM practitioners to validate our model. This was an appropriate data set for us to examine EAM success factors and measures across multiple projects, organizational, national contexts and as perceived by different stakeholder groups. The broad nature of the collected data used for analysis, however, also suggests several avenues for further deep examination of our model. For example, a subsequent study could collect *longitudinal* data from EAM practitioners within one organization to examine how success – or the realization of benefits specifically – from EAM evolves over time, for example, across different IT implementation project stages from initiation to deployment or operation or a large-scale system (Cotteleer & Bendoly, 2006). Such data could be used to examine or develop a *process* theory of benefits realization. Also, future research could examine one organizational network in more depth, to study success factors and measures relevant to EAM suppliers or providers on the one hand and EAM clients or consumers on the other hand. Data that would allow to separate vendors or providers of EAM from their clients or consumers would allow studying the overlap or dichotomies between success factors or relevant success metrics, or the different motivations or ambitions to realize value, benefits, or other indicators of success between these groups, as well as the potential for co-creating success (Payne *et al*, 2008). Such research would not only add substantially to our understanding of successful EAM and the role of stakeholder groups therein (Kluge *et al*, 2006) but also would contribute to the emerging body of research on value co-creation in IT contexts (e.g., Vlaar *et al*, 2008; Sarker *et al*, 2012).

For future research on EAM success specifically, our work adds an important extension to the growing body of empirical work. We focused in our evaluation of EAM success mainly on impacts that accrue on project and organizational levels, as evaluated by stakeholders from across the two relevant domains of EAM: business and IT (Aier & Winter, 2009). This is an important addition to other success factor research on EAM (Schmidt & Buxmann, 2011), as visualized in Figure 5. The visualization also develops suggestions for further expansion of the body of knowledge, in two ways: first, to examine success factors and measures on the *individual* level, for example, how EAM success translates to business or IT impact for

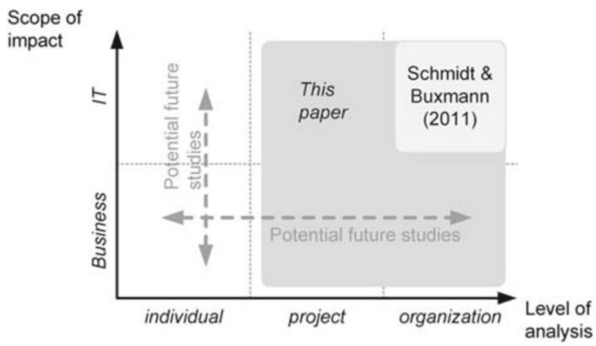

Figure 5 Existing and potential future studies of EAM success.

lead personnel such as chief architects, or indeed C-level executives, who broadly and consistently, are faced with architectural concerns (Luftman & Zadeh, 2011). Second, to examine whether impact, value, or benefits as well as relevant success factors migrate or change when being examined across all relevant levels, viz., individual (e.g., architects and end users), projects (e.g., business and IT projects) and organizations.

Second, regarding our understanding of EAM use by organizations, the findings from our research suggest a central role of an EAM organizational anchoring in EAM use and the achievement of benefits from it. Our definition of anchoring is similar to existing conceptualizations of grounding and culture in relation to EAM (Weiss & Winter, 2012; Aier, 2014), and future research should now proceed to establish conceptual boundaries between these concepts, and also explore different antecedents and consequences from EAM organizational anchoring. Specifically, we identify research streams both for behavioral science research and for design science research on EAM. In behavioral science research on EAM, existing theoretical empirical models (e.g., Schmidt & Buxmann, 2011), to the best of our knowledge, do not include EAM organizational anchoring. However, the findings from the present study suggest that EAM organizational anchoring plays a central role in EAM use and the consequences thereof. Including EAM organizational anchoring in these models, either as a mediator or an independent variable, could improve their explanatory power. For design science research on EAM, future research could explore how anchoring as a mechanism could be embedded in the development of EAM processes, EAM products, and EAM governance (Aier *et al*, 2011). Having indicated the importance of both EAM organizational anchoring and EAM use, the findings from this research suggest that these aspects should also be incorporated into design research to increase the eventual acceptance of the designed artifacts, and also to examine its role in improving effectiveness and efficiency and other key success metrics.

Furthermore, our *post-hoc* stakeholder analysis showed that the perception of benefits from EAM are roughly identical for business and IT stakeholders, in turn suggesting that EAM may have a pivotal role in integrating these two viewpoints. Still, more research could examine the different viewpoints across business and IT stakeholder groups in more detail, for instance, focusing on the configurations in which alignment between the views – and the achievement of success such as benefits, effectiveness, or efficiency gains – is maintained. An important extension to our research would be, for example, to investigate the determinants that lead to acceptance of EAM across the different stakeholder groups. While our work indicates the importance of organizational anchoring of EAM, the factors that lead to an acceptance of EAM in an organization – or indeed across business and IT camps – are yet to be fully understood.

We also found that perceptions of EAM benefits specifically vary by organizational level. Our sample size restricted the possibility of analysis to a between-groups examination between managerial and operational-level respondents, which showed significant differences. These findings suggest that benefit realization, as one key process by which organizations capitalize on success from its systems (Petter *et al*, 2012), may follow different paths on different organizational levels. The move from a model of the *variance* in success (as done in this study) to a model of the *process* through which success leads to the realization of benefits is therefore an important future research avenue to understand and proactively guide benefits management for EAM practitioners (Ward *et al*, 1996). Our findings on determinants of EAM project and organizational benefits and their determinants, together with the existing findings on IT-level benefits and their determinants (Schmidt & Buxmann, 2011) therefore provide fertile empirical ground for theorizing EAM benefit realization process models.

Our findings also clearly point to a need for further research on EAM success factors and measures. In particular, given the noted differences in evaluations by different stakeholder positions, we believe that a suitable future research strategy could involve multi-level research (Sun & Bhattacherjee, 2011) to examine which mechanisms explain differences in success factors as well as success measures that are palpable to EAM cohorts situated on different organizational levels, as well as between and across project and organizational levels. Appropriate starting points for such investigations could be models for cross-level linkages such as those described by Goodman (2000) and Burton-Jones & Gallivan (2007), and as used in multi-level studies of technology use (e.g., Sun & Bhattacherjee, 2011). Future research with a more differentiated and expanded dataset could proceed to examine, for example, whether the identified EAM success factors (such as product quality and anchoring) vary for benefits as a success measure that *only* accrue on a project level (as opposed to an organizational level) or not. An extended measurement model, on the other hand, could include measures for the perceived design freedom of EAM stakeholders. Such research could then extend our conceptualization toward a two-stage model that differentiates determinants and outcomes on an EA project level from those success factors and measures that are realized on an organizational level.

Furthermore, our study was conducted on the basis of perceptual measures. While this is a commonly accepted approach to study success factor models, the perception of success may deviate from measures of the actual value achieved. Several studies in related areas exist that may be used to conceptualize value generation or return-on-investment into EAM. For example, Seddon *et al* (2010) estimated organizational benefits from Enterprise Systems implementations by reviewing management presentations released after the implementations. Similarly, project review data might be perused to examine how EAM contributed to projects in which EAM constituted a key practice. Alternatively, studies could examine organizational performance data (e.g., shareholder value) prior and post EAM implementation or deployment, and other work could review whether intentions to continue to use EAM, over time, really translate to continuous engagement and ultimately benefits from EAM use.

Third, regarding IS success research, implications are at least threefold. First, our empirical results suggest that the DMSM may also be applied to examine success factors and measures from the use not only of technology-based systems (such as traditional information systems), but also of management systems such as EAM. Our findings corroborate earlier work that examined DMSM in the context of other management instruments such as process modeling (Bandara & Rosemann, 2005) or knowledge management (Kulkarni *et al*, 2007). Second, our research has identified the central role of organizational anchoring as the core linkage between success factors and success measures. These findings suggest that organizational anchoring has an influence on the success of management systems that is not fully captured in the original DMSM. Although other existing IS success models do not include organizational anchoring either as having a direct influence or as a mediator, some scholars have suggested that related factors such as social, people, or cultural issues should be included in IS success research (Seddon, 1997; Claver *et al*, 2001; Petter *et al*, 2013). Third, the findings from our research provide more clarification about the 'intentions to use' in IS success research (Petter *et al*, 2008, p. 241). In our research, the DMSM has been adapted and instantiated to measure *organizational benefits* and *intended use of a subgroup of people within an organization*: the EAM stakeholders. Given this context, planned future use was found to be an important success measure – indicating continuous engagement – as well as a determinant for benefit achievement. Consequently, these findings suggest that usage intention is an important concept in understanding success – at least in the EAM context: Although the use of EAM by a subgroup of an organization, the EAM stakeholders, provides direct benefits for this subgroup, the majority of the resulting benefits accrue to the organization as a whole. Hence, the congruence of the benefits and use is limited. However, EAM benefits on the organizational level can only be achieved in the long run through sustained and increased EAM use. Consequently, intentions to use are an important determinant as well as indicator of success.

For the management of EAs

The findings from this research provide practitioners and experts with important insight into relevant factors that facilitate EAM success. These findings can inform organizations about how to approach EAM so as to improve the value it can generate and the momentum it can sustain. This research has highlighted a number of important factors that must be considered to ensure successful EAM. The findings of this research yield three directly actionable recommendations for improving EAM success:

(1) Do not focus your EAM on techniques and model intensively your organization in an ivory tower; instead go into your projects and be a role model for conducting good EAM to shape your EAM organizational anchoring proactively.
(2) Focus your EAM on people rather than on processes and formalizations. Organizational anchoring of EAM begins in people's minds and is not created by enforced guidelines and rules. This approach will ultimately yield the required use of EAM in organizational project activities and the expected benefits. To develop appropriate organizational anchoring, organizations should develop the appropriate setup for their EAM infrastructure and EAM service delivery that suits their overall organizational anchoring.
(3) Make sure EAM products and services are being used. Our results confirm a belief that we have formed through practical experience: many companies get stuck with documentation, which often leads to EA initiatives dying out. Approaching EAM with a customer-oriented focus toward its stakeholders, and ensuring that relevant products and services are being actively put to use has to be considered right from the start.

Second, the developed measurement instrument for EAM success factors and measures provides a starting point for EAM practitioners to measure the degree to which firm-level EAM is successful in their organization. This ability not only ensures a transparent view of the current state of EAM success in general, but also allows for measurement of perceptions of EAM benefits on an organizational and project level specifically. This also could be used to track benefits over time. Of course, the measurement model provides a one-dimensional view on success without providing an assessment tool to evaluate costs and investments; however, the literature provides other frameworks that can be used to that end, and in complement to the instrument we developed and validated (e.g., Boucharas *et al*, 2010b; Weiss *et al*, 2013).

For the design of EAs

Our findings about EAM success factors and measures also allow us to propose a number of tentative design principles

Table 8 Summary of key contributions

Key contribution	*Implications for research*	*Implications for practice*
A theoretically developed and empirically validated model of EAM success factors and measures	Provides a foundation for further research on EAM success and measures on different levels of analysis and across different cohorts and units	Can be used to gain an understanding of the drivers and key metrics of EAM success and value potential for an organization
A rigorously developed and tested measurement instrument	Adds to the growing inventory of measurement instruments in the substantive context of EAM research, and provides a basis to integrate, compare, and extend the empirical body of knowledge	Can be used as an intra- or inter-organizational assessment tool to quantify return-on-investment, to understand value creation over time, or to benchmark against best practices
Clarification of the role of organizational anchoring in enabling successful EAM	Develops an understanding of anchoring as a focal concept in linking success factors to success measures relevant to management systems	Highlights key social and cultural responsibilities and requirements in making EAM an effective management system

for EAs based on the insights we derived how EAM can be successful. Specifically, we suggest four broad EAM design principles.

Principle 1 – establish an EAM infrastructure Our study shows that an EAM infrastructure of good quality needs to be established. This requires a substantial commitment of the organization and the provision of funding to set up this infrastructure. Management support is needed to succeed with this task. As an expert stated in our interviews: *With the new CIO the commitment to and investment in EAM significantly changed – and with this also its long-term impact.*

Principle 2 – create stakeholder awareness Awareness is needed before organizational anchoring can be established. Relevant stakeholder and local champions should be activated and their involvement needs to be secured and fostered. This is essential for making EAM a vital part of the management system of the organization. An expert during our interviews supported this view: *Since we have established transparency about everybody's involvement, the activity level went up significantly.*

Principle 3 – provide EA products and services of high quality Once infrastructure is in place and awareness has been created, EAM has to live up to its promise and provide high quality products and services. Our model emphasizes that service delivery and infrastructure are foundational pillars of anchoring. EAM products that are of high quality, among others in terms of correctness and completeness, are the basis for value creation. As one respondent put it: *We prove the value of EAM positioning our architects directly in project teams and having the project managers evaluating their value regularly*. This statement shows that regular evaluations and tight controlling can be important mechanisms to ensure provision of high quality services.

Principle 4 – secure stakeholder commitment Finally, EAM needs to be installed as a hub in the overall management processes of the organization. Continuous commitment to the usage of EAM helps achieving success and contributes to ongoing value creation in the future. An expert from the financial industry described this as follows: *EAM is a long-term investment – hence we are part of all significant IT change programs in our organization.*

Conclusions

The model developed in this study is an extension and continuation of research on EAM success. Overall, we contribute to the existing body of knowledge on this subject by compiling EAM success factors from the literature and from practical observation and by using this collection of factors to develop and validate the success factor model. Table 8 summarizes key research contributions and emerging implications.

In turn, our research advances our theoretical and empirical understanding of successful EAM, which will provide industry and academia with a more accurate and realistic view of the successful use of these key design vehicles in strategic planning, alignment, implementation and IT-enabled business transformation projects.

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References

Aier S (2014) The role of organizational culture for grounding, management, guidance and effectiveness of enterprise architecture principles. *Information Systems and e-Business Management* **12**(**1**), 43–70.

Aier S, Gleichauf B and Winter R (2011) *Understanding Enterprise Architecture Management Design – An Empirical Analysis. 10th International Conference Wirtschaftsinformatik*. Association for Information Systems, Zurich, Switzerland.

Aier S and Winter R (2009) Virtual decoupling for IT/Business alignment – conceptual foundations, architecture design and implementation example. *Business & Information Systems Engineering* **1**(**2**), 150–163.

Anderson JC and Gerbing DW (1981) Predicting the performance of measures in a confirmatory factor analysis with a pretest assessment of their substantive validities. *Journal of Applied Psychology* **76**(**5**), 732–740.

Anderson JC and Gerbing DW (1988) Structural equation modeling in practice: a review and recommended two-step approach. *Psychological Bulletin* **103**(**3**), 411–423.

Bagozzi RP and Phillips LW (1982) Representing and testing organizational theories: a holistic construal. *Administrative Science Quarterly* **27**(**3**), 459–489.

Ballantine J, Bonner M, Levy M, Martin A, Munro I and Powell P (1996) The 3-D model of information systems success: the search for the dependent variable continues. *Information Resources Management Journal* **9**(**4**), 5–15.

Bandara W (2006) Using Nvivo as a research management tool: a case narrative. In *3rd International Conference on Qualitative Research in IT and IT in Qualitative Research* (Ruth A, Ed), pp 6–19, Institute for Integrated and Intelligent Systems, Brisbane, Australia.

Bandara W, Gable GG and Rosemann M (2005) Factors and measures of business process modelling: model building through a multiple case study. *European Journal of Information Systems* **14**(**4**), 347–360.

Bandara W and Rosemann M (2005) What are the secrets of successful process modeling? Insights from an australian case study. *Systèmes d'Information et Management* **10**(**3**), 47–68.

Bean S (2010) Re-thinking enterprise architecture using systems and complexity approaches. *Journal of Enterprise Architecture* **6**(**4**), 7–13.

Bhattacherjee A (2001) Understanding information systems continuance: an expectation-confirmation model. *MIS Quarterly* **25**(**3**), 351–370.

Boh WF and Yellin D (2007) Using enterprise architecture standards in managing information technology. *Journal of Management Information Systems* **23**(**3**), 163–207.

Bollen KA and Lennox R (1991) Conventional wisdom on measurement: a structural equation perspective. *Psychological Bulletin* **110**(**2**), 305–314.

Boucharas V, van Steenbergen M, Jansen S and Brinkkemper S (2010a) The contribution of enterprise architecture to the achievement of organizational goals: a review of the evidence. In *Trends in Enterprise Architecture Research – TEAR2010* (Proper E, Lankhorst MM, Schönherr M, Barjis J and Overbeek S, Eds), pp 1–15, Springer, Delft, the Netherlands.

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

Brown SA, Massey AP, Montoya-Weiss MM and Burkman JR (2002) Do I really have to? User acceptance of mandated technology. *European Journal of Information Systems* **11**(**4**), 283–295.

Bruls WAG, van Steenbergen M, Foorthuis RM, Bos R and Brinkkemper S (2010) Domain architectures as an instrument to refine enterprise architecture. *Communications of the Association for Information Systems* **27**(**27**), 517–540.

Burton-Jones A and Gallivan MJ (2007) Toward a deeper understanding of system usage in organizations: a multilevel perspective. *MIS Quarterly* **31**(**4**), 657–679.

Centefelli RT and Bassellier G (2009) Interpretation of formative measurement in information systems research. *MIS Quarterly* **33**(**4**), 689–708.

Chin WW (1998) The partial least squares approach to structural equation modeling. In *Modern Methods for Business Research* (Marcoulides GA, Ed), pp 295–336, Lawrence Erlbaum Associates, Mahwah, NJ.

Claver E, Llopis J, González MR and Gascó JL (2001) The performance of information systems through organizational culture. *Information Technology & People* **14**(**3**), 247–260.

Cleland DI and King WR (1974) Developing a planning culture for more effective strategic planning. *Long Range Planning* **7**(**3**), 70–74.

Cohen J (1988) *Statistical Power Analysis for the Behavioral Sciences*. Lawrence Erlbaum Associates, Hillsdale, NJ.

Cotteleer MJ and Bendoly E (2006) Order lead-time improvement following enterprise information technology implementation: an empirical study. *MIS Quarterly* **30**(**3**), 643–660.

Cronbach LJ and Meehl PE (1955) Construct validity in psychological tests. *Psychological Bulletin* **52**(**4**), 281–302.

DeLone WH and McLean ER (1992) Information systems success: the quest for the dependent variable. *Information Systems Research* **3**(**1**), 60–95.

DeLone WH and McLean ER (2003) The delone and McLean model of information systems success: a ten-year update. *Journal of Management Information Systems* **19**(**4**), 9–30.

DeLone WH and McLean ER (2004) Measuring e-commerce success: applying the DeLone & McLean information systems success model. *International Journal of Electronic Commerce* **9**(**1**), 31–47.

Diamantopoulos A (2011) Incorporating formative measures into covariance-based structural equation models. *MIS Quarterly* **35**(**2**), 335–358.

Dietz JLG (2007) *Architecture: Building Strategy into Design*. Academic Service, the Hague, the Netherlands.

Edwards JR (2001) Multidimensional constructs in organizational behavior research: an integrative analytical framework. *Organizational Research Methods* **4**(**2**), 144–192.

Evermann J and Tate M (2011) Fitting covariance models for theory generation. *Journal of the Association for Information Systems* **12**(**9**), 632–661.

Eversole J and Barr RC (Eds.) (2003) *The Fire Chief's Handbook*. PennWell, Tulsa, OK.

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

Foorthuis RM, Hofman F, Brinkkemper S and Bos R (2012) Compliance assessments of projects adhering to enterprise architecture. *Journal of Database Management* **23**(**2**), 44–71.

Foorthuis RM, van Steenbergen M, Mushkudiani N, Bruls WAG, Brinkkemper S and Bos R (2010) On course, but not there yet: enterprise architecture conformance and benefits in systems development. 31st International Conference on Information Systems, Assocation for Information Systems, St. Louis, Missouri.

Fornell C and Larcker DF (1981) Evaluating structural equations with unobservable variables and measurement error. *Journal of Marketing Research* **18**(**1**), 39–50.

Gable GG, Sedera D and Chan T (2008) Re-conceptualizing information system Success: the IS-impact measurement model. *Journal of the Association for Information Systems* **9**(**7**), 377–408.

Gefen D, Straub DW and Boudreau M-C (2000) Structural equation modeling and regression: guidelines for research practice. *Communications of the Association for Information Systems* **4**(**7**), 1–77.

Goodman PS (2000) *Missing Organizational Linkages: Tools for Cross-Level Research*. Sage Publications, Thousand Oaks, CA.

Hair JF, Sarstedt M, Ringle CM and Mena JA (2012) An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science* **40**(**3**), 414–433.

Henderson JC and Venkatraman N (1999) Strategic alignment: leveraging information technology for transforming organizations. *IBM Systems Journal* **38**(**2–3**), 472–484.

Hinkin TR and Tracey JB (1999) An analysis of variance approach to content validation. *Organizational Research Methods* **2**(**2**), 175–186.
Hoerl R and Snee RD (2012) *Statistical Thinking: Improving Business Performance*. John Wiley & Sons, Hoboken, NJ.
Jasperson J, Carter PE and Zmud RW (2005) A comprehensive conceptualization of post-adoptive behaviors associated with information technology enabled work systems. *MIS Quarterly* **29**(**3**), 525–557.
Kaisler SH, Armour F and Valivullah M (2005) Enterprise architecting: critical problems. *38th Annual Hawaii International Conference on System Sciences*, IEEE, Big Island, Hawaii, p 224b.
Klein HK and Myers MD (1999) A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly* **23**(**1**), 67–94.
Kluge C, Dietzsch A and Rosemann M (2006) How to realise corporate value from enterprise architecture. *14th European Conference on Information Systems,* Association for Information Systems, Goeteborg, Sweden, pp 1572–1581.
Kock N (2011) *WarpPLS 2.0 User Manual*. ScriptWarp Systems, Laredo, TX.
Kock N and Lynn GS (2012) Lateral collinearity and misleading results in variance-based SEM: an illustration and recommendations. *Journal of the Association for Information Systems* **13**(**7**), 546–580.
Kulkarni UR, Ravindran S and Freeze R (2007) A knowledge management success model: theoretical development and empirical validation. *Journal of Management Information Systems* **23**(**3**), 309–347.
Lange M (2012) *Evaluating the Realization of Benefits from Enterprise Architecture Management*. Humboldt University Berlin, Berlin, Germany.
Lange M, Mendling J and Recker J (2012) Measuring the realization of benefits from enterprise architecture management. *Journal of Enterprise Architecture* **8**(**2**), 30–44.
Lee SKJ and Yu K (2004) Corporate culture and organizational performance. *Journal of Managerial Psychology* **19**(**4**), 340–359.
Löhe J and Legner C (2014) Overcoming implementation challenges in Enterprise Architecture Management: a design theory for architecture-driven IT management (ADRIMA). *Information Systems and e-Business Management* **12**(**1**), 101–137.
Luftman J and Zadeh HS (2011) Key information technology and management issues 2010–11: an international study. *Journal of Information Technology* **26**(**3**), 193–204.
MacKenzie KD and House R (1978) Paradigm development in the social sciences: a proposed research strategy. *Academy of Management Review* **3**(**1**), 7–23.
MacKenzie SB, Podsakoff PM and Podsakoff NP (2011) Construct measurement and validation procedures in MIS and behavioral research: integrating new and existing techniques. *MIS Quarterly* **35**(**2**), 293–334.
Magalhaes R, Zacarias M and Tribolet J (2007) Making sense of enterprise architectures as tools of organizational self-awareness. *Journal of Enterprise Architecture* **3**(**4**), 61–69.
Marcoulides GA and Saunders C (2006) Editor's comments: PLS: a silver bullet? *MIS Quarterly* **30**(**2**), iii–ix.
Mathieson K, Peacock E and Chin WW (2001) Extending the technology acceptance model: the influence of perceived user resources. *ACM SIGMIS Database* **32**(**3**), 86–112.
McGill T, Hobbs V and Klobas J (2003) User developed applications and information systems success: a test of DeLone and McLean's model. *Information Resources Management Journal* **16**(**1**), 24–45.
Morganwalp JM and Sage AP (2004) Enterprise architecture measures of effectiveness. *International Journal of Technology, Policy and Management* **4**(**1**), 81–94.
Niemann KD (2006) *From Enterprise Architecture to IT Governance: Elements of Effective IT Management*. Vieweg, Wiesbaden, Germany.
Niemi E and Pekkola S (2009) Adapting the DeLone and McLean Model for the Enterprise Architecture Benefit Realization Process. *42nd Hawaii International Conference on System Sciences*, IEEE, Waikoloa, Big Island.
Op't Land M, Proper E, Waage M, Cloo J and Steghuis C (2009) *Enterprise Architecture: Creating Value by Informed Governance*. Springer, Berlin, Germany.
Payne AF, Storbacka K and Frow P (2008) Managing the co-creation of value. *Journal of the Academy of Marketing Science* **36**(**1**), 83–96.
Petter S, DeLone WH and McLean ER (2008) Measuring information systems success: models, dimensions, measures, and interrelationships. *European Journal of Information Systems* **17**(**3**), 236–263.
Petter S, DeLone WH and McLean ER (2012) The past, present, and future of ,'IS success'. *Journal of the Association for Information Systems* **13**(**5**), 341–362.
Petter S, DeLone WH and McLean ER (2013) Information systems success: the quest for the independent variables. *Journal of Management Information Systems* **29**(**4**), 7–62.
Petter S and McLean ER (2009) A meta-analytic assessment of the DeLone and McLean IS success model: an examination of IS Success at the individual level. *Information & Management* **46**(**3**), 159–166.
Petter S, Straub DW and Rai A (2007) Specifying formative constructs in IS research. *MIS Quarterly* **31**(**4**), 623–656.
Premkumar G and Bhattacherjee A (2008) Explaining information systems usage: a test of competing models. *Omega* **36**(**1**), 64–75.
Recker J (2010) Continued use of process modeling grammars: the impact of individual difference factors. *European Journal of Information Systems* **19**(**1**), 76–92.
Richardson GL, Jackson BM and Dickson GW (1990) A principles-based enterprise architecture: lessons from texaco and star enterprise. *MIS Quarterly* **14**(**4**), 385–403.
Ringle CM, Sarstedt M and Straub DW (2012) Editor's comments: a critical look at the use of PLS-SEM in MIS quarterly. *MIS Quarterly* **36**(**1**), iii–xiv.
Rodrigues LS and Amaral L (2010) Issues in enterprise architecture value. *Journal of Enterprise Architecture* **6**(**4**), 27–32.
Ross JW, Weill P and Robertson D (2009) *Enterprise Architecture As Strategy: Creating a Foundation for Business Execution*. Harvard School Press, Boston, Massachusetts.
Salmans B and Kappelmann LA (2010) The state of EA: progress, not perfection. *In The SIM Guide to Enterprise Architecture* (Kappelmann LA, Ed), pp 165–187, CRC Press, New York.
Sarker S, Sarker S, Sahaym A and Bjørn-Anderson N (2012) Exploring value cocreation in relationships between an ERP vendor and its partners: a revelatory case study. *MIS Quarterly* **36**(**1**), 317–338.
Schmidt C and 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.
Seddon PB (1997) A respecification of the DeLone and McLean Model of IS success. *Information Systems Research* **8**(**3**), 240–253.
Seddon PB, Calvert C and Yang S (2010) A multi-year model of key factors affecting organizational benefits from enterprise systems. *MIS Quarterly* **34**(**2**), 305–328.
Sedera D and Gable GG (2010) Knowledge management competence for enterprise system success. *Journal of Strategic Information Systems* **19**(**4**), 296–306.
Simon D, Fischbach K and Schoder D (2013) An exploration of enterprise architecture research. *Communications of the Association for Information Systems* **32**(**1**), 1–72.
Simon D, Fischbach K and Schoder D (2014) Enterprise Architecture Management and its role in corporate strategic management. *Information Systems and e-Business Management* **12**(**1**), 5–42.
Smolander K, Rossi M and Purao S (2008) Software architectures: blueprint, literature. *Language or Decision? European Journal of Information Systems* **17**(**6**), 575–588.
Stevens JP (2001) *Applied Multivariate Statistics for the Social Sciences*. Lawrence Erlbaum Associates, Hillsdale, NJ.
Straub DW, Boudreau M-C and Gefen D (2004) Validation guidelines for is positivist research. *Communications of the Association for Information Systems* **13**(**24**), 380–427.
Sun Y and Bhattacherjee A (2011) Multi-level analysis in information systems research: the case of enterprise resource planning system usage in China. *Enterprise Information Systems* **5**(**4**), 469–494.
Tallon PP, Kraemer KL and Gurbaxani V (2000) Executives' perceptions of the business value of information technology: a process-oriented approach. *Journal of Management Information Systems* **16**(**4**), 145–173.
Tamm T, Seddon PB, Shanks G and Reynolds P (2011) How does enterprise architecture add value to organisations? *Communications of the Association for Information Systems* **28**(**10**), 141–168.
Teo TSH and Wong PK (1998) An empirical study of the performance impact of computerization in the retail industry. *Omega* **16**(**5**), 611–621.
Tenenhaus M, Vinzi VE, Chatelin Y-M and Lauro C (2005) PLS path modeling. *Computational Statistics and Data Analysis* **48**(**1**), 159–205.

The Open Group (2009) *TOGAF Version 9 Enterprise Edition*. Van Haren Publishing, Zaltbommel, the Netherlands.

Tversky A and Kahneman D (1974) Judgment under uncertainty: heuristics and biases. *Science* **185**(**4157**), 1124–1131.

Venkatesh V, Thong JYL, Chan FKY, Hu PJ and Brown SA (2011) Extending the two-stage information systems continuance model: incorporating UTAUT predictors and the role of context. *Information Systems Journal* **21**(**6**), 527–555.

Venkatesh V, Thong JYL and Xu X (2012) Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Quarterly* **36**(**1**), 157–178.

Venkatraman N and Ramanujam R (1987) Measurement of business economic performance: an examination of method convergence. *Journal of Management* **13**(**1**), 109–122.

Vlaar PWL, Van Fenema PC and Tiwari V (2008) Cocreating understanding and value in distributed work: how members of onsite and offshore vendor teams give, make, demand, and break sense. *MIS Quarterly* **32**(**2**), 227–255.

Ward J, Taylor P and Bond P (1996) Evaluation and realization of IS/IT benefits: an empirical study of current practice. *European Journal of Information Systems* **4**(**4**), 214–225.

Weber R (2012) Evaluating and developing theories in the information systems discipline. *Journal of the Association for Information Systems* **13**(**1**), 1–30.

Weiss S, Aier S and Winter R (2013) Institutionalization and the effectiveness of enterprise architecture management. *34th International Conference on Information Systems*, Association for Information Systems, Milan, Italy.

Weiss S and Winter R (2012) Development of measurement items for the institutionalization of Enterprise Architecture Management in organizations. In *Trends in Enterprise Architecture Research and Practice-Driven Research on Enterprise Transformation – TEAR 2012 and PRET 2012 Aier S, Ekstedt M, Matthes F, Proper E and Sanz JL, Eds), pp 268–283, Springer, Barcelona, Spain.*

Winter K, Buckl S, Matthes F and Schweda CM (2010) Investigating the state-of-the-art in enterprise architecture management methods in literature and practice. *5th Mediterranean Conference on Information Systems, Association for Information Systems*, Tel Aviv, Israel.

Winter R, Legner C and Fischbach K (2014) Introduction to the special issue on Enterprise Architecture Management. *Information Systems and e-Business Management* **12**(**1**), 1–4.

Wetzels M, Odekerken-Schröder G and Van Oppen C (2009) Using PLS path modeling for assessing hierarchical construct models: guidelines and empirical illustration. *MIS Quarterly* **33**(**1**), 177–195.

Wixom BH and Todd PA (2005) A theoretical integration of user satisfaction and technology acceptance. *Information Systems Research* **16**(**1**), 85–102.

Wright RT, Campbell DE, Thatcher JB and Roberts N (2012) Operationalizing multidimensional constructs in structural equation modeling: recommendations for IS research. *Communications of the Association for Information Systems* **30**(**23**), 367–412.

Yao G, Wu C-H and Yang C-T (2008) Examining the content validity of the WHOQOL-BREF from respondents' perspective by quantitative methods. *Social Indicators Research* **85**(**3**), 483–498.

Zink G (2009) How to successfully restart an enterprise architecture program after initial failure. *Journal of Enterprise Architecture* **5**(**2**), 31–41.

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