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Achieving benefits with enterprise architecture

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ABSTRACT

There is strong anecdotal evidence that Enterprise Architecture (EA) brings benefits to organisations and that organisations are investing significantly in EA initiatives. However, demonstrating the business value of EA has proven elusive. Many of the benefits of EA are intangible and value is achieved indirectly within business change projects. Furthermore, it is not the EA itself that provides benefits, it is the ability to provide advisory services enabled by the EA that is important. In this paper we focus on EA service capability and develop and test a new research model that explains how EA service brings benefits to organisations. Our findings highlight the importance of EA service capability and dynamic capabilities in creating benefits from EA.

1. Introduction

Enterprise Architecture (EA) defines the current and desirable future states of an organisation's processes, capabilities, application systems, data, and IT infrastructure and provides a roadmap for achieving this target from the current state (Ross et al., 2006; Tamm et al., 2011; Zachman, 1987). Enterprise Architecture Services (EAS) enact business strategy by guiding the building of the digitized processes, business capabilities, application systems and databases that support or automate an organisation's core business processes (Ross et al., 2006). Organisations world-wide are on track to spend $3.49 trillion in 2016 on IT (Gartner, 2016). EAS play an important role in ensuring that such IT investments deliver value in alignment with business strategy (Gartner, 2014).

Organisations use EAS for a variety of purposes including corporate strategic transformation (Tamm et al., 2015), fostering business innovation (Winter et al., 2014), corporate acquisitions (Toppenberg et al., 2015), technology interoperability (Winter et al., 2014), compliance assessment (Foorthuis et al., 2012), business-IT alignment (Ross et al., 2006) and technology standards management (Boh and Yellin, 2007). There is strong anecdotal evidence that EA provides value to organisations. For example, the EA group of a large bank delivered cost savings in excess of $200 million (1.4% of the company's operating expenditure) through IT asset rationalisation and reuse (Burns et al., 2009). In a large-scale IT-enabled business transformation, the EA group helped the organisation to avoid more than $20 million in costs in the first year of the program (about 2% of the total cost of the five-year program) through the identification of synergies and reuse opportunities (Tamm et al., 2015).

Despite these examples of the organisational importance and impact of EA, many organisations view EA as an abstract concept that requires significant investment with benefits that are difficult to demonstrate (Lange et al., 2016). Despite the potential for value creation offered by EA, many organisations view EA as an organisational "black hole" into which money is poured but where the value proposition is often ambiguous (De Vries and Van Rensburg, 2008). This is particularly the case with demonstrating the

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business value of EA, as the "payoffs" relating to EA may take years to emerge (Lesley and Efrom, 2014). Although this has led to an interest in modelling EA value creation (Singh et al., 2014; De Vries and Van Rensburg, 2008), a clear understanding of the project and organisational benefits for EAS is still required.

While there is work that defines the benefits that can accrue from EA (Boucharas et al., 2010; Plessius et al., 2014; Tamm et al., 2011) and the success factors related to EA benefits (Schmidt and Buxmann, 2011; Weiss et al., 2013), much of the existing research focuses on explaining how EA benefits are achieved (Lange et al., 2016; Niemi and Pekkola, 2016; Tamm et al., 2015; Toppenberg et al., 2015). In particular, there is a strong focus on EA artefacts and their management (Lange et al., 2016), project compliance with the EA artefacts (Foorthuis et al., 2016) and EA governance (Foorthuis et al., 2016. Some recent work has highlighted the importance of EA service provision (Frampton et al., 2015; Lange et al., 2016; Niemi and Pekkola, 2016; Tamm et al., 2015). We seek to extend this work by focusing on how EA service provision complements EA governance and explains how EA project and organisational benefits are realised. This is important, as EA is often perceived as an artefact while it also has process and service dimensions (Lange et al., 2016; Ross et al., 2006). The service provision perspective of EA reflects the EA group's broader role not only as the producer of EA documentation but also as the provider of internal advisory services related to the formulation and implementation of IT-enabled business strategies (Frampton et al., 2015).

Our research question is: *How do EA advisory services lead to organisational benefits?* We argue that EA services lead to benefits through business-driven and IT-driven change opportunities. We base our work in the resource-based theory (Barney, 1991; Wade and Hulland, 2004) and dynamic capabilities (Teece, 1998; Wheeler, 2002).

There are three main contributions from our work. First, on a theoretical level, we develop a research model that explains how EA service capability leads to organisational benefits, using the 'process view' of resource-based theory. We argue that EA service capability is related to organisational benefits indirectly through other organisational processes (Pang et al., 2014). In particular, the study focuses on the ways in which EA enables business-driven and IT-driven change opportunities. Each of these organisational change processes lead to project benefits, which in turn result in organisational benefits. Second, on an empirical level, we have developed measurement instruments for testing the hypotheses developed from our review of relevant literature and interviews with senior EA and business professionals. Using a cross-sectional survey, we tested the research model, targeting Chief Information Officers (CIOs) in large American organisations. Finally, on a practical level, we demonstrate the importance of EA as service rather than EA as artefact (Tamm et al., 2015). Furthermore we provide managers with evidence that investing in EA services will enable both business-driven and IT-driven change opportunities to be identified and realised, leading to project and organisational benefits.

The paper is organised as follows. We first discuss the background context of the study. This is followed by a discussion about the theoretical foundation of the study and the research model. Next, we present the survey research approach used in the study and the development of the measurement instrument. Following that we discuss the empirical evaluation of the research model. We then present our findings and contributions to research and practice, and conclude with a discussion about directions for future research.

2. Background

Our aim is to explain how EA service provision leads to organisational benefits. To do so, we first discuss EA and its purpose and value proposition. We then review empirical research on EA, its use and outcomes. Finally, we identify and discuss three trends within this stream of research, including the increasing focus on EA service provision and its importance to achieving benefits from EA.

2.1. EA purpose and value proposition

EA has been traditionally conceptualised as a collection of artefacts that represent an organisation's business systems and IT systems, together with a planning process for documenting these systems (Ross et al., 2006). EA includes details about an organisation's processes, capabilities, data, application systems and IT infrastructure using a variety of standardised representation techniques (Kaisler et al., 2005; Lankhorst, 2013). Enterprise architects typically define the current and future states of an organisation's business systems and IT systems, and provide a roadmap for achieving the transformation between them (Tamm et al., 2011). EA enables the alignment of an organisation's business strategy with its IT strategy and plays an important role in business and IS planning in large organisations globally (Ross et al., 2006; Tamm et al., 2011; Zachman, 1987).

2.2. Empirical research on EA

Early EA research was often conceptual and prescriptive in nature and focused on the various models, notations, and processes used to define the content of the EA within an IT context (e.g. Spewak and Hill, 1993; Zachman, 1987). More recent work has been empirical involving expert interviews, case studies and surveys, evolving to a broader focus on the management of EA within organisations across both business and IT contexts (see Table 1). This has contributed to a deeper understanding of how EA is used within organisations and the benefits it brings, from the perspectives of both business and IT stakeholders.

Three observations may be made in relation to recent empirical work on EA. First, there is an increasing trend from studies of EA primarily within an IT context to broader studies of EA within the business context. This trend is exemplified by early work focusing on how EA is used within IT infrastructure management (Boh and Yellin, 2007) and IT project success (Foorthuis et al., 2010). More recent work focuses on how EA can be successfully managed and anchored within organisations (Lange et al., 2016) and how EA can help business transformation (Tamm et al., 2015) and corporate acquisition projects (Toppenberg et al., 2015).

Table 1
Existing empirical research on EA and benefits.

Reference	Research method	Contribution	Stakeholder Perspective
Boh and Yellin (2007)	Survey	EA governance mechanisms for standardisation in IT infrastructure management	Chief architects
Foorthuis et al. (2010)	Survey	Project and organisational benefits that can be achieved from EA conformance	EA creators and users
Schmidt and Buxmann (2011)	Survey	Success factors for EA implementation and IT flexibility and effectiveness	Chief architects IT managers
Weiss et al. (2013)	Survey	Success factors for institutionalization of EA management	Enterprise architects
Simon et al. (2014)	Interviews	Use of EA and business models in corporate strategic management	Senior business managers
Plessius et al. (2014)	Survey	EA benefits can be classified using perspectives from the balanced scorecard	EA stakeholders (business and IT)
Aier (2014)	Survey	Organisational culture significantly impacts the extent to which EA principles and mechanisms are successful	Enterprise architects
Tamm et al. (2015)	Case Study	Use of EA capability in successful execution of large-scale business transformation	EA management stakeholders (business and IT)
Toppenberg et al. (2015)	Case Study	Use of EA capability in improving value created from corporate acquisitions	EA management stakeholders (business and IT)
Lange et al. (2016)	Survey	Organisational anchoring of EA is important and enabled by high quality EA products and services	EA management stakeholders (business and IT)
Niemi and Pekkola (2016)	Case Study	EA process quality, EA service quality and a supportive social environment are important to EA success	EA management stakeholders (business and IT)
Foorthuis et al. (2016)	Survey	EA delivers benefits indirectly through compliance with EA and architectural insight	EA stakeholders (business and IT)

Second, understanding of the benefits EA brings and how EA delivers them is increasing. EA can provide various IT benefits, including flexibility and efficiency (Schmidt and Buxmann, 2011), increase in standardisation and reuse of IT, and reduction in duplication of IT infrastructure (Boh and Yellin, 2007). EA can also provide various business benefits including strategic transformation (Tamm et al., 2015), process standardisation (Toppenberg et al., 2015; Weiss et al., 2013) and successful corporate acquisitions (Toppenberg et al., 2015). EA can provide benefits at both the project level (Foorthuis et al., 2010) and the organisation level (Lange et al., 2016; Tamm et al., 2015). Organisational benefits are also typically indirect in that they are achieved via another organisational process, for example, through corporate acquisition (Toppenberg et al., 2015) or strategic management (Simon et al., 2014).

Third, although EA content remains a significant factor in recent empirical studies, there is an increasing focus on the service dimension of EA (Lange et al., 2016; Niemi and Pekkola, 2016; Tamm et al., 2015). While high quality EA models and other artefacts are essential, EA professionals working collaboratively within business and IT change projects must successfully use them (Tamm et al., 2015).

2.3. EA service provision

Many methodologies and standards reflect the traditional perspective of EA as a collection of artefacts, such as the Open Group Architecture Framework (TOGAF) (The Open Group, 2016) and the Zachman Framework (Zachman, 1987). However, EA as a collection of artefacts by itself will not bring value to organisations. How it is used to deliver services to improve overall organisational performance is what matters. EA service provision can be defined as the extent to which organisational strategic decision-makers are provided with relevant, timely and high-quality information and advice about an organisation's current and planned business systems (Frampton et al., 2015). Recently, the importance of delivering an advisory service to organisations based on the EA has been acknowledged (Frampton et al., 2015; Lange et al., 2016; Niemi and Pekkola, 2016; Tamm et al., 2015).

3. Theoretical foundation

We base our research model on the resource based theory (Barney, 1991) and dynamic capabilities (Teece et al., 1997). The resource-based theory has been widely used by information systems researchers and is particularly valuable in studies of the strategic value of information systems and how they relate to firm performance (Wade and Hulland, 2004). It is particularly suitable for our study as we aim to explain how EA is used in strategic organisational change projects to bring value to organisations.

In resource-based theory, organisations are conceptualised as bundles of resources (Barney, 1991; Wade and Hulland, 2004). Resources may be tangible or intangible, and comprise assets and capabilities. Assets include IT hardware and software, data and people, while capabilities include organisational processes and routines that utilise assets in order to perform a task. While many assets are readily available and some are commodities, superior organisational performance can be largely attributed to the unique and valuable capabilities that enable organisations to perform activities more effectively and efficiently than their competitors (Amit and Schoemaker, 1993).

Within the resource-based theory, organisational capabilities are regarded as a critical determinant of firm performance (Aral and Weill, 2007). However, this view has been criticised as being too static and dynamic capabilities were proposed as a means of

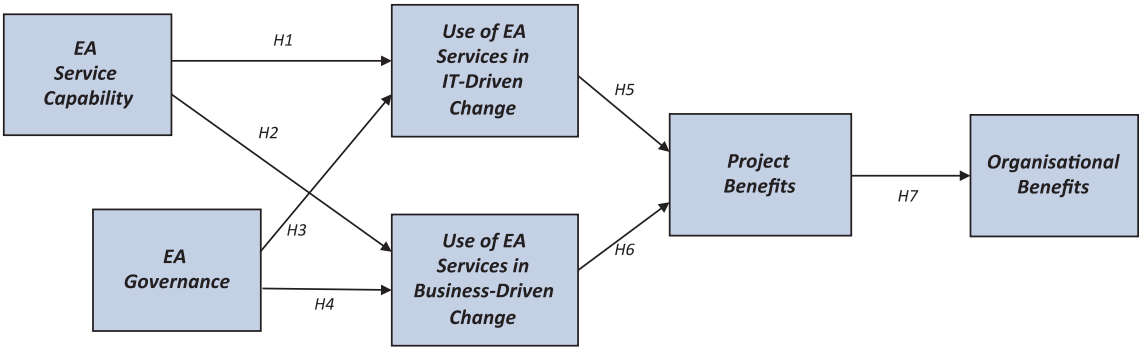

Fig. 1. Research model.

renewing and reconfiguring organisational resources to respond to rapidly changing environments (Teece et al., 1997). Dynamic capabilities are "the capacity of an organisation to purposefully create, extend or modify its resource base" (Helfat et al., 2007, p. 4). They are "the capacity to sense opportunities and to reconfigure knowledge assets, competencies and complementary assets and technologies to achieve sustainable competitive advantage" (Teece, 1998, p. 73). Furthermore, dynamic capabilities are a useful enabler of innovation, particularly in service sector organisations, through the process of sensing, seizing and transformation of the business environment (Kindstrom et al., 2013).

4. Research model

To develop the research model we followed two phases: explorative and confirmatory (MacKenzie and House, 1978). The explorative phase involved an extensive analysis of relevant literature (ref removed for blind review) followed by semi-structured interviews with 30 industry experts and two focus groups with enterprise architects and chief information officers (ref removed for blind review) to develop the research model. The confirmatory phase involved operationalization and empirical testing of the research model using a survey.

The research model conceptualises how EA Service Capability leads to Organisational Benefits (see Fig. 1). Definitions of constructs and hypotheses are summarised in Tables 2 and 3. We use the 'process view' of resource-based theory and argue that EA Service Capability is associated with Organisational Benefits indirectly, via other organisational processes (Pang et al., 2014) (Note that the 'process view' of resource-based theory is concerned with the design of variance models and should not be confused with research 'process models' (Mohr, 1982)). This perspective is important as it highlights that the key role of EA Service Capability is to *enable* other organisational processes that, in turn, create Organisational Benefits. We focus in particular on how EA Service Capability is used within organisations to co-create value within IT-driven change projects and business-driven change projects (Spohrer et al., 2007). These two ways of identifying change opportunities reflect the more traditional (e.g., Boh and Yellin, 2007) and the emerging use of EAS (e.g., Tamm et al., 2015; Toppenberg et al., 2015) within organisations, with some EA teams being more IT focussed while others having a stronger business emphasis. Both lead to Project Benefits, which in turn lead to Organisational Benefits.

Following Foorthuis et al. (2016), we also argue that EA Governance plays an important role in ensuring that EA Services are used both within IT-driven change projects and business-driven change projects. Including EA Governance in the model will enable us to compare the relative impact of service capability (influence) and governance (control) on the use of EA services in identifying and implementing change opportunities.

Table 2
Summary of construct definitions.

Construct	Definition
EA Service Capability	The extent to which the EA group is able to provide service to an organisation based on EA content, EA standards, EA stakeholder participation and the skills and knowledge of its EA professionals.
EA Governance	The extent to which organisational processes and directives ensure that projects conform and comply to EA content and standards.
Use of EA Services in IT-Driven Change	The extent to which EA services are used in decision-making concerning change and standardisation of IT applications and infrastructure, and to identify and implement new IT-based innovations.
Use of EA Services in Business-Driven Change	The extent to which EA services are used in decision-making concerning change and standardisation of business processes, products and services and to identify and implement new business innovations.
Project Benefits	The extent to which decision-making, project management effectiveness, IT platform and systems, and business capabilities are improved by EA services.
Organisational Benefits	The extent to which the organisation has higher return on investment and integration of strategy and execution than its competitors, increased value for customers and employees and the ability to sense changes in the environment and respond effectively and quickly.

Table 3
Summary of Hypotheses.

Hypotheses	Definition
H1	EA Service Capability has a positive impact on the Use of EA Services in IT-Driven Change
H2	EA Service Capability has a positive impact on the Use of EA Services in Business-Driven Change
H3	EA Governance has a positive impact on the Use of EA Services in IT-Driven Change.
H4	EA Governance has a positive impact on the Use of EA Services in Business-Driven Change.
H5	Use of EA Services in IT-Driven Change has a positive impact on Project Benefits
H6	Use of EA Services in Business-Driven Change has a positive impact on Project Benefits
H7	Project Benefits have a positive impact on Organisational Benefits

4.1. Construct definitions

4.1.1. EA service capability

Although EA has traditionally been conceptualised as either a collection of artefacts (Zachman, 1987) or a planning process (Spewak and Hill, 1993), we highlight the importance of EA as a service capability that provides advice to business and IT stakeholders (Asadi Someh et al., 2016; Lange et al., 2016; Niemi and Pekkola, 2016; Tamm et al., 2015). EA Service Capability is formed from four components: EA Content, EA Standards, EA Stakeholder Participation and EA Skills and Knowledge.

EA Content comprises various artefacts including business capability models and IT system models (data, applications etc.) and roadmaps that describe how to transition from the current state to a future desirable state (Lange et al., 2016; Ross et al., 2006). The models are linked within a layered architecture, with business capability models at the top level mapped to IT systems models. The models are rarely complete, but need to be "accurate enough" at any point in time (Toppenberg et al., 2015). They are typically updated on an as-needed basis, to encompass the detail required for the specific project at hand (Toppenberg et al., 2015).

EA Standards are the policies, rules and guidelines that underlie the EA practice in an organisation (Boh and Yellin, 2007). They are developed in order to guide the reduction of redundancy in IT infrastructure and enhance integration across different IT application systems. Standards also help in the management of enterprise data, the integration of business processes and to ensure regulatory compliance (Boh and Yellin, 2007).

EA Stakeholder Participation concerns the extent to which stakeholders outside the EA team participate in EA activities (Schmidt and Buxmann, 2011). Senior management needs to provide support and be actively *involved* in EA activities (Lange et al., 2016). Relevant IT and business stakeholders need to be actively involved when establishing EA content and standards, to ensure their quality. EA artefacts including models, roadmaps, standards and guidelines need to be approved by relevant IT and business stakeholders, sometimes as members of an architecture board (Schmidt and Buxmann, 2011).

EA Skills and Knowledge are essential for successful EA service delivery. EA professionals require deep knowledge about the organisation's business and IT systems to create the conceptual links between business and IT models and roadmaps. Excellent communication skills are needed to provide understanding of complex models and transformation plans. The ability to provide consulting services is important in order to be effective in their role (Frampton et al., 2015; Lange et al., 2016).

4.1.2. EA governance

Governance concerns specifying the decision rights and accountabilities of stakeholders and organisational structures associated with decision-making (Weill and Ross, 2004). EA Governance aims to ensure that the use of EA will lead to organisational benefits and to mitigate the risks associated with EA use (Foorthuis et al., 2016). EA governance includes internal directives to encourage and enforce compliance with EA plans and principles, review and approval processes to ensure project conformance to EA content and standards and mechanisms for tracking and negotiating required exceptions to the EA (Schmidt and Buxmann, 2011).

4.1.3. Use of EA services in IT-driven change

Use of EA Services in IT-driven Change concerns the extent to which EA services inform the identification, prioritisation and implementation of IT change opportunities, such as adding, removing or replacing IT components and the standardising of IT applications and infrastructure across the organisation (Boh and Yellin, 2007). IT-driven change projects will lead to interrelated business and IT benefits. We use dynamic capability theory (Teece et al., 1997) and adapt the four capabilities of the Net-Enabled Business Innovation Cycle (NEBIC) (Wheeler, 2002) to EA: (1) identify new EA enabled IT change opportunities, (2) assess the value and feasibility of the IT change opportunities to select viable IT change solutions, (3) implement the changes by renewing and reconfiguring IT applications, and (4) measure and assess the value of using EA in IT changes.

4.1.4. Use of EA services in business-driven change

This construct is similar to the previous construct, but focuses on business-driven change. Use of EA Services in Business-driven Change concerns the extent to which EA services inform the identification, prioritisation and implementation of business change opportunities, such as adding, removing or replacing business processes and standardising processes across the organisation (Foorthuis et al., 2016). Business-driven change projects will lead to interrelated business and IT benefits. We again use dynamic capability theory (Teece et al., 1997) and adapt the four capabilities of NEBIC (Wheeler, 2002) to EA: (1) identify new EA enabled business change opportunities, (2) assess the value and feasibility of the business change opportunities to select viable business

change solutions, (3) implement the changes by renewing and reconfiguring business processes, and (4) measure and assess the value of using EA in business changes.

4.1.5. Project benefits

Project benefits are the outcomes of discrete projects that are improved by EAS and is formed from four components: improved decision-making, project management effectiveness, improved business capabilities and improved IT platform and systems. Change projects will have elements of each component, depending on the nature of the change project.

Improved decision-making concerns the provision of information by EAS to better inform decision-makers both at the strategic and operational level, and improve the quality and outcomes of decisions made (Bernard, 2012; Tamm, 2012).

Project Management Effectiveness comprises project portfolio planning, coordination between projects and solution selection within projects (Tamm, 2012). Project portfolio planning is more effective when informed by EAS about the interdependencies between systems and processes. More effective project coordination results from information provided by EAS about the division and sequencing of work between projects. Solution selection within projects is more effective when informed by EAS about EA content and standards (Foorthuis et al., 2010).

Improved Business Capabilities concerns the adaptation, combination and re-use of existing business capabilities and the development of new business capabilities enabled by EAS. It will also lead to minimisation of redundant business capabilities across organisations, and enable the development of new and innovative products and services (Bharadwaj et al., 2013; Toppenberg et al., 2015).

Improved IT Platform and Systems comprises the development of a flexible IT platform that is quickly and easily adapted (Lange et al., 2016; Ross et al., 2006; Schmidt and Buxmann, 2011), better reuse and reduced duplication of IT resources (Boh and Yellin, 2007) and more compatible, integrated and interoperable IT systems (Boh and Yellin, 2007; Schmidt and Buxmann, 2011).

4.1.6. Organisational benefits

Organisational benefits are organisation-wide long term benefits that result from the outcomes of multiple change projects and is formed from three components: agility, competitive advantage and value.

Agility is the ability of an organisation to sense changes in the environment and respond effectively and quickly, thereby increasing the organisation's capacity for value creation and value capture (Chen et al., 2014; Sambamurthy et al., 2003; Teece et al., 2016). Relevant aspects of organisational agility include changes to products and services, adoption of new technologies, responding to changes in customer demand and expansion into new markets (Bradley et al., 2012; Tallon and Pinsonneault, 2011).

Competitive advantage has several dimensions including higher return on investment than competitors (Lange et al., 2016), better strategic alignment of business and IT than competitors (Tamm et al., 2015) and more success in integrating strategy and execution than competitors (Toppenberg et al., 2015).

Increased value for both customers and employees can also result from EA services (O'Cass and Sok, 2013; Toppenberg et al., 2015). This can, for example, include the ability to deliver better customer service and experiences based on a deeper knowledge of the customer (Ross et al., 2006).

4.2. Hypothesis development

The hypotheses highlight the two ways in which EAS leads to value: IT-driven change and business-driven change. These two dynamic capabilities reflect the more traditional and emerging use of EAS within organisations. Both lead to project-level benefits, and ultimately to organisational level benefits.

4.2.1. IT-driven and business-driven change

EA Service Capability influences and enables the Use of EA Services in IT-driven Change and Business-driven Change by providing high quality consulting services (Frampton et al., 2015). EA Service Capability communicates about EA content and standards to relevant stakeholders and builds trust to ensure transitions from current to desirable future states are achieved (Lange et al., 2016). Hence, we hypothesise that:

H1. EA Service Capability has a positive impact on the Use of EA Services in IT-Driven Change.

H2. EA Service Capability has a positive impact on the Use of EA Services in Business-driven Change.

EA Governance will strengthen the Use of EA Services in Business-driven and IT-driven Change, by putting in place well defined review and approval processes to encourage and enforce compliance with EA content and standards (Foorthuis et al., 2016; Weill and Ross, 2004). This complements the high quality consulting services that EA Service Capability provides. Hence, we hypothesise that:

H3. EA Governance has a positive impact on the Use of EA Services in IT-driven Change.

H4. EA Governance has a positive impact on the Use of EA Services in Business-driven Change.

4.2.2. IT-driven change and Business-driven lead to Project benefits

IT-driven Change leads to Project Benefits by providing useful information to IT decision-makers, enabling the coordination and optimisation of IT projects and building a better IT operating platform (Frampton et al., 2015; Tamm, 2012). EA Service Capability

enables an organisation to achieve greater benefits from IT-driven change in a number of ways. First, it helps optimise the project portfolio by providing information about interdependencies between projects, leading to improved prioritisation of projects and avoidance of duplication (Lange et al., 2016). Second, EA helps increase reuse by establishing a high quality solution architecture practice, and by setting clear standards and guidelines (Lange et al., 2016). Third, EA enables the organisation to create a flexible IT platform by disaggregating complex monolithic systems and providing information about dependencies between components (Ross et al., 2006). Fourth, EA helps optimise resource use by analysing existing systems to identify overlaps and resource gaps, leading to a more standardised and integrated operating platform (Ross et al., 2006). Fifth, EA enables the organisation to ensure that IT resources are complementary by identifying opportunities for synergy between IT resources (Asadi Someh et al., 2016). Overall, EA services lead to IT systems that are more compatible, integrated and interoperable to better support the business. Hence, we hypothesise that:

H5. Use of EA Services in IT-driven Change has a positive impact on Project Benefits.

Business-driven Change Projects lead to Project Benefits by providing useful information to business decision-makers, developing new and innovative products, services and business capabilities and sharing business resources (Bharadwaj et al., 2013). EA service provision enables the development of new products and services based on a better knowledge about existing business capabilities and strategic requirements (Toppenberg et al., 2015). Adapting and combining existing business capabilities based on EA services can lead to innovation in products and services (Bharadwaj et al., 2013). EA service provision also enables the development of new business capabilities, fosters the reuse of existing business capabilities across the organisation and minimises redundant business capabilities across the organisation (Teece et al., 2016). Hence, we hypothesise that:

H6. Use of EA Services in Business-driven Change has a positive impact on Project Benefits.

4.2.3. Project benefits lead to organisational benefits

Project Benefits lead to Organisational Benefits in several ways. A flexible IT platform with compatible, integrated and interoperable systems, improved IT and business decision-making and business capabilities that foster product and service innovation will lead to improved organisational agility (Chen et al., 2014; Queiroz et al., 2017). The provision of better knowledge and information about business and IT strategic directions provides value for managers, employees and customers (O'Cass and Sok, 2013; Toppenberg et al., 2015;). New and innovative products, services and business capabilities enabled by EA services create value for customers. This value creation will also lead to better return on investment and strategic alignment between business and IT in contrast to competitors. It will enable organisations to adopt new technologies more successfully and respond quicker to changes in customer demand by offering relevant new products and services (Bradley et al., 2012; Tallon and Pinsonneault, 2011). Hence, we hypothesise that:

H7. Project Benefits have a positive impact on Organisational Benefits.

5. Research method

We tested our research model using a cross-sectional survey, targeting CIOs who had experience in using EA in large American organisations. The perceptions of CIOs provide a valid source for collecting data about the organisational value of IT systems (Davern and Wilkin, 2010; Tallon and Kraemer, 2007). CIOs are familiar with organisational strategy formulation processes and issues relating to organisational capabilities, benefits and firm performance (Weill and Woerner, 2013) thus making them a suitable target population for our study. Other recent empirical studies in EA have also used a similar single respondent survey approach (e.g., Boh and Yellin, 2007; Lange et al., 2016).

Measures for constructs were adapted from the literature where valid instruments exist. Otherwise, we developed new measures in several stages to ensure content validity, construct validity and reliability (Gefen et al., 2000). The process involved conceptualization, item generation, academic and expert practitioner interviews and a pilot test (MacKenzie et al., 2011). Details of measures used for each construct are in Appendix A.

6. Results

We selected partial least squares structural equation modelling (PLS-SEM) as our preferred statistical method, as it is well suited to exploratory research (Esposito et al., 2010; Hair et al., 2013, 2014) where the identification and articulation of relationships is a central focus (Goodhue et al., 2012; Ringle et al., 2012). It is also a useful method when new measures are being tested (Gefen et al., 2011). We used the software package SmartPLS, version 3.0. The statistical analysis followed established guidelines (Hair et al., 2014).

6.1. Data collection

A purposive sampling technique was used for data collection (Neuman, 2006; Recker, 2013), and was targeted at CIOs of private sector organisations in the U.S. The survey was administered by Qualtrics using their panel partners in the U.S. We sought responses from private sector CIOs in organisations where EA had been established for a minimum of two years (close to 70% of our respondents had been employed by their organisation for at least 5 years) and where the EA group had more than five employees (about

Table 4
Number of years CIOs employed in the organisation.

Number of years	Frequency	Percentage
2–5 years	63	32.8%
More than 5 years	129	67.2%

Table 5
Number of employees in the EA Team.

Number of employees	Frequency	Percentage
5 to 10	93	48.4%
Over 10	99	51.6%

half of our respondents had an EA team larger than 10). Responses were screened for these criteria. Tables 4 and 5 provide an overview of the respondents and the EA teams in their organisations.

Once the survey responses were received, the data was examined for missing values, unengaged responses, outliers, skewness and kurtosis. We removed responses from CIOs with less than two years of tenure to ensure they had sufficient time in their role for EA service to demonstrate organisational benefits. Incomplete responses or responses where the standard deviation was less than 0.3 (Gaskin, 2012) were eliminated. This resulted in a total of 192 valid responses. To test for external validity, the data was assessed for non-response bias by comparing responses from the first and last quartile of survey participants using a two-tailed test (*t*-test) (Gefen et al., 2011). The *t*-test did not yield significant differences between the two respondent groups, hence indicating that non-response bias was not an issue. The collected data was assessed for common method bias and measures for reflective and formative constructs were validated (see Appendix B).

6.2. Structural model

The hypotheses were tested using PLS (SmartPLS 3.0, path weighting scheme). A bootstrapping method (5000 iterations) was used to compute significance levels (Hair et al., 2013). The variance inflation factors (VIFs) were all less than 5, suggesting that multicollinearity was unlikely to be a concern. The results are presented in Fig. 2 and Table 6 below.

The primary criterion used to evaluate the results of structural models in PLS path modelling is R^2 (Gefen et al., 2011). The model explains 63.2% of the variance of Organisational Benefits and 58.1% of the variance of Project Benefits. Furthermore, EA Service Capability and EA Governance together explain 54.1% of the variance in Use of EA Services in IT-Driven Change and 43.9% or the variance in Use of EA Services in Business-Driven Change. Overall, the R^2 values provide substantial support for the explanatory power of the research model.

The hypotheses were evaluated by examining significance and weights of the structural paths in the research model. All of the hypotheses were significantly supported at the $p \leq 0.001$ level except H4 which was supported at the $p \leq 0.01$ level.

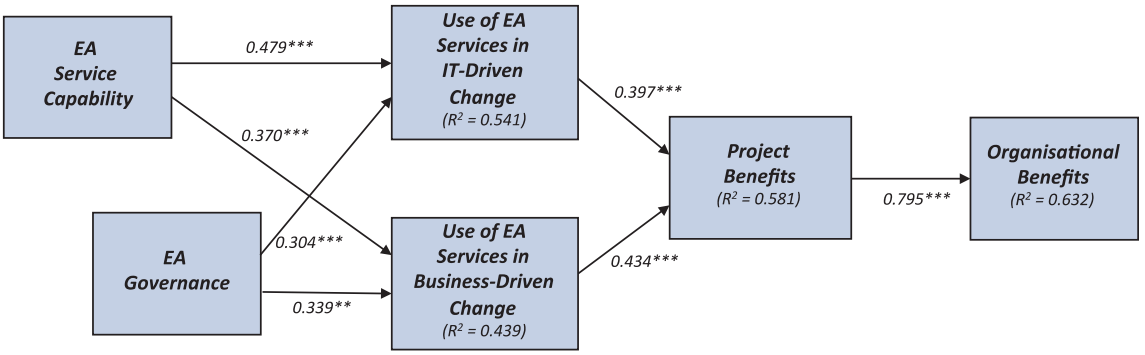

Fig. 2. Assessment of structural model using SmartPLS (n = 192).

Table 6
Results of Hypothesis significance testing.

Hypotheses	Path coefficients	T Statistics	P Values
EA Service Capability → Use of EA Services in IT Change	0.479***	5.590	0.000
EA Service Capability → Use of EA Services in Business Change	0.370***	3.506	0.000
EA Governance → Use of EA Services in IT Change	0.304***	3.207	0.001
EA Governance → Use of EA Services in Business Change	0.339**	3.158	0.002
Use of EA Services in IT Change → Project Benefits	0.397***	3.767	0.000
Use of EA Services in Business Change → Project Benefits	0.434***	4.097	0.000
Project Benefits → Org Benefits	0.795***	22.642	0.000

*p ≤ .0.05.
** p ≤ 0.01.
*** p ≤ 0.001.

7. Discussion

The aim of this study was to better understand how EA service provision may be defined and used to explain how EA brings benefits to organisations. EA service provision reflects the extent to which organisational strategic decision-makers are provided with relevant, timely and high-quality information and advice about an organisation's current and planned business systems and IT systems (Frampton et al., 2015). We extend previous definitions of EA service (for example Lange et al., 2016) and conceptualise it as a capability.

We argue that EA Governance also plays an important role in ensuring that EA Services are used within IT-driven change projects and business-driven change projects (Foorthuis et al., 2016). EA Governance involves the use of *controls* to ensure conformance and compliance to EA content and standards, whereas EA Service Capability *influences* change projects to use EA content and standards through trusted consultations and knowledge sharing.

We highlight two ways in which change opportunities are identified and implemented: IT-driven change and business-driven change. These reflect the more traditional and emerging use of EA services within organisations, and both lead to project-level benefits and organisational-level benefits.

Structural model analysis showed that all of the hypotheses proposed were significant. EA Service Capability and EA Governance both had a positive impact on the Use of EA Services in IT-driven Change and the Use of EA Services in Business-driven Change. The impact of EA Service Capability was much greater than the impact of EA Governance. The Use of EA Services in IT-driven Change and the Use of EA Services in Business-driven Change both had a positive impact of Project Benefits. The strength of the impact was very similar for both constructs. Project Benefits had a strong positive impact of Organisational Benefits. These results are important in explaining how EA brings value to organisations and are explored in detail below.

7.1. Reflections on findings

7.1.1. EA Service Capability and EA Governance

EA Service Capability is the key concept in the research model, and is formed from four components: EA content, EA standards, EA stakeholder participation and the skills and knowledge of the organisation's EA professionals. Each of these components is a significant first order construct forming EA Service Capability, with EA Content (0.318***) and EA Standards (0.385***) weighted higher than People Skills (0.256***) and Stakeholder Participation (0.225***). Together, these four components cover the construct's conceptual domain and clearly extend previous conceptualisations (for example Lange et al., 2016; Niemi and Pekkola, 2016). The EA service capability perspective reflects the EA group's broader role not only as the producer of EA documentation but also as the provider of internal advisory services related to the formulation and implementation of IT-enabled business strategies (Frampton et al., 2015; Tamm et al., 2015).

The new conceptualisation of EA Service Capability incorporates all the elements that are required to provide a high-quality EA service. Models for IT systems and business capabilities and roadmaps to define transitions to desirable future states, together with standards for IT systems, business processes and regulatory compliance are essential pre-requisites for successful EA service provision. Furthermore, necessary human capabilities required for successful EA service provision include the active involvement of top management and other key business and IT stakeholders and EA professionals with excellent communication skills and a deep knowledge of the organisation's business and IT systems.

It is important to complement EA Service Capability with EA Governance to ensure that EA services are used in business-driven and IT-driven change projects. While EA Service Capability is about providing valuable advice based on knowledge sharing and trusting relationships, EA Governance is about encouraging and enforcing compliance with EA models and standards. These two approaches complement each other and both are necessary to ensure that EA services are used. Therefore, it is possible that EA Service Capability and EA Governance may not be fully independent and may compensate for each other. For example, strong EA Service Capability may compensate for poor EA Governance. We tested for a statistical interaction between EA Service Capability and EA Governance but did not find any. Further in-depth, qualitative studies could explore this issue further.

7.1.2. IT-driven and business-driven dynamic capabilities

We conceptualised IT-driven and Business-driven Change as dynamic capabilities concerned with the identification, prioritisation, implementation and measurement of the value of these change opportunities (Wheeler, 2002). This extends previous work by revealing the ways in which key decision makers within organisations may use EA services. In order to identify EA-enabled IT and business change opportunities,

knowledge of the external market and technological innovation is important (Wheeler, 2002). While this is implicit in the measures of these constructs, these specific knowledge items could explicitly be included in the EA Skills and Knowledge construct in future studies.

EA Service Capability was found to have a significant positive impact on both the Use of EA Services in IT-driven Change (H1, 0.479***) and the Use of EA Services in Business-driven Change (H2, 0.370***). EA Governance was also found to have a significant positive impact on both the Use of EA Services in IT-driven Change (H3, 0.304***) and the Use of EA Services in Business-driven Change (H4, 0.339**). Interestingly, the influence of the traditional governance-based approach was not as strong as the impact of the emerging service provision approach to EA. Clearly, both EA governance and EA service provision are required for the successful use of EA within dynamic capabilities related to IT and business change opportunities. Together they explain 54.1% of the variance in Use of EA Services in IT-Driven Change and 43.9% or the variance in Use of EA Services in Business-Driven Change.

7.1.3. Project Benefits

We conceptualised Project Benefits as comprising improved decision making, project management effectiveness, improved business capabilities and improved IT platform and systems. The Use of EA Services in IT-driven Change was found to have a significant positive impact on Project Benefits (H5, 0.397***). Having well developed dynamic capabilities, particularly within a project including both EA and IT teams working together, is crucial for digital innovation (Sambamurthy et al., 2003). EA services can provide valuable input into identifying, prioritising and implementing opportunities for change and standardisation of IT. The Use of EA Services in Business-driven Change was also found to have a significant positive impact on Project Benefits (H6, 0.434***). Having well-developed dynamic capabilities is important in identifying, prioritising and implementing business change, involving business capabilities, processes, and products (Teece et al., 1997; Teece et al., 2016). The Use of EA Services in IT-driven Change and Business-driven Change together explain 58.1% of the variance in Project Benefits.

Each of the four components of Project Benefits is a significant first order contributor forming Project Benefits, with Improved Business Capabilities weighted highest (0.376***), followed by Improved Decision Making (0.307***), Improved IT Platform and Systems (0.243***) and Project Management Effectiveness (0.193***). It is interesting to note that components of Project Benefits related to the emerging business use of EAS (Improved Business Capabilities and Decision Making) (e.g., Tamm et al., 2015; Toppenberg et al., 2015) weighted higher than components of Project Benefits related to the more traditional EAS use (IT platform and Systems and Project Management Effectiveness) of EA in IT (e.g., Boh and Yellin, 2007).

7.1.4. Organisational benefits

We conceptualised Organisational Benefits as comprising Agility, Competitive Advantage and Value. Project Benefits was found to have a significant positive impact on Organisational Benefits (H7, 0.795***), and explained 63.2% of the variance in Organisational Benefits. The association between Project Benefits and Organisational Benefits is very high. However, the cross loadings show that the two constructs are clearly separate, although strongly associated. Furthermore, we tested for common method bias and the constructs were validated (see Appendix B).

Flexible, integrated and interoperable IT systems and platforms together with new and innovative products and services will enable organisations to improve Agility. Improved decision-making, better project planning and coordination, more effective solution selection and improved business capabilities will increase Competitive Advantage and Organisational Value.

Each of the three above-mentioned components of Organisational Benefits is a significant first order construct for Organisational Benefits, with Agility (0.428***) weighted higher than both Competitive Advantage (0.391***) and Value (0.293***), highlighting the importance of Agility as a major organisational benefit from the use of EA (Foorthuis et al., 2016).

7.2. Implications for EA research

There are two main contributions from our study. First, we have developed a new and comprehensive conceptualisation for EA Service Capability. Our conceptualisation extends previous conceptualisations (for example Lange et al. (2016) and Niemi and Pekkola (2016)) as EA is defined as a capability and includes four components: EA content, EA standards, EA stakeholder participation, and the skills and knowledge of EA professionals. We believe all of these elements are essential to the effective provision of EA service and their value is realised only when service is provided. For example high quality EA content and standards can remain unused in contexts where EA services are not effective (Frampton et al., 2015).

Second, we have developed and tested a research model that explains how EA brings benefits to organisations. EA leads to organisational benefits indirectly via organisational change projects. These change projects are identified either by IT-driven or business-driven dynamic capabilities, enabled by EAS. These dynamic capabilities reflect the traditional and emerging ways in which EA can be used within organisations to identify change opportunities.

The comprehensive conceptualisation of EA Service Capability together with the use of dynamic capabilities to explain how EA is used within IT-driven and business-driven change projects incorporates many of the concepts in previous research models. For example, EA Management Organisational Anchoring (Lange et al., 2016) is comprised of top management commitment, EA awareness and EA understanding. Top management commitment and EA awareness amongst relevant stakeholders are included within the EA Service Capability concept in our study. EA understanding is defined as the extent to which a common EA understanding has been established amongst EA stakeholders (Lange et al., 2016) and is implicit in both Use of EA Services in IT Change and Use of EA Services in Business Change. These two constructs are dynamic capabilities and concern how EA Service Capability enables project teams to identify, prioritise, implement and assess change opportunities (Wheeler, 2002). A common EA understanding amongst stakeholders is crucial to each of these steps, in particular the ability to identify change opportunities. Although EA Service Capability is clearly important in obtaining organisational benefits from EA, EA

Governance remains important as well (Foorthuis et al., 2016).

7.3. Implications for EA practice

An important managerial implication of this study is that for EA to bring benefits to organisations, an effective EA service capability must be developed. It is not sufficient to develop a high-quality set of models and documentation. Having a group of EA professionals with knowledge of the organisation's IT systems and business, together with excellent communication and consulting skills is crucial to getting value from EA. However, the EA service capability should be complemented by effective EA governance mechanisms. Effective EA governance and service capability work together to ensure benefits are achieved from EA.

Organisations also need to develop two complementary dynamic capabilities to identify opportunities for organisational change. There are opportunities within organisations for change projects that are IT-driven and others that are business-driven. Both ways of identifying change opportunities will lead to both IT and business benefits at the project level.

The EA service capability needs to be positioned within organisations so that it has the opportunity to advise both IT-driven as well as business-driven initiatives. Organisations where EA follows the more traditional IT focus can still gain value, but are not using their EA service capability to its full potential. The emerging use of EA within business-driven change projects can to lead to significant project and organisational benefits.

7.4. Limitations and areas for future research

There are three limitations in our study. First, the use of perceptual measures is contentious, particularly for Organisational Benefits. However, previous studies have found that perceived organisational performance is strongly correlated with objective measures (Venkatraman and Ramanujam, 1987). Also, objective measures for EA are very difficult to obtain as the benefits are often intangible and indirect (Lange et al., 2016). Furthermore, several other studies of EA success and benefits have successfully used perceptual measures (e.g., Aier, 2014; Boh and Yellin, 2007; Lange et al., 2016; Schmidt and Buxmann, 2011).

Second, the sample of organisations for our survey was opportunistic rather than random. Although this may limit the generalizability of our results, we have collected data from a wide variety of organisations and have filtered respondents to ensure there is a mature EA function within the organisation. We also focused on CIOs to ensure our respondents had sufficient knowledge about EA and its use and impact within their organisation to answer all questions effectively (Weill and Woerner, 2013).

Third, alternative data collection approaches in the survey could have been used. For example, to prevent possible 'blind responses', some questions could have been reversed. A 'matched pairs' survey design could have been used with different respondents used to complete different sections of the survey. For example, one respondent could have completed the Project Benefits questions and another to complete the Organisational Benefits section of the survey. This would have been difficult to achieve using Qualtrics data collection. Alternatively, a 'two wave' data collection approach could have been used where the EA-related questions and the Organisational Benefit questions could have been collected at different points in time. We also could have included control variables to check the statistical model for confounding effects.

We identify three opportunities for future research. First, although 30 interviews with industry experts and two focus groups with enterprise architects and chief information officers (ref removed for blind review) were used when developing the research model, there is a need for in-depth case studies to better understand the concepts and relationships. In particular, how are the dynamic capabilities enabled by EA Service Capability and what are the mechanisms by which project and organisational benefits are achieved. Second, longitudinal studies are needed to better understand how and why EA Service Capabilities evolve over time, reflecting EA maturity (Steenbergen et al., 2010). Understanding how EA maturity influences Project Benefits and Organisational Benefits needs to be explored. Third, the longitudinal studies will lead to a better understanding of the process through which Organisational Benefits are achieved. This could form the basis for the proposal of a process theory to complement the variance theory presented in this paper.

8. Conclusion

We have proposed and evaluated a variance model that extends previous research on how EA leads to value. In particular we highlight the importance of EA service and argue that EA benefits are achieved through IT-driven and business-driven dynamic capabilities. The key contributions to knowledge are a new and comprehensive conceptualisation of EA Service Capability and a theoretically grounded and empirically evaluated research model that explains how EA benefits are realised. This is important for both researchers and practitioners.

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Appendix A. Measurement instrument

See Table A1.

Table A1
Measurement of constructs.

Construct	Type	Sub-construct	Type	Items
EA service capability	Formative	EA Content (adapted from Lange et al. (2016))	Formative	To what extent has your organisation developed the following EA content: ● Business capability models. ● IT system models. ● Mappings between business capability models and IT system models. ● Roadmaps to enhance understanding of the transition from current to future business capabilities. ● Roadmaps to enhance understanding of the transition from current to future IT systems.
		EA Standards (adapted from Boh and Yellin (2007)	Formative	To what extent has your organisation developed EA standards to: ● Reduce redundancy of IT infrastructure services provided by different groups. ● Enhance integration across different IT application systems. ● Enhance management of enterprise data. ● Enhance integration of business processes ● Ensure regulatory compliance
		EA Stakeholder Participation (adapted from Schmidt and Buxmann (2011))	Formative	To what extent do the following statements reflect the current situation in your organisation: ● Top management is actively involved in EA activities. ● We ensure a high level of stakeholder participation in establishing EA content and standards. ● Target EA plans are approved by all relevant stakeholders (eg. Architecture board)
		EA Skills and knowledge (adapted from Lange et al. (2016))	Formative	To what extent does your organisation have EA professionals with the following attributes: ● Deep knowledge of the organisation's business. ● Deep knowledge of the organisation's IT systems. ● Excellent communication skills. ● Ability to provide valuable consulting services.
EA Governance (adapted from Schmidt and Buxmann (2011))	Reflective	NA	NA	To what extent do the following statements reflect the current situation in your organisation: ● We evaluate and review project conformance to EA plans and principles ● We have well-defined review and approval processes to ensure project conformance to EA content and standards. ● Internal directives require the compliance with EA content and standards for all projects. ● Exceptions to EA content and standards are tracked, negotiated and agreed upon.
Use of EA Services in IT-Driven Change (adapted from Wheeler (2002) and Boh and Yellin (2007))	Formative	NA	NA	To what extent are EA services used to assist in decisions to: ● Identify EA-enabled IT change opportunities. ● Prioritise EA-enabled IT change solutions. ● Implement EA-enabled IT change solutions. ● Standardise IT applications across the organisation. ● Measure and assess the value of using EA in IT change.
Use of EA Services in Business-Driven Change (adapted from Wheeler (2002) and Foorthuis et al. (2010))	Formative	NA	NA	To what extent are EA services used to assist in decisions to: ● Identify EA-enabled business change opportunities. ● Prioritise EA-enabled business change solutions. ● Implement EA-enabled business change solutions. ● Standardise business processes. ● Measure and assess the value of using EA in business change.

(*continued on next page*)

Table A1 (*continued*)

Construct	Type	Sub-construct	Type	Items
Project Benefits	Formative	Improved Decision Making (new measure from Bernard (2012); Tamm (2012))	Formative	To what extent do the following statements reflect the current situation in your organisation: ● Business decision-making is improved by EA services. ● Business decision makers are informed by EA services about existing business capabilities and IT systems. ● IT decision-making is improved by EA services. ● IT decision makers are informed by EA services about existing business capabilities and IT systems.
	Formative	Project Management Effectiveness (new measure from (Foorthuis et al. (2016); Lange et al. (2016); Tamm (2012))	Formative	To what extent do the following statements reflect the current situation in your organisation: ● Project portfolio planning is effective and informed by EA services about the interdependencies between systems and processes. ● Coordination within projects is effective, informed by EA services about the division and sequencing of work between projects. ● Solution selection within projects is effective and informed by EA services, content and standards.
	Formative	Improved IT Platform and Systems (new measure from (Ross et al. (2006); Boh and Yellin (2007))	Formative	To what extent do the following statements reflect the current situation in your organisation: ● Our IT platform is flexible and can be quickly and easily adapted. ● IT resource utilization involves opportunities for reuse and reducing duplications. ● Our IT systems are sufficiently compatible, integrated and interoperable as required to support the business.
		Improved Business Capabilities (new measure from (Bharadwaj et al. (2013); Toppenberg et al. (2015))	Formative	To what extent do the following statements reflect the current situation in your organisation: ● We develop new products and services informed by EA services about existing business capabilities and strategic requirements. ● We adapt and combine business capabilities enabled by EA services to foster product and service innovation. ● We develop new business capabilities informed by EA services about existing business capabilities and strategic requirements. ● We foster re-use of business capabilities across the organisation enabled by EA services. ● We minimize redundant business capabilities across the organisation enabled by EA services.
Organisational Benefits	Formative	Agility (adapted from Tallon (2008); Tallon and Pinsonneault (2011)	Reflective	How quickly and easily can your organisation perform the following actions: ● Change (i.e. expand or reduce) the variety of products and services offered. ● Adopt new technologies to produce better, faster and cheaper products and services. ● Respond to changes in customer demand. ● Expand into new regional or international markets.
		Competitive Advantage (adapted from Lange et al. (2016); Tamm et al. (2015))	Formative	To what extent do the following statements reflect the current situation in your organisation: ● We have a higher return on investment than our competitors. ● We have better strategic alignment between business and IT than our competitors. ● We are more successful in integrating strategy and execution than our competitors.
		Value (adapted from O'Cass and Sok (2013); Ross et al. (2006))	Formative	To what extent do the following statements reflect the current situation in your organisation: ● EA services increases value for customers. ● EA services increases value for employees.

Appendix B. Measurement validation

B.1. Common method bias test

The data sample was assessed for common method bias, which would indicate a systematic error of measurement. During the development of the survey, we followed guidelines from the literature to reduce common method bias through various steps, including conducting expert interviews, pre-testing and pilot testing (Podsakoff et al., 2003). These steps ensured that survey items were clear, consistent and non-ambiguous. In addition, clear definitions of EA and capability were provided at the beginning of the survey. All items were grouped and related to specific constructs. During the data collection phase, two attention filters were inserted into the survey. The attention filter questions were general in nature and not related to the constructs. Any incorrect answers to these filter questions meant that the responses were screened out. Following Podsakoff et al. (2003), we performed another test for common method bias, Harman's single factor test. This involves conducting an unrotated factor analysis in SPSS and analysing the solution. The first factor from the analysis explained 37.71% of the total variance. According to Gefen et al. (2011), since the first factor does not explain the total variance, a common method bias is unlikely.

B.2. Measurement validation for reflective constructs

The measurement properties of reflective constructs (EA Governance, Agility) were examined in terms of construct reliability and convergent and discriminant validity. In terms of construct reliability, we report two internal consistency measures in Table B1: composite reliability (ICR) and Cronbach's α (Cα) (Hair et al., 2013). All scales met the 0.70 cut-off, indicating that results based on these scales should be consistent.

Convergent validity was examined by observing the square root of the average variance extracted (shaded diagonal elements in Table B1). A minimum level of 0.70 suggests, on average, the construct accounts for at least 50% of its measures' variance (Fornell and Larcker, 1981; Henseler et al., 2016). Both our reflective scales met this criterion, indicating satisfactory convergent validity.

To examine the discriminant validity of the reflective constructs, we conducted two tests. First, we obtained evidence of discriminant validity by observing that the square root of the average variance shared among a construct's measures (shaded diagonal elements in Table B1) is larger than the correlations between the construct and other constructs (off-diagonal elements) in the model. All measures met this criterion (Fornell and Larcker, 1981; Henseler et al., 2016) suggesting satisfactory discriminant validity. We also established discriminant validity by observing loadings and the difference between the loadings and the cross-loadings. All items loaded highest on their first-order constructs. An acceptable difference between loadings and cross loadings is 0.10 (Henseler et al., 2016; Nevo and Wade, 2011; Wixom and Todd, 2005). As shown in Table B2, all our items met these criteria, providing support for discriminant and convergent validity for our scales. Please note that in Table B2, we report loadings and cross-loadings for all the constructs, however, our focus at this stage is mainly on validating the measurement properties of reflective constructs. We acknowledge that the loadings for formative constructs are not less relevant and our reporting is for completeness and also to observe cross-loadings.

B.3. Measurement validation for formative constructs

In order to validate the first-order formative measurement models, we first established their content validity by reviewing the literature, specifying the domain and nature of the constructs and refining their indicators using expert interviews (Hair et al., 2013; MacKenzie et al., 2011; Petter et al., 2007). In this way we captured at least the major dimensions of the constructs. We also carefully checked the direction of causality, interchangeability of indicators, covariation among indicators and nomological net of the indicators in the design of our formative constructs (Petter et al., 2007). Furthermore, we were careful to relate the measures to the existing theory from the information systems and related literature to minimise interpretational confounding (Kim et al., 2010). To ensure the reliability of the first-order formative constructs, we examined multi-collinearity using the Variance Inflation Factor (VIF) (Henseler et al., 2016; Petter et al., 2007). All the VIF scores were less than 5, suggesting collinearity is not a problem in this analysis (see Table B3) (Hair et al., 2013). To further validate the formative measurement model, we examined relative contribution (weights) of each indicator to its corresponding first-order construct (Hair et al., 2013) (see Table B3)..All indicators were important (relative to each other) and significant in forming their first-order constructs, providing evidence that they are valid dimensions of the construct.

We also examined the validity of second-order formative constructs using VIF and weights of the first-order component (See Table B4). All the VIF scores were less than 5 (Hair et al., 2013), suggesting there is no multi-collinearity problem. All the first-order constructs were important relative to each other and had significant effect on their second-order constructs (Hair et al., 2013).

Table B1
Reliabilities, AVEs and correlations for reflective constructs.

Constructs	ICR	Cα	EA Governance	Agility
EA Governance	0.873	0.805	**0.795**	
Agility	0.841	0.750	0.537	**0.756**

Notes: ICR is the internal consistency measure (composite reliability) and Cα is the Cronbach's alpha. Bolded diagonal elements are the square root of the AVE among constructs and associated measures. Off-diagonal elements are correlations among constructs.

Table B2
Loadings and cross-loading.

Constructs	Indicators	1	2	3	4	5	6	7	8	9	10	11	12	13	14
EA Content	eacont1	0.791	0.520	0.420	0.472	0.507	0.467	0.450	0.482	0.520	0.426	0.509	0.361	0.332	0.454
	eacont2	0.806	0.531	0.497	0.444	0.456	0.436	0.359	0.476	0.386	0.499	0.441	0.458	0.421	0.427
	eacont3	0.749	0.536	0.349	0.339	0.354	0.409	0.385	0.405	0.428	0.398	0.494	0.351	0.367	0.449
	eacont4	0.742	0.477	0.383	0.380	0.472	0.490	0.442	0.308	0.416	0.448	0.435	0.395	0.349	0.424
	eacont5	0.721	0.458	0.361	0.412	0.447	0.449	0.407	0.347	0.402	0.427	0.428	0.437	0.330	0.410
EA Standards	eastand1	0.563	0.817	0.463	0.538	0.532	0.572	0.517	0.551	0.575	0.450	0.587	0.441	0.469	0.546
	eastand2	0.572	0.782	0.448	0.436	0.450	0.486	0.420	0.451	0.466	0.412	0.464	0.451	0.349	0.404
	eastand3	0.477	0.808	0.554	0.476	0.498	0.513	0.446	0.516	0.529	0.452	0.509	0.378	0.405	0.411
	eastand4	0.501	0.774	0.484	0.465	0.511	0.533	0.493	0.522	0.601	0.497	0.580	0.510	0.452	0.485
	eastand5	0.504	0.792	0.490	0.513	0.493	0.482	0.449	0.475	0.460	0.430	0.446	0.329	0.371	0.434
People Skills	eaprofs1	0.467	0.452	0.809	0.586	0.564	0.455	0.362	0.560	0.439	0.426	0.431	0.402	0.501	0.474
	eaprofs2	0.500	0.522	0.813	0.459	0.479	0.414	0.325	0.468	0.358	0.464	0.389	0.281	0.418	0.363
	eaprofs3	0.372	0.472	0.759	0.524	0.421	0.394	0.296	0.391	0.388	0.426	0.391	0.340	0.368	0.366
	eaprofs4	0.299	0.447	0.711	0.530	0.415	0.338	0.321	0.329	0.261	0.401	0.326	0.333	0.319	0.304
Stakeholder Participation	stakepar1	0.497	0.452	0.544	0.798	0.538	0.467	0.466	0.447	0.490	0.460	0.489	0.448	0.448	0.445
	stakepar2	0.431	0.550	0.558	0.850	0.647	0.524	0.446	0.495	0.469	0.412	0.491	0.468	0.440	0.441
	stakepar3	0.391	0.497	0.522	0.780	0.589	0.456	0.376	0.372	0.441	0.410	0.468	0.336	0.341	0.442
EA Governance	eagov1	0.439	0.448	0.480	0.633	0.775	0.477	0.503	0.518	0.437	0.354	0.511	0.429	0.428	0.419
	eagov2	0.485	0.528	0.513	0.626	0.848	0.538	0.487	0.539	0.520	0.457	0.495	0.468	0.456	0.470
	eagov3	0.436	0.503	0.467	0.515	0.761	0.497	0.490	0.408	0.512	0.415	0.483	0.371	0.388	0.444
	eagov4	0.523	0.513	0.481	0.543	0.793	0.592	0.479	0.430	0.551	0.526	0.564	0.437	0.460	0.510
Use of EA Services in IT Change	itchg5	0.490	0.555	0.471	0.564	0.498	0.798	0.503	0.454	0.497	0.460	0.495	0.415	0.352	0.469
	itchg6	0.521	0.538	0.434	0.485	0.580	0.850	0.619	0.503	0.611	0.455	0.527	0.396	0.401	0.506
	itchg7	0.360	0.435	0.354	0.359	0.489	0.708	0.515	0.491	0.470	0.412	0.461	0.362	0.364	0.458
	itchg8	0.456	0.529	0.369	0.433	0.558	0.819	0.553	0.546	0.531	0.460	0.560	0.462	0.483	0.508
Use of EA Services in Business Change	buschg4	0.414	0.445	0.328	0.342	0.434	0.471	0.743	0.462	0.492	0.441	0.512	0.497	0.393	0.527
	buschg5	0.412	0.458	0.385	0.426	0.487	0.601	0.810	0.514	0.524	0.432	0.558	0.435	0.438	0.406
	buschg6	0.387	0.464	0.300	0.442	0.531	0.583	0.800	0.459	0.495	0.442	0.534	0.452	0.404	0.418
	buschg7	0.482	0.528	0.342	0.491	0.540	0.561	0.873	0.537	0.582	0.467	0.556	0.508	0.407	0.537
Improved Decision Making	outcitc1	0.418	0.477	0.458	0.446	0.536	0.533	0.505	0.764	0.545	0.460	0.569	0.525	0.485	0.501
	outcit2	0.516	0.585	0.514	0.422	0.522	0.548	0.585	0.864	0.630	0.606	0.636	0.575	0.616	0.545
	outcb1	0.427	0.511	0.445	0.445	0.442	0.475	0.507	0.833	0.599	0.477	0.676	0.425	0.486	0.532
	outcb2	0.427	0.515	0.485	0.493	0.495	0.494	0.442	0.838	0.627	0.517	0.651	0.564	0.559	0.561
Project Management Effectiveness	outcit3	0.517	0.570	0.404	0.490	0.578	0.582	0.561	0.640	0.887	0.577	0.716	0.533	0.548	0.546
	outcit4	0.483	0.533	0.347	0.449	0.502	0.531	0.533	0.580	0.828	0.525	0.672	0.523	0.518	0.557
	outcit5	0.425	0.585	0.438	0.526	0.532	0.573	0.563	0.629	0.823	0.494	0.653	0.504	0.504	0.540
Improved IT Platform and Systems	outcit6	0.351	0.309	0.353	0.370	0.359	0.344	0.369	0.442	0.380	0.725	0.552	0.527	0.519	0.444
	outcit7	0.421	0.479	0.422	0.361	0.334	0.442	0.397	0.480	0.524	0.789	0.549	0.448	0.459	0.475
	outcit8	0.568	0.516	0.515	0.503	0.575	0.515	0.509	0.557	0.562	0.853	0.576	0.543	0.466	0.510
Improved Business Capabilities	outcb3	0.461	0.470	0.437	0.459	0.562	0.463	0.507	0.616	0.634	0.554	0.797	0.527	0.608	0.539
	outcb4	0.477	0.563	0.390	0.497	0.476	0.442	0.505	0.607	0.637	0.524	0.788	0.529	0.513	0.556
	outcb5	0.462	0.550	0.332	0.477	0.479	0.548	0.578	0.600	0.644	0.596	0.803	0.526	0.506	0.534
	outcb7	0.486	0.502	0.388	0.453	0.533	0.483	0.491	0.612	0.642	0.534	0.795	0.495	0.557	0.547
	outcb8	0.484	0.503	0.426	0.471	0.512	0.566	0.537	0.609	0.623	0.555	0.773	0.497	0.447	0.472
Agility	agility1	0.296	0.331	0.207	0.303	0.403	0.397	0.468	0.335	0.378	0.339	0.360	0.665	0.371	0.393
	agility2	0.491	0.378	0.393	0.436	0.402	0.363	0.444	0.536	0.414	0.563	0.509	0.789	0.622	0.619
	agility3	0.425	0.457	0.388	0.396	0.368	0.391	0.436	0.595	0.526	0.515	0.526	0.826	0.583	0.585
	agility4	0.358	0.435	0.287	0.425	0.471	0.416	0.423	0.399	0.538	0.475	0.559	0.734	0.431	0.502
Value	orgb2	0.429	0.469	0.511	0.498	0.506	0.475	0.451	0.633	0.592	0.531	0.576	0.585	0.877	0.589
	orgb3	0.414	0.453	0.427	0.411	0.466	0.409	0.444	0.534	0.509	0.529	0.596	0.616	0.898	0.597
Competitive Advantage	orgb1	0.435	0.441	0.386	0.416	0.462	0.436	0.463	0.510	0.482	0.438	0.524	0.626	0.572	0.853
	orgb4	0.466	0.431	0.387	0.481	0.501	0.498	0.454	0.533	0.529	0.490	0.596	0.524	0.526	0.793
	orgb5	0.505	0.565	0.445	0.479	0.495	0.582	0.530	0.574	0.602	0.580	0.557	0.585	0.558	0.833

Table B3
Outer weights significance testing results for first-order constructs.

Construct	Indicators	VIF	Weights
EA Content	eacont1	1.661	0.315***
	eacont2	1.655	0.378***
	eacont3	1.804	0.164*
	eacont4	1.947	0.235**
	eacont5	1.769	0.207***
EA Standards	eastand1	1.903	0.294***
	eastand2	1.835	0.224**
	eastand3	2.055	0.229***
	eastand4	1.796	0.252***
	eastand5	1.789	0.259***
EA people skills	eaprofs1	1.626	0.303***
	eaprofs2	1.553	0.318***
	eaprofs3	1.596	0.306***
	eaprofs4	1.496	0.332***
EA Stakeholder Participation	stakepar1	1.939	0.448***
	stakepar2	2.169	0.413***
	stakepar3	1.921	0.372***
Use of EA services in IT-driven change	itchg5	1.463	0.404***
	itchg6	1.913	0.383***
	itchg7	1.724	0.164*
	itchg8	1.901	0.288***
Use of EA services in business-driven change	buschg4	1.642	0.218*
	buschg5	1.723	0.348***
	buschg6	1.994	0.224*
	buschg7	2.022	0.432***
Improved decision making	outcb1	1.893	0.318***
	outcb2	1.843	0.339***
	outcit1	1.821	0.195***
	outcit2	2.087	0.350***
Project management effectiveness	outcit3	1.949	0.447***
	outcit4	1.809	0.336***
	outcit5	1.567	0.395***
Improved business capabilities	outcb3	1.926	0.244***
	outcb4	1.973	0.229***
	outcb5	1.959	0.282***
	outcb7	1.955	0.218***
	outcb8	1.844	0.290***
Improved IT platform and systems	outcit6	1.358	0.317***
	outcit7	1.411	0.401***
	outcit8	1.377	0.532***
Value	orgb2	1.497	0.537***
	orgb3	1.497	0.589***
Competitive advantage	orgb1	1.527	0.481***
	orgb4	1.813	0.303***
	orgb5	1.891	0.420***

Table B4
Outer weights significance testing results for second-order constructs.

Construct	Sub-construct	VIF	Weights
EA Service provision capability	EA Content	1.913	0.318***
	EA Standards	2.246	0.385***
	People skills	2.093	0.256***
	Stakeholder participation	2.111	0.225***
Project benefits	Improved decision making	2.831	0.307***
	Project management effectiveness	2.116	0.193***
	Improved business capabilities	4.113	0.376***
	Improved IT platform and systems	3.406	0.243***
Organisational benefits	Value	2.379	0.293***
	Competitive advantage	2.587	0.391***
	Agility	2.531	0.428***

*p ≤ .0.05.
**p ≤ 0.01.
*** p ≤ 0.001.

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