Making Connections: A Typological Theory on Enterprise Architecture Features and Organizational Outcomes

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ABSTRACT

Enterprise Architecture (EA) is an important concept, promising various benefits such as reducing redundancy in IT investments, aligning IT strategy and business strategy, and enhancing communication between IT specialists and business leaders. Experts suggest that the more mature an organization's EA, the greater benefit the organization will achieve. However, because EA is a conceptual innovation, organizations have more flexibility in implementing EA. Thus, it is possible that the expected outcomes from implementing EA depend not only on how well EA is implemented, but also on *the kinds of EA* that are implemented (i.e., EA features). In this preliminary study, we propose a typological theory that links EA features with organizational outcomes. We analyze five popular branded EA frameworks to identify the types of EA features and frameworks that are connected to specified outcomes. Several hypotheses are presented, and future research is needed to further connect EA features to organizational outcomes.

Keywords

Enterprise Architecture, features, affordances, typology, organizational outcomes

INTRODUCTION

Enterprise Architecture (EA) is important because it is linked with outcomes such as reduced redundancy of IT investments, greater alignment between IT strategy and business strategy, and better communication between IT specialists and business leaders (Boh and Yellin, 2007; Ross, Weill and Robertson, 2006; Salmans and Kappelman, 2010; Tamm, Seddon, Shanks and Reynolds, 2011). Experts recognize that the benefits of EA may depend on how well companies implement EA. To capture variation in how well organizations implement EA, experts have proposed a variety of EA maturity models (NASCIO, 2003; Ross, 2003). The basic idea is: the more mature a company's EA discipline, the better benefits the company will achieve.

However, EA is a conceptual innovation which has more conceptual components. Thus, it has high *interpretive flexibility* (Orlikowski, 1992) and grants more *subjective interpretations* unto prospective adopters (Birkinshaw, Hamel and Mol, 2008). As a result, organizations have greater flexibility in implementing EA. A recent Gartner study showed that most organizations chose a home-grown or hybrid EA framework rather than using one of the many branded EA methodologies (Gall, 2012).

In this paper, we raise the question of whether the outcomes organizations achieve from implementing EA may depend, not just on how well they implement EA (for example, achieving certain EA maturity stages), but also on *the kind of EA* they implement; that is, the version and features of EA they actually use and the affordances provided by those features. Our research question is: *what are the links between the adopted EA features and organizational outcomes*?

To answer this question, we propose a typological theory on EA features. A typological theory specifies and categorizes independent variables (e.g., EA features) into configurations or *types*. A typological theory is used to specify the pathway through which particular types connect to specific outcomes (George and Bennett, 2005). Therefore, the contribution of the proposed typological theory is that it specifies a link between EA features and expected organizational outcomes. We argue that by understanding *what kind of* EA organizations implement (i.e., what EA features they use), we will have a better understanding of the benefits organizations gain *than* if we look solely at *how well* organizations implement EA (i.e., the typical EA maturity model).

The rest of the paper is as follows. First, we quickly review the concept of Enterprise Architecture, its definition, characteristics, and expected outcomes. We then group these outcomes into a small set of outcomes. Next, five popular branded EA frameworks are analyzed, upon which we build to propose a typological theory on EA features and organizational outcomes. Hypotheses are developed, and we conclude with future research directions.

WHAT IS ENTERPRISE ARCHITECTURE?

It is not difficult to find various EA definitions, some are quite contradictory to each other. For example, Ross et al. (2006) defines EA as "the *organizing logic* for business processes and IT infrastructure" (p. 9)(emphasis added) while the SIM EA

Working Group (SIMEAWG) defines EA as "the holistic view *set of descriptions* about the enterprise over time" (p 2) (emphasis added). For the purpose of classification, we would simply define EA as *one of several strategic planning programs* that aim to align IT with business strategy. The objective is to reduce redundancy in IT investments and to increase strategic competitiveness of organizations.

Characteristics of Enterprise Architecture

Enterprise Architecture has several distinct characteristics; each has important implications for its adopters.

First, EA has ***more conceptual components*** than technical and material components, consisting mostly planning processes and documentations (Tamm et al., 2011). This sets EA apart from technological innovations, which are made up mostly from technical and material components (e.g., data warehouses, enterprise systems). Most of EA developments involve activities at an abstract level, such as modeling activities, standardizing procedures, or coordinating decisions. There are limited activities that involve technical and physical IT artifacts, like setting up databases, purchasing software packages, or installing enterprise systems.

> **Implication***:* EA therefore does not require intensive capital investment, but it requires intensive collaboration and devotion across business functions (i.e., effort intensive). Because the goal is to achieve alignment between IT and business strategy at an *enterprise perspective*, the challenge is to find support not only from executive managers, but also from middle-level managers who contribute to EA developments, and later use EA in their decision making process. With low capital requirement, but high effort-intensity, many overlook the necessity of EA, and find it difficult to commit their time and energy.[1]

Second, EA has high ***interpretive flexibility*** (Orlikowski, 1992), or the involvement of adopters to constitute the realizations of the innovation. Because EA contains more conceptual components, it allows more subjective interpretations from prospective adopters (Birkinshaw et al., 2008), giving them the flexibility to interpret and comprehend EA in ways that most fit their needs.

> **Implication***:* Many find it easier to reinvent or customize existing EA frameworks to fit their needs. Although adjustments and customizations are often needed at some levels to implement an innovation, in the case of EA, adopters experience a higher flexibility to adjust EA frameworks into their organizations. A recent survey from Gartner found that up to 37% of EA adoption used a homemade or hybrid framework (Gall, 2012). Among the rest, no branded framework accounts for more than 8% of organizations.

Finally, EA adoption may be more susceptible to ***knowledge barriers*** (Attewell, 1992). Having less technical and material components, EA proponents are often left with abstract and theoretical principles to induce their own actionable items. Consequently, this leaves a huge knowledge burden on adopters to figure out and accumulate the necessary know-how to carry out the adoption, something Attewell (1992) terms *knowledge barriers*. As a result, the adoption process can unfold over years, and involve a lot of interpretations and discussions.

> **Implication***:* In many cases, prospective adopters seek for necessary knowledge from external sources, such as consulting firms, conferences, associations, news reports of success stories, or academic research. A report from the U.S. Government Accountability Office (GAO) identified that around 75% of EA development costs, or about $610 million dollars, in federal agencies came from contractors' services (e.g., support, training, and consulting) (GAO, 2006). This perhaps explains the exponential growth in EA models, characterized as the "jungle of EA frameworks" (Schekkerman, 2004), by consulting firms, associations, or practitioner groups in responding to the demand for know-how knowledge from adopters.

Expected Outcomes of Enterprise Architecture

One of the reasons why EA is an important concept because it is linked to significant organizational outcomes such as lower IT costs or greater alignment between IT strategy and business strategy (Boh and Yellin, 2007; Ross et al., 2006; Salmans and Kappelman, 2010). In general, there are five most important outcomes attributed to effective use of EA. (See Radeke (2010), Foorthuis, van Steenbergen, Mushkudiani, Bruls and Brinkkemper (2010), or Tamm et al. (2011) for more systematic literature review on EA benefits.)

1. **Increase system integration and standardization**: EA is found to increase system interoperability, allowing firms to overcome the issues of system incompatibilities (Richardson, Jackson and Dickson, 1990). It creates a standardized and integrated environment for business processes, thus increases sharing and integration between business functions (Boh and Yellin, 2007; Venkatesh, Bala, Venkatraman and Bates, 2007).

[1] Observations made from preliminary interviews

2. **Improve IT-business alignment**: studies on EA benefits in general agree that EA can enhance alignment between IT strategy and business strategy (Radeke, 2010; Tamm et al., 2011). A survey by the Society of Information Management (SIM) EA Working group found that a majority of IT professionals used EA as a tool for decision making, alignment, and communicating organizational objectives (Kappelman, McGinnis, Pettile and Sidorova, 2008). In fact, IT-business alignment is an objective of EA since its inception (Sessions, 2007).
3. **Overcome system complexity**: another original objective that EA has is to solve the problem of system complexity (Sessions, 2007). By providing a blueprint of IT architecture, EA enables communication between business functions in a holistic way (Schekkerman, 2004). Many IT specialists reported to use EA as a tool to better communicate their objectives to business leaders (Kappelman et al., 2008).
4. **Build effective IT management**: the uses of EA for effective IT management are also recognized by practitioners and academics. Many reported that EA can reduce IT costs and risks, increase IT responsiveness, increase management satisfaction, and increase resource management (Bernard, 2004; Ross et al., 2006; Salmans and Kappelman, 2010). The use of EA as a "best practice" for IT management was recognized in the early 1990s, to the extent that the government issued the Clinger-Cohen Act in 1996 which mandated IT architecture in all federal agencies (Kappelman, 2010).
5. **Create strategic competitiveness**: in recent years, many researchers asserted that EA can create or increase strategic competitiveness of organizations. Ross and her colleagues at MIT argued that matured IT architecture can create strategic competences that allow organizations to generate substantial business value (Ross, 2003; Ross et al., 2006). Others have looked at the use of Service-Oriented Architecture (SOA) with EA to increase strategic agility of organizations (Ren and Lyytinen, 2008) or to enhance service delivery (Alwadain, Fielt, Korthaus and Rosemann, 2011).

Summary

In short, EA is an important and interesting phenomenon in its own right. It contains mostly conceptual components, thus it has high interpretive flexibility and is more susceptible to knowledge barriers. EA has been found to link to significant organizational outcomes, such as increase system integration and standardization, improve IT-business alignment, overcome system complexity, build effective IT management, and create strategic competitiveness. In the next section, we develop a typological theory to link EA features to organizational outcomes.

A TYPOLOGICAL THEORY ON ENTERPRISE ARCHITECTURE FEATURES

Research has established that how well EA is implemented will affect the achieved outcomes (Ross, 2003; Salmans, 2010). As a result, several maturity models have been proposed as a means to guide EA development (NASCIO, 2003; Ross, 2003). However, because EA is a conceptual innovation, with more conceptual components than technical and material components, organizations have greater flexibility in implementing EA. As a result, the organizational outcomes from implementing EA may depend not only on how well EA is implemented (i.e., a typical maturity model), but also on the *kind of EA* that is implemented. In other words, the version and specific features of EA that organizations choose to adopt may have a significant impact on the outcomes.

Studies have found the significant role of technology features on organizational performance. In a fully cross research on communication media and features, Griffith and Northcraft (1994) found that the communication system features (e.g., anonymity and documentation) had significant effects on negotiation outcomes, just as much as the communication media did (e.g., paper-and-pencil and computer-mediated systems). Later, Griffith (1999) proposed that technology features can be the trigger for user sensemaking in organizations. Similarly, others argued for the notion of technology features and affordances as the missing link in studying IT effects and outcomes (Markus and Silver, 2008) or organizational change (Zammuto, Griffith, Majchrzak, Dougherty and Faraj, 2007).

Therefore, we theorize that by analyzing the features of EA frameworks that are implemented in organizations, we can better understand the link between EA and specific outcomes *than* if we look solely at how well EA is implemented. To this end, we propose a typological theory on EA features (George and Bennett, 2005). A typological theory is a theory that specifies independent variables (e.g., EA features) into categories on which the researchers would draw hypotheses about how these variables operate independently and in specified conjunctions or configurations (i.e., types) to produce particular effects (e.g., organizational performance).

In the following section, we analyze five branded EA frameworks for features that are prominent and likely to be related to the expected outcomes of EA. Based on their characteristics, those EA frameworks are grouped into a small number of types. We then develop hypotheses to link the use of EA types with EA features and expected outcomes.

Analysis of Branded Enterprise Architecture Frameworks

The five branded EA frameworks that are analyzed in this section are popular EA frameworks found in the public and private sectors. They are the Zachman framework, the Open Group Architecture Framework (TOGAF), the Federal Enterprise Architecture framework (FEA), the Gartner's framework, and the framework of MIT Center of Information Systems Research (CISR).

The Zachman Framework: In 1987, John A. Zachman published an article in an IBM journal which laid down the *ontological* foundation for an Information Systems Architecture (Zachman, 1987). Later, Zachman expanded the original framework and created what is known today as the Zachman framework. The premise of the Zachman framework is the idea of classifying all descriptive models that constitute the architecture of an enterprise. Thus, it is a **taxonomy** for describing a business at enterprise level based on its information and technical characteristics. Although it does not provide a methodology, or the process of doing Enterprise Architecture (Zachman, 2011), it does, in fact, inspire many other subsequent EA frameworks, such as the TOGAF or the FEA framework.

The TOGAF Framework: TOGAF is a framework consists of a detailed method and a set of supporting tools for developing EA. Its first version was introduced in 1995 based on the Technical Architecture Framework for Information Management (TAFIM) of the U.S. Department of Defense (TOGAF, 2009)(p. 3).

The core of the TOGAF framework is an Architectural Development Method (ADM), a step-by-step approach to develop EA. Thus, it is an example of **EA methodologies** which tells you how to do EA (Sessions, 2007). Other TOGAF components include an Enterprise Continuum that outlines the continuum of architectures and provides taxonomies of architecture and solution artifacts, reference models, an Architecture Governance, and an Architecture Maturity Models. TOGAF's governance and maturity model, however, are still primitive and not well developed like other models.

The FEA Framework: the FEA framework is one of the most used frameworks in the public sector, especially among federal agencies. It was initiated by the CIO Council in April 1998, following the Clinger-Cohen Act of 1996. To date, the FEA framework can be characterized by the followings:

- A segment approach: an incremental approach to Federal Enterprise Architecture by focus on developing architectures for major cross-cutting business areas.
- A set of reference models: these reference models provide taxonomy and ontology for IT resources.
- Architecture in levels: categorizing architectures into enterprise architecture, segment architecture, and solution architecture.
- Results-oriented architecture: utilizing a Performance Improvement Lifecycle that centers on architecture.
- An **assessment framework:** a framework that assess the maturity of EA program.

In short, FEA framework contains a well-developed taxonomy (i.e., reference models), a methodology (i.e., the segment approach), a maturity model (i.e., the assessment framework), and some basic levels of governance structure (i.e., architecture in levels, Performance Improvement Lifecycle).

The Gartner Framework: In 2005, Gartner completed the acquisition of Meta Group, its main rival in architecture consultations. Gartner soon merged two companies' architecture knowledge into one. Today, Gartner's EA method does not have a concrete guidance like other frameworks. Instead, Gartner operates on several EA principles and work with its clients to develop a framework that fit their needs.

Gartner's EA principles are listed as below (Lapkin, 2005)(p. 1):

- A "top-down" discipline that has business strategy as trigger for business, information, and technology development.
- Any "solution" that requires business, information, and technology components to interoperate in support of business capabilities.
- Development of future state architecture *before* the current state is documented, as well as a road map to transform the current state to the future state architecture.
- "Architecting" is only *a small part of the job*, and good architect needs also strategizing, communicating, leading and governing.
- EA is not the end in itself, but it is one of several strategic planning disciplines that organizations should practice to align their technology with their business strategy.

In short, Gartner framework does not contain any taxonomy, and its methodology is flexible depending on the needs of its clients (Robertson and Blanton, 2008; Sessions, 2007). Instead, it focuses on a good **governance structure** to develop and link EA with other strategic initiatives.

The CISR Framework: after years of studying IT governance and management in successful organizations, Ross and her colleagues at MIT proposed the CISR's framework as an *organizing logic* to manage and evolve EA (Ross et al., 2006). Their framework is characterized by the following:

- An operating model to guide EA efforts. It outlines different strategic components for EA developments.
- An Enterprise Architecture, defined as an "organizing logic for business processes and IT infrastructure" (Ross et al., 2006)(p. 9). EA evolves through stages of maturity. There are four stages: application silo architecture, standardized technology architecture, rationalized data architecture, and modular architecture.
- An IT engagement model to coordinate and align IT and business activities. It is the mechanism through which changes are carried out.

CISR framework does not have any taxonomy, but its strengths lie in its **governance structure** and **maturity model**. Its influences have been evident for both practitioners and academics.

Table 1 compares the results from the analysis of the five popular branded EA Frameworks. Overall, we identify four typical features found in five branded EA frameworks.

1. **Taxonomy**: an architectural taxonomy or reference of technical standards and procedures. This provides a detail descriptive framework of IT assets and IT processes within an organization. The Zachman framework provides an *ideal* example of a taxonomy.
2. **Methodology**: an architectural development process, that is, a methodology, to transform the IT architecture. A methodology provides detail steps in how to do EA. The TOGAF framework has a clear example of EA methodology.
3. **Maturity model**: an assessment of the maturity and effectiveness of EA programs. Maturity models are found in the FEA framework or CISR framework.
4. **Governance structure**: consisting of governance disciplines to connect EA with decision makings and to generate business value from EA. Examples include strategic directions, decision rights, project life cycle, and relationships with other strategic initiatives. The governance structure feature is found in the Gartner and CISR framework.

Features	Taxonomy	Methodology	Maturity	Governance Structure
Zachman	++			
TOGAF	+	++	+	+
FEA	+	+	+	+
Gartner		+		++
CISR		+	++	++

"+" means the feature is presented; "++" means the feature is well developed; blank means no feature is found

Table 1: Comparison of Five Popular Branded EA Frameworks

A Typology on Enterprise Architecture Features and Frameworks

In this section, we develop a typology on EA features and frameworks. Based on the analysis above, we identify two types of EA frameworks and two types of EA features, presented below.

EA frameworks can be classified into two types: enterprise IT architecture (EITA) (Kettinger, Marchand and Davis, 2010; Lucke, Krell and Lechner, 2010) and enterprise architecture management (EAM) (Radeke, 2010, 2011; Schmidt and Buxmann, 2011).

- EITA is a technical-oriented type of EA whose objective is to achieve an enterprise-wide view and development on IT architectures, IT standards, and IT procedures. EITA has its root from an engineering and system architecting perspective, with features such as taxonomy or architectural methodologies. Examples are the Zachman framework, the TOGAF framework, or the FEA framework.

- EAM is a business-oriented type of EA whose objective is to holistically organize and manage IT systems for the purposes of transforming and making continuous improvements. EAM comes from a management and strategic planning perspective, focusing on features such as maturity model or governance structure. The Gartner and CISR framework are examples of this type.

EA features can also be categorized into two types: EA as a plan and EA as a planning process (Tamm et al., 2011).

- "EA as a plan" features: focus on the assessment of the *current effectiveness* of IS/IT. EA is used as a *plan* to inform the managers the current status of the IT system and application developments. The metaphor often used is a blueprint or a map. A taxonomy and a maturity model are features of this type.
- "EA as a planning process" features: focus on achieving *future effectiveness* of IS/IT. EA is used as *a planning process* to transform current IT systems and applications to a desirable state. EA is often defined as a "management discipline" or an "organizing logic" under this type, characterized by features such as methodologies or governance structure.

Table 2 provides a typology on EA features and frameworks. Note that a framework can appear in multiple quadrants depending on the features it has.

		EA Features	
		"EA as a plan"	"EA as a planning process"
EA Frameworks	Enterprise Architecture Management	**Feature:** maturity model **Example**: TOGAF, FEA, and CISR framework	**Feature:** governance structure **Example**: CISR and Gartner framework
	Enterprise IT Architecture	**Feature:** taxonomy **Example**: Zachman framework, FEA, and TOGAF	**Feature:** methodology **Example**: TOGAF, FEA, Gartner, and CISR framework

Table 2: A Typology on EA Features and Frameworks

Hypotheses Development

In this section, we generate several hypotheses to link the types of EA features and frameworks to organizational outcomes. Recall from the previous section, there are generally five most important outcomes attributed to EA: increase integration and standardization, improve IT-business alignment, overcome system complexity, build effective IT management, and create strategic competitiveness.

First, because a taxonomy provides a descriptive framework for all IT assets and processes, it allows managers to identify redundancy and streamline their IT activities. A thorough taxonomy also allows different business functions communicate better based on a common understanding of IT systems. Thus, we postulate,

> H1a: *Organizations with an EA taxonomy feature will likely to experience higher integration and standardization than organizations without an EA taxonomy*.
>
> H1b: *Organizations with an EA taxonomy feature will less likely to suffer from system complexity than organizations without an EA taxonomy*.

Furthermore, EA framework that has a methodology will assist organizations in their implementation, thus more likely to better align IT strategy with business strategy.

> H2a: *Organizations with an EA methodology will likely to experience greater IT-business alignment than organizations without an EA methodology*.

Also, a good governance structure also allows organizations to effectively implement EA in relation to other business activities. Ross et al. (2006) found that effective EA governance structure was more likely to result in IT-business alignment. Therefore,

> H2b: *Organizations with an EA governance structure will likely to experience greater IT-business alignment than organizations without an EA governance*.

On the other hand, a maturity model allows managers to assess the current effectiveness of EA development, while taking advantage of the evolving IT architecture. We suggest,

> H3: *Organizations with an EA maturity model will likely to have more effective IT management practices than organizations without an EA maturity model*.

Finally, a governance structure will allow managers to generate strategic competences based on existing IT architecture (Ross et al., 2006). Thus,

> H4: *Organizations with an EA governance structure will likely to have greater strategic competitiveness than organizations without an EA governance structure*.

Taken together, an EA framework with maturity model and governance structure, that is, a EAM type, will be more likely to gain greater benefits on IT management and planning, while an EA framework with taxonomy and maturity model, that is, an EITA type, will be more likely to gain greater technical benefits (e.g., system integration, standardization). Thus, we propose,

> H5: *Organizations using an EAM type of Enterprise Architecture will have greater benefits on IT management and planning than organizations using an EITA type*.

CONCLUSION

EA is a conceptual innovation; therefore, organizations have more flexibility in implementing EA. As a result, organizational outcomes achieved from implementing EA may depend not only on how well EA is implemented but also on the features that are implemented. In this preliminary study, we propose a typological theory on EA features on which we generate several hypotheses to link EA features and organizational outcomes. It provides the first step for those who are looking for a way to examine the benefits of doing EA. Future research, in forms of surveys or case studies on the actual EA efforts, would further validate the proposed hypotheses.

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