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IT architects and IT-business alignment: a theoretical review

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Abstract

The strategic significance of IT architecture has been recognized for decades. However, the roles of IT architects and their importance to IT-business alignment are still underrated in theory and practice. This article provides a literature review, classifies the roles of IT architects, and describes their influence on IT-business alignment. The main aims of IT architects are effective and efficient selection and integration of IT components/services to meet the business requirements by providing guidance and standards. Eight types of IT architects were found that perform at the strategy/business level and the project/solution level. Enterprise architects are essential for achieving IT-business alignment; they can shape an organization's IT landscape towards business flexibility or standardization in order to differentiate on the market or lead on costs.

1. Introduction

IT architecture is a source of differentiation and can translate into competitive advantage for a firm [1, 2]. It is an element of the strategic alignment process along with IT strategy, business strategy, and the organization [3]. IT architecture relates to IT planning and is integral to an organization's IT [4, 5]. However, there is no universally agreed upon definition for IT architecture [4, 6]. In practice, the term architecture is hardly understood outside the

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construction industry [7]. The role of the IT architect remains vague in the literature and in practice [8, 9, 10]; few researchers have studied the IT architects' roles [11]. Consequently, little is known about the role of IT architects for achieving IT-business alignment.

The major aim of this study is to develop an understanding about the roles of IT architects and their influence on IT-business alignment. This paper seeks to address two research questions. First, what types of IT architects exist and which of these refer to IT-business alignment? Second, how can IT architects align to the business strategy?

A theoretical review was carried out [12]. The purpose of this method is to study the body of knowledge that has been gathered regarding the types of IT architects and their impact for attaining IT-business alignment. The literature was studied to identify various IT architect types based on their tasks, responsibilities, and outcomes (i.e., artifacts). The study suggests that enterprise architects act at the strategic level and vastly influence IT-business alignment. In the course of this, business architects or business analysts may support enterprise architects for a more accurate elicitation of the business requirements.

The following section describes the role of the IT architect in general. Then, in the third section, various types of IT architects are presented and assigned to either the strategy/business level or the project/solution level. The fourth section explicates the signification of IT-business alignment. The enterprise architects' impact on IT-business alignment is discussed in section number five. Finally, in the conclusion section, the key statements are summarized and future research directions are pointed out.

2. The role of the IT architect in general

IT architecture is concerned with IT planning and is inherent to an organization's IT [4, 5]. The creators of IT architectures are often referred to as IT architects, a term which is a representation of the role that is responsible for the development of IT architecture [13, 14]. The development of IT architecture is a key topic in strategic IT planning alongside IT-business alignment, competitive advantage, and IT resource management [1]. IT architectures are developed by defining IT capabilities in accordance with policies and technical choices to support the strategic objectives of an organization [6]. However, there is no definition for IT architecture that is universal and generally accepted [4, 6]. Occasionally, IT architecture is used as a synonym for IT infrastructure or technology standards of an organization [6]. The related notion of enterprise architecture can also be confusing [15]. If the terms IT architecture and enterprise architecture are not clear in academia, the roles of IT/enterprise architects in practice will also be unclear and inconsistent.

Seminal publications that treated IT architecture signified the need for effective and efficient integration of IT. Zachman [16] outlined IT architecture as a logical construct to define interfaces and integrate all components of an IT system. Similarly, Earl [4] considered IT architecture as a framework for IT integration (systems, interfaces, and compatibilities) and IT choices over time. Keen [17] emphasized the need to balance competing demands with regard to the integration of all IT resources: maintenance of options for new IT resources, accommodation of standards, and protection of investments. Efficiency and effectiveness are not only basic needs for architectural design and implementation but also criteria for the selection of IT resources [17, 18]. The selection of IT resources requires trade-off analyses from IT architects [19]. IT architects are to design and implement the IT components/services efficiently and effectively so that these are in line with the scope, capabilities, and governance of the IT strategy [18].

The extant literature provides various descriptions for IT architects that complement aforementioned key attributes of IT architecture. The important features of IT architecture are guidance, business requirements, and standards. IT architecture sets guidelines for the development of IT applications, integrates open systems from multiple vendors, manages networks, and provides data access, security, and control to the organization [20]. IT architecture also provides guidance to an organization for analysis, design, and implementation of the IT infrastructure to meet IT and business requirements over time [4]. It must provide structures to implement the requirements of the business effectively [4]. IT architecture is a blueprint comprising long-term organizational requirements for IT at a high level as well as a detailed plan for combinations of IT and non-IT resources/capabilities within a cohesive whole [21]. Architectural policies and standards (i.e., rules, protocols, and specifications that are shared by various business entities) mature as the IT architecture develops [21]. The IT architecture of an organization encompasses IT applications and physical resources for data processing, storage, and transport [22]. Henderson and Venkatraman [18] subdivided IT architecture into data architecture, IT application portfolio, and configurations of hardware, software,

and communication equipment. Overall, IT architecture helps create IT applications and the IT infrastructure for achieving business flexibility or business standardization [23].

In this paper, IT architecture is used as a synoptic notion covering all architectural activities and outcomes. IT architecture embraces different levels and various functions with associated roles (e.g., enterprise architects, solution architects). As the terminology for IT architecture is not uniform, the subordinated expressions are also heterogeneous and occasionally confused. Organizations allocate IT-architecture tasks to different roles with various names [14]. Although research on types of IT architects has been scarce [14], a few categories of IT architects are presented in the literature, but these differ as well.

3. Different types of IT architects perform at two main levels

IT architects operate at distinct levels. Martin, Dmitrieva, and Akeroyd [24] reviewed the information architecture literature and mentioned two main levels. The upper level is the enterprise level for delivering the value of "integration, flexibility, and reuse"; the lower level is the solution or project level in which individual systems are created. From qualitative research, Akenine [25] identified IT architect roles at three levels: a strategic level connected to the business, a technical level for solution design, and an intermediate level between business and technology.

Akenine's [25] goal was to find consistent roles for IT architects. A focus group of experts from distinct industries conducted workshops and reviews to characterize the roles of IT architects based on 40 artifacts and architectural deliverables. So, four roles of IT architects were suggested that provided typical artifacts (Table 1).

Table 1. IT architect types, main responsibilities, and typical artifacts [14, 25, 26]

IT architect type	Tasks and responsibilities	Typical artifacts
Enterprise architect	Overall IT strategy IT support of business strategy Cost-effectiveness of IT architecture (i.e., IT investments are aligned to the organization's business) Governance Global technical standards	IT strategies Capability maps City plans Integration strategies As-is/to-be analyses Architectural principles, etc.
Business architect	Requirement analysis (organization/business/processes, technical solution) Process improvement Process modeling Benefit realization from projects	Process maps Use cases Information models
Solution architect	Solution design based on requirements Balance of functional and non-functional requirements (trade-offs, priorities) Solution integration Reuse of existing functions and services Alignment of solutions to standards Alignment of projects to architectural principles Reuse of existing capabilities by projects	Application diagrams System maps Service interfaces Technical interfaces Integration strategies
Software architect	Structure and design of software systems Functional requirements (flexibility, performance, reusability, testability, and usability) Ongoing project support Tasks may be like those given by solution architects	Frameworks Class models Patterns Aspects

Akenine's [25] research findings were later examined by Figueiredo et al. [14, 26]. Founded on 27 semi-structured interviews with 22 participants from nine firms and grounded theory methods, Figueiredo et al.'s [14, 26] study basically confirmed Akenine's [25] IT-architect typology but suggested eliminating the business architect role. According to Figueiredo et al. [14, 26], the tasks of business architects are performed by enterprise architects or, in case of their unavailability, by solution architects.

Foorthuis and Brinkkemper [27] conducted action research and focus group interviews in a governmental organization that engaged over 2000 employees in the Netherlands. The authors distinguished two IT architecture levels: the enterprise/domain level and the project level. They [27, p. 38] defined enterprise architecture as "the high-

level set of views and prescriptions that guide the coherent design and implementation of processes, organizational structures, information provision and technology within an organization," where views and prescriptions refer to current (as-is) and future states (to-be). Domain architecture is optional and distinguishes from the enterprise architecture by relating to specific groups of products/services, processes, or functions. Finally, project architectures refer to single projects.

The Open Group Architecture Framework (TOGAF) [28] has categorized IT architects in the following manner: enterprise architects ponder on business functions and leadership; segment architects focus on technical solutions for a specific business segment in the value chain; and solution architects concentrate on products, components, systems, and technologies for a specific matter. The segment architect from TOGAF [28] corresponds to the domain architect from Foorthuis and Brinkkemper [27]. TOGAF [28] does not present a project architect as others in the literature have done [27, 29]; instead, a solution architect is mentioned, which is comparable to the solution architect from Akenine [25]. In large companies, IT architects may be employed on an intermediate business-unit level. These architects concentrate on business-unit strategies and coordinate with enterprise architects at the corporate strategy level and architects at the project level [29].

Roles of IT architects have been examined based on activities demanded in the human resources market [30]. Manual content analysis was applied on job advertisements; 37 task categories were inductively developed. As a result, three main types of IT architects were identified: enterprise architects align IT strategies with the business and are responsible for methods, governance, policies, principles, and processes; solution architects specify system requirements and functions for detailed system designs; software architects analyze requirements and design IT applications. Besides, the e-commerce architect and the digital architect were described as emerging types of IT architects.

In a viewpoint article, Unde [31] suggested also three types of IT architects. The enterprise architect acts at the strategic level and is in line with previous descriptions; the technical architect works at the project level and is similar to the solution architect described by Akenine [25]. Unde's [31] solution architect is a hybrid that is technically and strategically positioned between the other types at a program level. With the exception of the solution architect from Unde [31], all other IT architect types can clearly be allocated to either the strategy/business level or the project/solution level. Table 2 displays the types of IT architects at the assigned levels.

Table 2: IT architect types given by various publications

Level	IT architect type	[14]	[25]	[27]	[28]	[29]	[30]	[31]
Strategy/ Business	Enterprise	X	X	X	X	X	X	X
	Business		X*			X**		
	Segment				X			
	Domain			X				
Project/ Solution	Solution	X	X		X		X	X
	Software	X	X				X	
	Project			X		X		
	Technical							X

* Business *analysis*   ** Bus. *unit*

From the seven publications that were reviewed (Table 2), six show three types of IT architects. In total, eight different types of IT architects have been indicated. These were assigned either to the strategy/business level or the project/solution level. All publications include the type "enterprise architect" at the strategic level.

Although there is no generally accepted definition for enterprise architecture [32], there is little doubt in the literature that enterprise architecture represents the highest IT-architectural view of an organization and that it connects IT strategy and business strategy [15, 33]. The key aspects of enterprise architecture are integration and standardization of an organization's IT resources and capabilities that must be logically organized [15, 29, 34] by means of principles, methods, and models [35]. Because of its strategic nature, enterprise architecture adopts a long-term perspective. Thus,

the enterprise architect is the most obvious IT-architect type for IT-business alignment. The sense of IT-business alignment and the connection to enterprise architecture are highlighted in the following two sections.

4. The meaning of IT-business alignment

IT-business alignment is one of the most popular IT-research topics [36]. The principal objectives of IT-business alignment are improvement of performance (lower costs, higher revenues, and higher returns on investment) and competitive advantage through IT. Moreover, additional goals may be quality improvement [37] or reactions to new opportunities [38].

The terms used for IT-business alignment are manifold: strategic alignment of IT [37], business-IT alignment, strategic IT alignment [39], and alignment of IT [40]. From a common understanding, all expressions imply congruence of links between business and IT strategies, including correspondence of the objectives derived from these strategies [41], so that IT applications are consistent with business strategies [42]. High-level planning outputs—that is, the mission statements and the objectives—from both business and IT strategies, must match and comprise business and IT environments [41]. Consistency is crucial because IT decisions impact the business and business decisions affect IT. For example, IT designs can support or hinder subsequent business decisions [17]. A useful definition for IT-business alignment has recently been provided [39, p. 454]: "the extent to which a firm's relative investments in different IT areas (e.g., hardware, application software, maintenance) is consistent with the firm's business strategy." Alignment embraces capabilities, priorities, decisions, and actions from IT areas to support the business strategy of a firm [43].

5. IT-business alignment by enterprise architects

IT architecture is the core of a firm's IT strategy [4]; it combines business strategy, IT capabilities, and human resources [21]. IT architecture is one of the main competences for IT-business alignment; it examines the impacts of IT on business processes [44] and fulfills a central function in the alignment process, along with IT strategy, business strategy, and the organization [3]. IT architecture has been considered as a key alignment component in light of IT processes and infrastructure [18, 45]. It decides on IT resources required to provide an integrated platform. According to Unde [31], IT architecture must define strategies and "make sure" that IT aligns to the business, which includes selecting appropriate IT platforms. IT solutions "must" be planned so that they are aligned to the business [46].

Academic publications that describe IT architecture as a way for IT-business alignment emerged at the beginning of the millennium with an increasing frequency [47]. Zhang, Chen, and Luo [47] reviewed 111 papers, published between 2002 and 2016, from which 40 articles dealt with accomplishing IT-business alignment by using methods from enterprise architecture. Results from a survey in 2002 showed that for 21% of the respondents, the main reason for investing in IT architecture was the improvement of IT-business alignment [48]. Another survey in 2006 with 140 CIOs from hospitals in the USA revealed that the maturity of IT architecture had positive effects on the improvement of IT-business alignment and on IT value [34, 49].

Many authors agreed that enterprise architecture is an effective means for IT-business alignment and IT-value creation [50, 51, 52, 53]; but there are differences in how researchers express the strengths of the need for enterprise architecture to IT-business alignment. For that aim, enterprise architecture has been seen as an "enabler" [55, 56], as a "tool" [6], or an "ability" [23]. Enterprise architecture was also viewed as a necessary "purpose" [57], a "method" [58], a "framework" [59], a "construction" [60], or a "representation of the organization" [61] for IT-business alignment. The "role" of the enterprise architect for accomplishing IT-business alignment was examined for skills [53]; however, alignment activities have been neglected in theory. So, little is known about *how* alignment is realized.

Kettinger, Marchand, and Davis [23] described global business approaches that reflect how enterprise architects can align to a firm's business. In accordance with the globalization approach, a firm can decide on more or less business flexibility and business standardization. Business flexibility offers high responsiveness and tailored product/services for maximized customer value on local markets; business standardization provides process and learning efficiencies and enables highest impact with global approaches. The enterprise architects can build corresponding IT solutions: IT applications (user software) and underlying IT infrastructure (e.g., server hardware, platform software, and networks) can be standardized or customized in accordance with a global business approach

to generate the highest profits for a firm (Table 3). According to Earl [4], IT applications may be aligned to one of the generic strategies from Porter [62]; the outer right column in Table 3 displays the applicable strategy [62].

The multinational approach concerns few countries; IT infrastructure and IT applications are designed to meet local requirements; the firm pursues a focus/differentiation strategy. On the other extreme, in global approaches (over 100 countries), firms may compete on costs, which requires high standardization of all processes, IT infrastructures, and IT applications. International and transnational approaches lie somewhere in between and must weigh business flexibility (customization of IT) and business standardization. The enterprise architect may adjust in favor of flexibility (higher responsiveness, higher costs) or standardization (lower responsiveness, lower costs). The point of differentiation or the cost leadership position can suffer, and the risk of "stuck in the middle" increases [62]. Yet, "stuck in the middle" can also be considered as an opportunity [63].

Table 3: IT-business alignment through IT architecture [derived from 23, 62, 63]

Global business approach	Business flexibility	Business standardization	Enterprise architecture		Generic strategy
			IT infrastructure	IT applications	
Multinational (e.g., 2...8 countries)	High	-	Locally customized	Locally customized	Differentiation (focus on a geographic market segment)
International (e.g., 9...25 countries)	Medium	Low	Regionally standardized	Locally customized	"Stuck in the middle"
Transnational (e.g., 26...100 countries)	Low	Medium	Globally standardized	Regionally customized	"Stuck in the middle"
Global (> 100 countries)	-	High	Globally standardized	Globally standardized	Overall cost leadership

6. Conclusions and future research

Both IT architecture and IT-business alignment are strategically imperative for competitive advantage and value creation. However, little attention has been paid to the roles of IT architects in view of IT-business alignment.

The main aims of IT architects are effective and efficient selection and integration of IT components/services to meet the business requirements. For these purposes, they provide guidance and standards. The literature review has identified eight different types of IT architects that perform at two main levels: the strategy/business level and the project/solution level. All examined papers reflect the strategic orientation of the enterprise architects. The importance of enterprise architects to IT-business alignment has been reflected. Enterprise architects may receive support from business architects or business analysts to improve the alignment.

The global business approaches were used to exemplify how enterprise architects can align to the business and realize competitive advantage through differentiation or cost efficiency. The findings of this article suggest that enterprise architects are essential for achieving IT-business alignment; they are able to shape an organization's IT landscape towards business flexibility or standardization.

Further empirical research may test the hypothesis "enterprise architects are fundamental for accomplishing IT-business alignment" by structured interviews and/or surveys. More studies are needed to understand better the activities, techniques, and tools of enterprise architects to reach the alignment goals. Upcoming investigations may also be carried out on the strategic roles of business architects and business analysts and their cooperation with enterprise architects to advance IT-business alignment. Finally, the functions of IT architects in digital environments (e.g., big data, machine learning, artificial intelligence) need more examinations.

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