

DOES ENTERPRISE ARCHITECTURE SUPPORT THE DIGITAL TRANSFORMATION ENDEAVORS? QUESTIONING THE OLD CONCEPTS IN LIGHT OF NEW FINDINGS

Research full-length paper

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Abstract

Digital transformation commonly refers to a disruptive process that changes significantly the way organizations evolve, compete, interact and create value. Therefore, it is critical for companies to handle with the business potential of innovative digital capabilities, to update their operational and decision making processes and to develop new strategic business models. In this complex endeavor, the evolution of firm's information system is an important facet that brings together technology, organization and human actors. Enterprise Architecture (EA) methods and frameworks are proposed as essential techniques to handle such evolutions. However, the complex and disruptive nature of the underlying transformations raise multiple questions concerning the adequacy of EA for digital transformation projects. Therefore, this paper aims to examine the extent to which existing EA approaches support such projects. It presents an analysis of interviews with both IT and business projects managers from five different companies. We asked about concrete projects, both about the project goals and the EA methods used, but also about the difficulties and challenges they face in their daily work when using EA frameworks. The analysis show that although existing EA frameworks are essential tools to support and drive digital transformation projects, some important contextual and organizational characteristics are missing. These characteristics are discussed and a research agenda is suggested to fill this gap.

Keywords: Digital transformation; Enterprise Architecture strategies, Customer Data management. ROI evaluation, Prioritizing Digital Projects.

1 Introduction

In the age of the digital transformations (DT), information systems (IS) have become very complex by the accumulation of heterogeneous computer projects for punctual and specific needs (TOG, 2011). In this situation, the Information Systems Department faces the challenge of maintaining and evolving the multiple components of the IS: the foundation of technical infrastructure and IT applications, business processes, user skills, etc. Beyond these imperatives, the CIO must constantly ensure alignment between the organization's strategy and the IS. This alignment is the guarantor of the company's competitiveness and survival (J. W. Ross et al, 2006).

Recent years have witnessed rapid advancement in managerial practices and technological tools that aid enterprise to master their Business-IT alignment, and their ability to support informed and timely decisions (Bharadwaj et al., 2013). Among these tools and practices, Enterprise Architecture (EA) and EA Management (EAM) are essential. While EA describes the fundamental structures of an organization (e.g., Infrastructures, processes ...), EAM is concerned with the coordinated development of EA to consistently respond to business and IT goals and ensure their alignment within strategic opportunities, and necessities (Ross et al., 2006). Consultants, systems integrators and research organizations such as Cap Gemini, IBM, Accenture, or Gartner have made a significant contribution to the diffusion of EA in companies.

As shown by many states of the art and states of practice (Lapkin, 2004), (F. Lillehagen, D. Karlsen, 2005), the EA has evolved considerably since the Zachman framework. On the practitioners' side, the EA challenges concern the development of roadmaps for the implementation of changes, IT portfolio management and complexity management, the evaluation of the benefits of EA have also been detailed according to these developments (Schekkerman, 2005), (Abraham et al., 2012), (Winter et al., 2010). However, none of the cited state-of-the-art provides a clear picture of the influence of digital transformation contexts on future practice in the field of EA; when these frameworks were developed, the digital transformation challenges were not yet that obvious. We were focusing more on cost rationalization and IS optimization. According to our consulting experience, there seems to be no regular application of EAM, in current corporate practice, as leading specialist or support service for digital transformations. We believe the main reason is that EAM is considered to be a discipline that is located in the IT departments and mostly about IT while enterprise transformations such as DT is much broader than an IT transformation (Hafsi et al., 2016), and it impacts different aspects of the enterprise. Furthermore, the communication support by EAM currently does not perform better than expected (Abraham et al., 2012), (Winter et al., 2010).

In our daily practice as consultant in EAM and DT, we often notice, when talking to architects, that, on the one hand, architects do not clearly know how to support DT managers, and on the other hand, these managers are not aware of how EAM might support their DT endeavors. While current research usually analyses, from a global perspective, how EAM can add value and support enterprise transformation (e.g., Tamm et al., 2011; Pittl et al., 2017), we consider that there is an urgent need to understand whether the EA is consistent with Digital Transformation context; we focus, on this paper, on adequacy from an organizational and contextual perspective. We focus on two specific research questions:

- RQ1: What are the main challenges of managing the impact of digital transformation projects on IS?
- RQ2: Does EA support these challenges, if not, what are the limits of EA in digital transformation context and how can we evolve EA practice to be more consistent with the new context of DT?

Our approach is original; it compares research and practice by looking at (i) similarities and differences of EA in these two worlds, (ii) comparing hot topics in EA practice with risks already identified in EA-related research. Based on this analysis, we draw few research issued hints on how to deal with the next generation of EA in order to drive and pilot digital transformation; the interviews we conducted with specialists allowed us to propose potential areas for improvement arising from their experiences in the field of EA and digital transformation.

In the next section, we select some references to enrich our background knowledge about digital transformation and enterprise architecture. In section III, we present the results of our interviews. Section IV concludes the paper.

2 Background

2.1 Digital transformation challenges

Digital concurrence has never been so unstable due to more and more demanding customer and new disruptive competitors. CEOs from most industries investigate digitalization opportunities. Different extensive studies on the topic have been piloted by the Digital Business Centre of MIT. (G. Westerman et al, 2011), have interviewed 157 executives from 50 companies in 15 countries and across eight industries over multiple years. And (M. Fitzgerald et al, 2013) have surveyed 1559 executives from all over the world. Digital transformation was defined as “*the use of technology to radically improve performance or reach of enterprises*”. Another more complete definition of the phenomenon is that it can be noticed “*as the changes that digital technology cause or influence in all aspects of human life*” (E. Stolterman et al, 2012). Finally, digital transformation can also be defined as “*the ultimate level of digital literacy that “is accomplished when the digital usages, which have been established, enable innovation and creativity and motivate significant transformation within the professional or knowledge*

domain” (A. Martin, 2008). This last description would seem to go profounder than others because it underlines the motivation for and the consequences of undergoing digital transformation.

These definitions of digital transformation can be classified into two distinct points of view:

- Organizational: A change process that can be experienced and completed (for example by a particular organization) (Ross, et al, 2016), (Kohnke et al., 2017).
- Contextual: A wider phenomenon that disturbs a specific operating environment, such as an industry, or, generally speaking, the surrounding world. (Matt et al, 2015), (Kohnke et al., 2017).

Both points-of-view are used in this research, the first when considering the situation of an organization and the latter when considering the environment in which it operates. We will then use this distinction to structure our research method about the challenges of DT and the limits of the EA.

According to the study by (G. Westerman et al, 2011), “*none of the 50 companies, most of which had a turnover of more than \$1 billion, had successfully transformed transformation projects*”. It would seem that companies are finding major challenges in the area that we’ll notice in table1. To explore this issue, we rely on both studies mentioned above, and on some supplementary publications.

In addition to the studies by Westerman et al. and Fitzgerald et al. (previously introduced), a third study was accomplished by Prahalad and Krishnan and is based on the responses of around 500 senior executives in the context of driving strategic transformation with IT (C. K. Prahalad and M. S. Krishnan, 2002). The other study (J. P. Kotter, 1995) is based on his personal experience in seeing transformation projects fail. We have also pointed out several more recent studies to make sure of the permanence of older studies findings.

Challenge	References
Lack of urgency	(Haffke, 2016), (G. Westerman et al, 2011), (M. Fitzgerald et al, 2013), (C. K. Prahalad and M. S. Krishnan, 2002), (J. P. Kotter, 1995), (Piccinini et al., 2015), (Nwankpa et al., 2016)
Conflicting roles and goals (coordination and leadership issues)	(Haffke, 2016), (G. Westerman et al, 2011), (M. Fitzgerald et al, 2013), (C. K. Prahalad and M. S. Krishnan, 2002), (J. P. Kotter, 1995), (Schwer et al., 2018), (Sandberg et al., 2014)
failing to communicate a global vision	(Ross et al., 2016), (G. Westerman et al, 2011), (M. Fitzgerald et al, 2013), (J. P. Kotter, 1995), (Piccinini et al., 2015), (Nwankpa et al., 2016)
Cultural issues	(Haffke, 2016), (G. Westerman et al, 2011), (M. Fitzgerald et al, 2013), (J. P. Kotter, 1995), (Sandberg et al., 2014)
Useless IT, restrictive legacy systems	(G. Westerman et al, 2011), (M. Fitzgerald et al, 2013), (C. K. Prahalad and M. S. Krishnan, 2002), (J. P. Kotter, 1995)

Table 1. Digital transformation challenges.

2.2 Enterprise Architecture in practice:

Several Studies have associated some benefits that can be accomplished by exploiting enterprise architecture. These effects are usually indirect and far-reaching over an extended period of time, which regularly makes it difficult to evaluate an exact ROI for Enterprise Architecture projects (D. F. Rico, 2006). Nevertheless, in the very few cases where ROI has been calculated, the results seem to be remarkable (D. F. Rico, 2006) ((D. F. Rico, 2007).

These benefits are investigated based on a set of studies found in the literature; they contain both academic and professional studies. The benefits noticed by each study are listed in the table below.

Analyzing the list of advantages (Table 2), we note that while many of the benefits are comprehensively associated with IT, these are not limited to just IT issues. As a matter of fact, EA has been shown in the studies listed to deal with some of the key business challenges that companies are facing today.

Benefit	References
Increased responsiveness and flexibility (to change)	(Abraham et al., 2012), (Winter et al., 2010) (J. W. Ross, 2006), (S. Aziz and T. Obitz, 2007), (B. Salmans and L. Kappelman, 2010), (J. A. Zachman, 2001), (Winter et al., 2010)
Increased business-IT alignment	(J. W. Ross, 2006), (B. Salmans and L. Kappelman, 2010), (J. A. Zachman, 2001), (The Open Group, 2009), (L. Kappelman, 2008), (Asfaw et al., 2009), (Lankhorst et al., 2009)
Mastered IT costs, more operative use of IT resources	(J. W. Ross, 2006), (S. Aziz and T. Obitz, 2007) , (B. Salmans and L. Kappelman, 2010), (J. A. Zachman, 2001), (The Open Group, 2009), (L. Kappelman, 2008)
Improved risk management	(J. W. Ross, 2006), (S. Aziz and T. Obitz, 2007),), (The Open Group, 2009), (Winter et al., 2010)
Enhanced IS integration/interoperability	(B. Salmans and L. Kappelman, 2010), (J. A. Zachman, 2001), (Winter et al., 2010)
Clear vision about outcomes expected from strategic business initiatives	(J. W. Ross, 2006), (B. Salmans and L. Kappelman, 2010), (L. Kappelman, 2008), (Abraham et al., 2012)
Improved business processes	(S. Aziz and T. Obitz, 2007), (Asfaw et al., 2009), (Lankhorst et al., 2009), (Winter et al., 2010)
Improved utilization of IT	(B. Salmans and L. Kappelman, 2010),(L. Kappelman, 2008)
Reduced complexity of IT	(B. Salmans and L. Kappelman, 2010), (The Open Group, 2009), (Asfaw et al., 2009), (Lankhorst et al., 2009), (Proper et al., 2018), (Reijnen et al., 2018), (Winter et al., 2010)

Table2. Enterprise Architecture benefits

When comparing elements from table 1 and 2, we can notice that Enterprise Architecture responds to the challenges encountered in digital transformation projects, especially when it is about communicating and sharing a targeted vision of the business strategy that should be supported by the information system. However, none of the cited state-of-the-art provides a clear picture of the influence of digital transformation contexts on future practice in the field of EA and their benefits.

Recent studies, e.g. (Gils et al., 2018), underline the need of developing new language and modeling techniques to make them better adapted to the new context of digital transformation; they notice that during digital transformations, coordination and communication among involved stakeholders is key. Shared understanding, agreement, and commitment, are required on topics such as: the overall digital strategy of the enterprise, the current affairs of the enterprise and its context, as well as the ideal future affairs. Models, and ultimately enterprise modeling languages and frameworks, are generally seen as an effective way to enable such (informed) coordination. When these existent languages were developed, the digital transformation challenges were not yet that visible.. As such, it is logical to expect that these languages need to improve their expressiveness (Gils et al., 2018) and may require some “updates” based on available tools such as Data Analytics and Intelligent Systems (Fayoumi, 2018) or even IS architecture evolution (Zimmermann et al., 2015) to be truly ready for the digital transformations.

Summarized, related work focusses on how EAM can support transformations management from an IS architecture and modeling point of view. The demand perspective of DT management is not available in the current discussion. We investigate how to adapt EA practice to the new context of DT.

The following chapter describes the results of our interviews and proposes areas for improvement to adapt the old methods of EA to the contexts of digital transformation.

3 Research methodology

In this study, we adopted an exploratory approach to investigate the difficulties encountered in the use of EA methods and how these methods could evolve to suit a digital transformation context. We conducted face-to-face semi-structured interviews with IT and business projects managers from five companies from financial sectors. We have tried to choose 5 experts with a huge experience in EA and transformations issues from 5 financial institutions of different sizes with a variety of products, this choice does not necessarily reflect all the problems of the financial field but it gives a global idea on the French financial market. The profiles of interviewees are described in Table3. The interview was structured around three main themes: DT challenges based on a well-defined DT project, Enterprise architecture benefits and limits, and finally, how to adapt and evolve the EA practice to drive digital transformation. After transcribing the interviews, data analysis was executed using thematic analysis method which consists in identifying and categorizing significant ideas to draw the fundamental semantic elements (Negura, 2006). The purpose is to compare and discuss the results of each interview. The results of our exploratory research are presented according to identified themes collected from our consulting experience and based on our questions structure:

Part 1: Digital Transformation:

- According to your experience, what does digital transformation mean for your organization?
- The purpose (s) of digital transformation that you have worked on is (are)?
- What are the biggest challenges impacting your organization's ability to compete more effectively in a digital environment?

Part 2: Enterprise Architecture

- Which EA framework do you use?
- What is the level of Enterprise Architecture?
- What are the benefits expected of using EA in digital transformation context?
- What are the limitations of the enterprise architecture that you have encountered in this DT project?

Part 3: Adaptation proposal of EA:

- Contextual evolution of EA
- Organizational evolution of EA

Enterprise	Role	Business Field	customer portfolio	Interviewee's background
EN1	Enterprise architect	Banking	10.7 million of active customers	IT
EN2	IT project manager	insurance	7,6 million of active customers	IT
EN3	CIO	Banking	120.000 clients	Business & Organization
EN4	EA Manager	Financial services	2000 clients	Enterprise strategy
EN5	Functional architect	Financial services	1 million of clients	Banking processes

Table 3. Interviewee's profiles

4 Results and discussion

4.1 Results restitution

The results of our exploratory research are presented according to identified themes.

Enter-prise	What does digital transformation mean for your organization	DT projects example	Organizational challenges perceived of DT	Contextual challenges perceived of DT
EN1	Innovation & acquisition of new technologies	Automated detection of Bank Card Fraud Using Artificial Intelligence	Conflicting objectives (coordination and leadership problems) Conflicting roles and goals (coordination and leadership issues) Lack of collaboration, siloted business units	Regulatory issues
EN2	A new opportunity to better understand and develop the customer relationship New business capacities - New business models	Cross Canal: Innovative services adapted to the mobile format / to enrich the existing services (eg geo-location of care networks).	No target vision communicated and shared between departments No clear strategy of the data in the company's IS Insufficient resources	Missing skills about new trends of technology : Unclear business case about using big data
EN3	Process optimization & automatization New business capacities - New business models	Automation of client claim using virtual agents	Obsolescent IT systems Evolution of the Legacy very expensive Difficulty of prioritizing digital transformation projects	Cultural issues Lack of urgency (of digital transformation)
EN4	A new opportunity to better understand and develop the customer relationship	Multi-Channel: Multiplication of access profiles and media	Difficulty of prioritizing digital transformation projects Business cases not clear	Regulatory issues
EN5	Process optimization & automatization A new opportunity to better understand and develop the customer relationship	Enriching the client's journey: a 360 ° view of customers through unique references	Lack of collaboration between departments Insufficient resources	trends of technology : Unclear business case about using big data Regulatory issues

Table4. Restitution of interviews by company – DT Part (1/2)

EA methods used	TOGAF-inspired, a personalized method
EA maturity	High
Expected benefits of using EA in digital transformation context	Increased responsiveness and flexibility (to change) Increased business-IT alignment
EA organizational limits based on the defined project	Heavy maintenance of Architecture repository Low level of information's freshness Need to manage and master all concepts of modeling language
EA contextual limits based on the defined project	Expressiveness of the Modeling Language : Not able de model contextual elements like customer trends

Table5a. Restitution of interviews by company – EA Part 2/2 for EN1

EA methods used	EA-Urba “French method”
EA maturity	High
Expected benefits of using EA in digital transformation context	Mastered IT costs, more operative use of IT resources Enhanced integration/interoperability Reduced IT costs, more effective use of IT resources
EA organizational limits based on the defined project	Lack of a standard method to model customer data Need tools to prioritize projects: no clear strategy to prioritize digital transformation projects Inability to evaluate ROI of EA and then justify investment of EA activities
EA contextual limits based on the defined project	The Archimate metamodel is not sufficient to model the temporality of the customer needs

Table5b. Restitution of interviews by company – EA Part 2/2 for EN2

EA methods used	Zachman
EA maturity	High
Expected benefits of using EA in digital transformation context	Clear vision about outcomes expected from strategic business initiatives Improved utilization of IT Reduced IT costs, more effective use of IT resources
EA organizational limits based on the defined project	The Department of Architecture is isolated from the rest of the company : EA focuses on the application layer, it does not have a functional and business vision Lack of a consolidated overview of all business processes
EA contextual limits based on the defined project	Expressiveness of the Modeling Language: Not able to deal naturally with the duality of human and digital actors.

Table5c. Restitution of interviews by company – EA Part 2/2 for EN3

EA methods used	TOGAF
EA maturity	High
Expected benefits of using EA in digital transformation context	Enhanced integration/interoperability Mastered IT costs
EA organizational limits based on the defined project	Very heavy maintenance of enterprise repository: Very low level of information's freshness. Inability to evaluate ROI of EA and then justify investment of EA activities
EA contextual limits based on the defined project	Lack of a digital transformation-oriented metamodel in order to model properties such as context and a client journey.

Table5d. Restitution of interviews by company – EA Part 2/2 for EN4

4.2 Discussion

We claim that some of the problems which are identified in tables 5a, 5b, 5c and 5d are not necessarily new but a problem of EAM since its beginning; especially issues about inability to evaluate ROI of EA and then justifying investment of EA activities; this issue have become notably important these days because of the growth of the cost control methods in digital transformation contexts (G. Westerman et al., 2011).

The last part of our interviews was devoted to discuss the evolution of EA practice based on limits listed in tables 5a, 5b, 5c and 5d; for EN5, as they had no framework for EA, their responses were not relevant for part 2 of the interview. We asked participants how EA methods could be adapted to meet the requirements of digital transformation. Contextual and organizational themes are emerged:

Contextual Modeling theme:

A major concern is how Information Systems can successfully adapt to support frequent variations in business conditions originating, for instance, from changes in customers' demand, environmental aspects, regulations, and many others. The need for new contextual modeling techniques to operate in changing environments is addressed by proposing approaches that integrates contextual development with information system (IS) development taking into account changes in the application context of the solution (Bērziša et al., 2015); new models or metamodels representing business and IS designs consisting of goals, key performance indicators, capabilities are needed.

An important research is carried out by (Stirna, J et al, 2012) who propose an approach, Capability Driven Development, that integrates contextual development with IS development, the context modeling part consists of context elements to describe the context constituents, as well as indicators in the form of measurable properties that can be used to monitor a specific organizational situation.

These, are the main needs that emerged during the interviews:

- **Managing Contextual data:**

One of the most important concerns of companies with a digital tendency is to filter, interpret and use customer data from the Big Data, as this is the only chance to manage "customer events". Companies move from Big Data to Smart Data - the continuous assignment of new data and data sources to each customer profile, thus a move towards a 360 degree vision of customers. This is mainly due to two aspects: integration and time market. Only those who integrate and use data, media and channels quickly in their digital communication are able to form a competitive advantage. According to these fundamental changes, it is absolutely necessary to put the company up to the requirements of tomorrow in time. Hence the need for flexible methods that model and trace customer data through sales and distribution processes (Gils et al., 2018), (Fayoumi, 2018). The five Interviewees expressed their need to have an EA practice that allows them to model customer data by taking into account their context in order to meet these needs:

- **Modeling multichannel marketing**

Today's customer is hungry for information, economical, flexible and mobile. It is increasingly in contact with the company through different channels and is waiting for a seamless transition between offline and online offerings. If today's consumers are active on all channels, companies must also be present at all points of contact, or more precisely ubiquitous. But to hand the customer the right offer at the right time, through his preferred channel, it takes a comprehensive view of the customer (Zimmermann et al., 2015).

- **Managing the customer Journey**

Clients meet many customer contact points in their daily lives. To encourage customers to buy at these points of interaction, they must be challenged with tailor-made offers tailored to the situation. To do this, all existing information in the company must be consolidated into a single data set. Creating such high-quality customer reference data at Big Data time is harder for companies than ever before: a 360 ° vision of the customer is virtually impossible without technical support and modeling tools (Winter et al., 2010)

- Managing smart data

The statistical, mathematical and linguistic processes used today allow, on one hand, analyzes that show the existing relations between the data, on the other hand, predictions on future developments and trends based on the existing data history (Gils et al., 2018). Big Data becomes Smart Data and companies need new models to describe this intelligence (Fayoumi, 2018)

Organizational theme:

- Managing Compliance issues through EA

The number of continuously increasing digital data is concomitant with the plurality of regulatory requirements and legal provisions. For example, European anti-terrorist decrees prohibit transactions with terrorist persons or organizations. Therefore, each company must make regular comparisons of partner data with national and international sanction lists. Failures at this level cut off companies from markets and customers that can lead to significant financial damage, loss of image and judicial consequences.

Enterprise architects have to be aware of compliance issues and informed of new regulations to take them into account when designing new solutions.

- Managing information freshness:

Among the points that emerged during the interviews is the need for teams of models that are simple to update, participants all talked about the lack of freshness in the information modeled in the architecture repositories (Winter et al., 2010), EA needs to set up a governance and a typology of models that allow iterating according to the client's need, the introduction of the notion of time could be relevant.

- Prioritizing DT projects:

The interviewees mentioned the need to develop new techniques and tools to assist decision-makers in prioritizing digital transformation projects, a transformation program often consists of several lots or projects, program need these models that measure adherence between projects and then help them prioritize projects according to the most urgent need (Reijnen et al., 2018).

- Defining the ROI of EA in a digital transformation context

Several studies have associated benefits that can be accomplished by using enterprise architecture. These effects are typically indirect, far-reaching, enterprise wide and compound over a long period of time, which typically makes it hard to evaluate an exact ROI for Enterprise Architecture projects (Rico 2006).

The changing context of digital transformation is pushing CIOs to justify their use of enterprise architecture, according to the interviewees; EA must be piloted and evaluated through its ROI.

5 Conclusion and future Works

Enterprise architecture Management is the organizing practice helping organizations to healthy reflect the integration and standardization requirements of the company's operating model in digital context; it is such as a backbone for enterprise and IS evolution. Considering digital transformation as a particular enterprise evolution endeavor, we have in this paper explored how to evolve EA methods to support digital transformation initiatives with a focus on contextual and organizational needs. This paper presents an analysis of interviews with both IT and business projects managers from five different companies. The results show that although existing EA frameworks are essential tools to support and push digital transformation projects, some important properties are missed. We then provided suggestions, based on interviews and literature, on how to possibly improve EA to better meet the challenges of digital transformations. In further research, we intend to further elaborate these suggestions, in particular with the aim of finding strategies that work in real world practice:

- New models oriented digital transformation that describe and trace the client journey and its changing context; these models are a prerequisite that will allow us to implement a method of prioritizing projects according to elements such as context.
- A methodology for evaluating the ROI of the enterprise architecture to justify its use to decision-makers.

As future work, we intend to define and develop a global approach taking into account these 2 proposed further into a complete methodology to support and drive digital transformation; for this purpose, we consider that this methodology should be implemented and experimented in real-world cases.

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