Enterprise Architecture; Growing up to Evidence-based Management?

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1 Introduction

This year marks the tenth anniversary of *the* Netherlands Architecture Forum (NAF). Over the past ten years, the field of *enterprise architecture* has witnessed a tremendous development. Both nationally and internationally. Both in practice and in academia.

The history of enterprise architecture actually goes back further than ten years. As we will argue below, the roots of enterprise architecture can (at least) be traced back to the mid 1980s. In this paper we will review the past, and potential future, of enterprise architecture in terms of a number of observed trends.

This paper is not intended as a *scientific paper* in the strict sense, but rather as an *opinion paper*. Where relevant, we will indeed add citations to relevant / supporting literature. However, the observed trends should be regarded as personal observations, and as potential hypothesis for further investigation at the best.

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2 From Computer Architecture to Information Systems Architecture

One of the first references to the term *architecture*, in the context of IT, can be found in a paper from 1964 on the architecture of the IBM System/360 [ABB64]. There it was used to introduce the notion of *computer architecture*.

Later, in the 1980s, the term architecture started to get used in the domain of information systems development as well. This occurred both in Europe and North America. The North American use of the concept of architecture in an information systems context, can (at least) be traced back to a report on a large multi client study, the PRISM project [Ham86] conducted in 1986, as well as the *later* paper by John Zachman [Zac87]. The European origins can be traced back to the early work of August-Wilhelm Scheer on the ARIS framework, also dating back to 1986 [Sch86, Sch88, Sch00].

In Europe, the ARIS framework of August-Wilhelm Scheer eventually formed the base for the well known IDS-Scheer toolset. In North America, the PRISM project was a multi-year research project, led by Michael Hammer, Thomas H. Davenport, and James Champy. The research project was called the Partnership for Research in Information Systems Management (PRISM), and was sponsored by approximately sixty of the largest global companies (DEC, IBM, Xerox, Texaco, Swissair, Johnson and Johnson, Pacific Bell, AT&T, etc.). This research effort produced an architecture framework known as the PRISM Architecture Model, which was published in 1986. The PRISM framework has strongly influenced other enterprise architecture standards, methods and frameworks [DHM89, RJD90, BD10, Riv07]. Many years later, the PRISM report also influenced the IEEE definition of architecture, as many of the IEEE 1471 committee members (Digital included) were employed by the original sponsors of their earlier work on PRISM.

The Zachman [Zac87] paper is often referred to as one of the founding papers of the field of enterprise architecture. It should be noted, however, that the PRISM and ARIS frameworks pre-date the Zachman framework. Although, these frameworks have indeed been published in less accessible sources.

The important message of the ARIS, PRISM and Zachman frameworks is the need to consider *information systems* from multiple perspectives based on stakes, concerns, as well as different aspects of the information systems and its business / technology context, while at the same time focusing on the key properties of the information system. The latter focus is also captured by the phrase *fundamental organization* in the IEEE 1471 [IEE00] architecture definition: "*the fundamental organization of a system embodied in its components, their relationships to each other and to the environment, and the principles guiding its design and evolution.*", where *fundamental* is dependent on the key concerns / stakes of the stakeholders involved in an architecting effort.

The basic idea to consider information systems in a holistic way, i.e. from multiple related perspectives, was actually already identified before being linked to the term *information systems architecture*. For example, Multiview [WAA85] already identified five essential viewpoints for the development of information systems: Human Activity System, Information Modelling, Socio-Technical System, Human-Computer Interface and the Technical System. Even though

the authors of Multiview did not use the term *architecture*, one can argue that Multiview is effectively one of the earliest explicit information systems architecture frameworks. During the same period in which Multiview was developed, the so-called CRIS Task Group of the IFIP working group 8.1 developed similar notions in 1982 [OSV82, OST83], where stakeholder *views* were captured from different perspectives. Special attention was paid to disagreement about which aspect (or *perspective*) was to dominate the system design (viz. "process", "data" or "behaviour"). In the early 1980s, the CRIS Task Group already identified several *human roles* (stakeholders!) involved in information system development, such as *executive responsible*, *development coordinator*, *business analyst*, *business designer*, quite similar to the stakeholder dimension of e.g. the Zachman framework.

3 From Information Systems Architecture to Enterprise Architecture

The awareness that the design of information systems needed to be seen in a broader business and enterprise context, triggered several authors to shift towards the use of the term *enterprise architecture* rather than *information systems architecture*. One of the first authors to use the term *enterprise architecture* was Steven H. Spewak [Spe93].

The initial *enterprise architecture/information systems architecture* approaches focused on the development of information systems, while taking the models / architectures of other relevant aspects of the enterprise as a *given*. However, due to the strong connection between e.g. business processes, business services, and the underlying information systems, it was only natural to not just treat such perspectives as a *given*, but rather to *co-design* these in tandem with the information systems and their underlying IT support.

Earlier versions of TOGAF [TOG05], and certainly its predecessor TAFIM [TAF96], still treated the so-called *business architecture* as a *given* thing. By defining *Enterprise Architecture Planning (EAP)* as "*the process of defining architectures for the use of information in support of the business and the plan for implementing those architectures*", Spewak [Spe93] also seems to suggest to take *business architecture* as a *given*. Boar [Boa99] in "*Constructing Blueprints for Enterprise IT architectures*" does the same.

The shift from taking a *business architecture* as a given input, to the realisation that business and IT should be co-designed as a whole, could be seen as the birth of modern day *enterprise architecture*. The *strategic alignment model* by Henderson & Venkatraman [HV93] has played an important role in taking this step to the co-design of *business architecture* and *information systems architecture*. Henderson & Venkatraman [HV93] indeed suggests that aligning business and IT should not necessarily require that the business strategy should be treated as a given. There are several ways to align business and IT. Also the work by e.g. Tapscott and Caston [TC93] contributed to this realisation, as well as the work by Ross et al [RWR06].

Without an attempt to be complete, approaches that do indeed take a more co-design oriented perspective include the Integrated Architecture Framework (IAF) [GBR99, VWH+10], ArchiMate [JVB+03, Lan05], DYA [WVLV01, WVLV05] and DEMO [Die06]. Also the most recent

version of TOGAF [TOG09] does indeed suggest to *co-design* the business architecture and the information systems architecture.

4 From Business-to-IT-stack centricity to Enterprise Coherence

The realisation that information systems architecture and business architecture need to be *co-designed* in tandem, led most enterprise architecture approaches to capture a business architecture in terms of modelling concepts such as business services, business processes, business actors, etc.

Among an increasing group of researchers and practitioners, the 'reduction' of 'the business' to these modelling concepts resulted in the position that enterprise architecture should really be about more than just the '*Business-to-IT-stack*', which only focuses on business architecture, information systems architecture, and IT architecture. In particular Graves [Gra08], Fehskens [Feh08] and Wagter et al [Wag09] have argued that '*Business-to-IT-stack*' centricity is a major weakness of contemporary enterprise architecture approaches, and that enterprise architecture should involve many more aspects of an organization, such as a clear connection to its strategy, its financial structures, the abilities of its work force, etc. More specifically, Wagter et al [Wag09] argue that enterprise architecture should not just be concerned with Business-IT alignment, but rather with the alignment of all relevant aspects of an enterprise. Therefore, rather than using the term *alignment*, Wagter et al [Wag09] suggest to use the term *enterprise coherence* to stress the multi-facetness.

A first enterprise architecture method to indeed explicitly move beyond a '*Business-to-IT-stack*' centricity is the GEA method [Wag09]. GEA argues that the coherence between several aspects of an enterprise needs to be managed / governed explicitly, by means of an enterprise architecture. To indeed co-design the different aspect on an enterprise architecture, and to use it (both the co-design process, and the resulting architecture) in managing / governing enterprise coherence, it is necessary to take the concerns, and associated strategic dialogues, of senior management as a *starting point*. In other words, the way in which architecture is integrated into the strategic dialogue should take the concerns, language, and style of communication of senior management as a starting point, and not the typical domains / layers / columns as identified in the traditional architecture frameworks.

As argued in [WPW11], existing approaches and frameworks, such as, Zachman [SZ92], DYA [WVLV05], TOGAF [TOG09], IAF [VWH+10], ArchiMate [Lan05, IJLP09], take a Blueprint style of thinking about change [DV03]. The need to really involve senior management, however, suggests the use of another style of thinking, involving internal / external stakeholder interests, strategy formulation processes, formal and informal power structures, and the associated processes of creating win-win situations and forming coalitions. In terms of De Caluwé and Vermaak [DV03], this would entail a Yellow-print style of thinking about change.

In the development of the GEA method, this line of thinking was taken as a starting point, by taking the perspective that the actual political power structures / domains, and associated strategic

dialogues, within an enterprise should be taken as a starting point, rather than the aspect / perspective frameworks suggested by existing architecture approaches. In line with this, rather than structuring the models and views in terms of the Business-to-IT-stack, GEA [WPW11] suggests to structure the models and views primarily based on the domains that are meaningful within the strategic and political dialogue in an enterprise. This leads to a framework of perspectives that enable an explicit governance of coherence; i.e. *coherence governance perspectives*. For example, in terms of 'human resourcing', 'clients', 'regulators', 'culture', 'intellectual property', 'suppliers', etc. Needless to say that these perspectives are highly organization specific. In other words, there is not one-size-fits-all framework. The existing Blue-print oriented frameworks can still be used to further structure the dialogue between the *coherence governance perspectives*, especially where it concerns issues pertaining to the Business-to-IT-stack.

It is to be expected that organizations aiming to use enterprise architecture to steer / direct major transformations, will increasingly move from a Business-to-IT-stack centricity perspective to an enterprise coherence perspective on their enterprise architectures.

5 From Descriptive Architecture to Prescriptive Architecture

One of the accepted standards for defining architecture is the earlier quoted IEEE 1471 [IEE00] definition: "*the fundamental organization of a system embodied in its components, their relationships to each other and to the environment, and the principles guiding its design and evolution.*". This definition really points primarily at what the things are that an architecture is concerned *about*: "*its components, their relationships to each other and to the environment, and the principles guiding its design and evolution*", while the reference to "*the fundamental organization*" provides a statement of the desired granularity.

As suggested in [GP11], one can make a distinction between:

1. The *purpose* which an enterprise architecture serves.
2. The *meaning* of an enterprise architecture, i.e. what it aims to do.
3. The *elements* of an enterprise architecture in terms of the typical components used in capturing an enterprise architecture.

As argued in [OPW$^+$08], key concepts in the field of enterprise architecture include *concerns*, *architecture principles*, *models*, *views* and *frameworks*. They indeed cover different means to express "*the fundamental organization of a system embodied in its components, their relationships to each other and to the environment, and the principles guiding its design and evolution.*", and as such define the *elements* of an enterprise architecture.

The definition of architecture as proposed by Dietz [Die08] focuses on architecture as a "*normative restriction of design freedom*" (or put more positively: a *reduction of design stress*). This definition can be seen as expressing the *meaning* of an enterprise architecture.

In [GP11], the *purpose* of enterprise architecture is stated to be "*... the main purpose of an enterprise architecture is to align an enterprise to its essential requirements. As such, it should*

provide an elaboration of an enterprise's strategy to those properties that are necessary and sufficient to meet these requirements". In terms of Op 't Land et al [OPW$^+$08], an architecture does so by enabling *informed governance* of enterprise transformations.

When starting out from the stated purpose of an enterprise architecture, and combining this with its primary meaning as a normative restriction of design freedom, it is logical to expect that the actual elements used in an enterprise architecture should primarily serve a regulative goal. The elements of an architecture should therefore enable a normative restriction of design freedom.

Even though several approaches position principles as an important element of enterprise architecture [DHM89, RJD90, TC93, WVLV05, OPW$^+$08, TOG09, VWH$^+$10, BD10], while some even go as far to position principles as being the essence of architecture [Die08, Hoo09, Ham86, Feh10], contemporary approaches / frameworks traditionally focus on *models* and *views*. This triggered the authors of [GP11] to set up a NAF working group to indeed further elaborate the concept of architecture principle, leading to the cited publication.

A growing awareness for the core purpose of enterprise architecture as a means to align an enterprise to its essential requirements (including its coherence), naturally leads to a stronger focus on the normative aspect of enterprise architecture, and thus on the role of architecture principles. This leads to a shift from a focus on enterprise architecture as a *descriptive* means to a *prescriptive* means. In other words, from *descriptive architecture* to *prescriptive architecture*. As argued in [GP11], this does not necessarily mean that *models* and *views* would become obsolete. However, they would rather become the more instructive / illustrative extension of the more regulative *architecture principles*, while also enabling the study / analysis of the impact / consequences of different alternatives. An example of a prescriptive architecture in the Dutch context is of course the NORA [NOR] and her government domain specific family members GEMMA, PETRA, WILMA and MARIJ.

It is expected that organizations, which take the purpose of enterprise architecture to align the enterprise to its essential goals and requirements, seriously, will increasingly focus on *prescriptive architectures*. Again, this does not mean that *models* and *views* would become obsolete. They remain valuable means for instructive / illustrative / evaluative extensions of prescriptive architectures.

6 From Architecting the Execution Capability to Architecting the Dynamic Capability

An enterprise is likely to change continuously. The capabilities needed to change an enterprise are quite different from the capability needed to run its day-to-day business. It therefore seems sensible to make a clear distinction between the capability of an enterprise to run its day-to-day business on the one hand, and its capability to change itself on the other hand. Teece et al [TPS97] refer a "*firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments*" as its *dynamic capability*. In line with this, we suggest to refer to the ability for an enterprise to run its day-to-day business as its *execution capability*.

It is important to realize that the humans involved in an enterprise can play a role towards both the *execution capability* and the *dynamic capability* of an enterprise. For human beings this is quite natural behaviour. While executing our daily activities, we typically also learn how to do these activities better and / or adapt them to changing needs / circumstances. In these cases, we decide to 'on the fly' innovate our *execution capability*. In doing so, we (briefly) use our *dynamic capability*.

When considering an enterprise from an architectural perspective, one can of course opt to focus the architecture efforts on one of these capabilities or both. In most cases that we know of, as well as the examples discussed in the various architecture approaches, the focus is on architecting the *execution capability* only. One exception we are aware of are enterprises who have e.g. created a *development architecture* focusing on the way the enterprise will go about developing new information systems. An example is the development architecture from the Dutch Tax Administration [AFJE$^+$00].

Whether an enterprise's architecture effort should focus on the *execution capability* and / or the *dynamic capability* depends of course on an enterprise's strategy. In terms of the Discipline of Market Leaders from Treacy and Wiersema [TW97], it would be logical for enterprises focusing on:

1. *operational excellence*, that the *execution capability* requires architecting priority,
2. *product leadership*, that the parts of the *dynamic capability* dealing with product / service innovation require architecting priority,
3. *client intimacy*, that the parts of the *execution capability* and the *dynamic capability* that deal with client interaction require architecting priority.

In recent work on agile service development [Lan12], it was also argued how in an agile service context it is necessary to move from only having an efficient execution capability to a situation in which there is an effective combination of the execution and the dynamic capability. One should focus on designing the execution capability in such a way that it lends itself to quick changes within given boundaries and ambitions, while the dynamic capability should be designed in such a way that it can use this built in agility of the execution capability to meet anticipated changes in the environment, as well as the ability to take appropriate actions to transform the execution capability when having to meet unanticipated changes.

In [Lan12] some guidelines are provided on how to balance an architecting effort between the dynamic and execution capabilities. However, more research is needed. At the same time, the need for enterprises to be agile, does stress the need to be able to make explicit tradeoffs on how to deal with this agility across the two capabilities.

7 From Intuition-based Management to Evidence-based Management

The final trend we would like to discuss involves a shift that is in our view currently taking place. Modern day enterprises need to change in order to survive. At the same time they need

to do so in the face of a increasing number of regulations on compliance and transparency. At the same time, a considerable part of an enterprise's shareholder value is '*tied*' up in the needed transformations. As a consequence, the processes needed to transform the enterprise become a *core* business process themselves, requiring ample management attention.

In addition, due to the increasing amount of shareholder value (and / or taxpayer's money) that is tied up in such transformations, one can expected that the requirements on the transparency with which these decision are made will increase. Would it not be logical for companies that are listed on the stock market, to also report annually on their ability to transform in an effective way? In other words, not just how well their execution capability is able to earn a revenue for its shareholders, but also how well the dynamic capability is able to ensure the continuation of this revenue in a cost-effective way?

In this sense, one can expect (or at least hope!) that senior management will increasingly be held responsible (by shareholders, tax payers, and ultimately auditors) for their ability to steer and control transformations. Even more, senior management should not only worry about the cost effectiveness of change, but also about governance, risk management, compliance, etc., associated to these transformations. Given the earlier discussion on the purpose of enterprise architecture, and its role for informed governance, it shall not be surprising that we take the point of view that enterprise architecture would indeed provide a means to senior management to take more control over the transformations and the associated decision making on the future of the enterprises for which they are *responsible*. Using enterprise architecture, one can more crisply analyse problems in an existing situation, articulate desired directions (using architecture in a prescriptive way), analyse the costs / benefits of different options (using architecture in a more descriptive way), and guard that transformation projects are indeed moving in the desired direction.

In parallel to this, one can also observe an interesting trend in the field of management. As argued in [PS06, PS11], there is an increasing call for evidence-based management instead of (yet not fully replacing) intuition-based management. The authors draw an interesting analogy to the trend in medicine towards evidence-based medicine [EBM12], which is defined in [SRG$^+$96] as: "*the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients.*". If you think that doctors would always base their diagnose on sound evidence and reasoning, then [PS11] invites us to rethink this.

Evidence-based management certainly has its challenges. The section in [PS06] on "*What Makes It Hard to Be Evidence Based?*" provides some interesting insights in these challenges. Or should we say excuses? Some examples include:

1. There's too much evidence.
2. There's not enough good evidence.
3. The evidence doesn't quite apply.
4. People are trying to mislead you.
5. You are trying to mislead you.

6. The side effects outweigh the cure.

7. Stories are more persuasive, anyway.

When considering the promise of evidence-based management, there is indeed a strong analogy to the potential contribution of enterprise architecture. In this way, one can argue that enterprise architecture can become a leading mechanism in enabling evidence-based management of transformations. Or rather, the field of enterprise architecture should take upon it as its *mission* to enable evidence-based management of transformations. We explicitly use the word *enable* to stress the fact that it is senior management who has to take the *responsibility* to take decisions based on evidence. It remains their choice not to take that responsibility, and explain to the shareholders, tax payers and auditors, why they did not.

8 Conclusion

In this paper we discussed our view on the history, and potential future evolution, of enterprise architecture. It represents our current understanding of past, present and future, but does not claim to be scientifically sound. However, it is our firm believe that enterprise architecture can, and *should*, play a crucial role in enabling senior management of enterprises to take their responsibility in steering / controlling / guiding enterprise transformations (be they 'top down' pre-meditated transformations or spontaneous 'bottom up' transformations), based on evidence-based insights. It is certainly one of the driving hypotheses in our work.

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