

# Article

## Enterprise Architecture Dynamic Alignment Model

Atiogbe Didier Koffi

### Abstract

*An organization's fundamental need to respond to influencing forces in its environment is very likely to require some transformation of the enterprise to align itself with new business strategies. Enterprise Architecture (EA) can play a crucial role to increase the chances of implementing such initiatives in a timely and effective manner throughout all layers of the organization. This article presents a Systems Theory-inspired EA model that predicts over the EA implementation lifecycle fundamental dynamic patterns induced by the various EA components and the influence that they have on each other. With an improved understanding of the dynamic behavior of key enterprise components, EA practitioners become better equipped to effectively lead organizational transformation endeavors towards more predictable and beneficial outcomes.*

### Keywords

Dynamic enterprise alignment model, quantitative architecture model, enterprise architecture perspectives, program management, enterprise risk management, enterprise stakeholders collaboration, enterprise architecture lifecycle

### INTRODUCTION

Achieving alignment between business and IT has been a major concern among IT professionals and firm executives for the majority of the past 30 years (Ullah & Lai 2013; Chen 2010; Henderson & Venkatraman 1992). Enterprise Architecture (EA) has been advocated on many occasions as a means to achieve this seemingly elusive objective (Gotze & Jensen-Waud 2013; Doucet et al. 2009).

Furthermore, about 70% to 90% of all enterprise strategic initiatives have failed due to the enterprise inability to properly and timely implement them (Mintzberg 1994; Kaplan & Norton 2004). Poor levels of congruence (i.e., consistency and coherence) among EA artifacts have been identified as the main causes of strategic initiative failures (Miles et al. 1984; Beer et al. 1991; Kaufman 1992; Kotter 1995; Hoogervorst 2004; Galliers & Baets 1998; Pettigrew 1998).

This article presents a Systems Theory-inspired (Adams et al. 2014; Rouse 2005) EA model that predicts over the EA implementation lifecycle fundamental dynamic patterns induced by the various EA components and the influence that they have on each other. These Behavior Patterns only emerge when we treat the enterprise holistically by analyzing the influence of the relationships that bind any two EA artifacts in relation to the combined influence of all other EA artifacts (Steensen 2013). The identified patterns simultaneously involve interactions among all common stratifications of EA: Business Architecture, Information Systems Architecture, and Technology Architecture (TOGAF® 2011; Gall et al. 2008). With an improved understanding of the dynamic behavior of key enterprise components, EA practitioners become better equipped to effectively lead

organizational transformation endeavors towards more predictable and beneficial outcomes (FEAPO 2014; Holst 2013; Kurstedt 2000).

The article expands upon our prior modeling work on the influence that EA Perspectives have on each other (Koffi 2010).

### THE ZACHMAN FRAMEWORK™ EA PERSPECTIVES

The Zachman Framework (ZF) (Zachman 2009) rows or Perspectives represent a total view of the enterprise from the perspective of a given group of stakeholders who share common concerns:

- The first row of the ZF represents the Contextual Perspective  
This aims at defining the broad Business Scope of the enterprise as seen from the viewpoint of Planners. Enterprise purpose, cost/profit goals, and positioning in its global environment reside in this perspective.
- The second row of the ZF represents the Conceptual Perspective  
This is the Owner's perspective. It contains various Enterprise Business Models.
- The third row of the ZF represents the Logical Perspective  
This is the realm of Designers and Architects who capture Information System-level Models of the enterprise.
- The fourth row represents the Physical Perspective  
Here Engineers specify various Technologies, Tools, and Materials that will realize the Information System-level Models.

- The fifth row represents the Detailed Perspective In-house and/or contracted Programmers and Technicians create very detailed Specifications of Physical System Components or Software Code.
- The sixth row is the actual Operating or Functioning enterprise

Each column in the ZF focuses on one of the following fundamental questions about the enterprise: What, How, Where, Who, When, and Why. The answers are architectural Aspects or focuses of the enterprise:

- The What column represents the Data description of the enterprise
- The How column represents the Process or Function description of the enterprise
- The Where column represents the Network description of the enterprise
- The Who column represents the People description of the enterprise
- The When column represents the Time description of the enterprise
- The Why column represents the Motivation description of the enterprise

A given cell in the ZF represents a unique model at the intersection of a Perspective and an architectural Aspect. A cell serves a unique purpose in relation to any other cell on either one of its two axes.

Table 1 summarizes for each one of the first five EA Perspectives their respective stakeholders and main artifacts.

### MODEL FORMULATION AND DEFINITION OF ALIGNMENT

Our model is based on a numerical matrix M that we have described in a prior publication (Koffi 2010). The matrix captures the relative strengths of constraints placed upon each EA Perspective by itself and contiguous Perspectives.

The relative constraints strengths used in this article are shown in Table 2. Their values are chosen to demonstrate the use of our model. They are obtained by assuming that the constraints strengths applied to a given Perspective's ZF cell by another ZF cell located on the same ZF row are equal to the constraints strengths that it receives from the cell immediately above it but is twice as strong as the constraints strengths that it receives in the form of feedback from the cell immediately below it (Sowa & Zachman 1992). We encourage the interested reader to use our model with different strength ratios that would be more representative of the actual degrees of feedback (rework) and intra-Perspective integration that occur within the specific organization being modeled. This author recommends defining those ratios by taking into consideration three measures of achievement. These

measures quantify the maturity level of each EA Perspective's artifacts creation process (Beer 1972):

- Productivity is the ratio of actuality and capability
- Latency is the ratio of capability and potentiality
- Performance is the ratio of actuality and potentiality

**Table 1: EA Perspectives' Stakeholders and Main Artifacts**

EA Perspective	Stakeholders	Main EA Artifacts
Contextual	Planners	Broad Business Scope of the enterprise as seen from the viewpoint of Planners Enterprise purpose and objectives, cost/profit goals, and positioning in its global environment
Conceptual	Owners	Enterprise Business Models
Logical	Architects/ Designers	Information System Models of the enterprise
Physical	Engineers	Technologies, Tools, and Materials that realize the Information System Models
Detailed	Technicians/ Programmers	Detailed Specifications of Physical System Components

Actuality, capability, and potentiality have the following definitions (Beer 1972):

- Actuality: "What we are managing to do now, with existing resources, under existing constraints?"
- Capability: "What we could be doing (still right now) with existing resources, under existing constraints, if we really worked at it"
- Potentiality: "What we ought to be doing by developing our resources and removing obstacles, although still operating within the bounds of what is already known to be feasible"

In Table 2, 'X' stands for Contextual Perspective, 'C' stands for Conceptual Perspective, 'L' stands for Logical Perspective, 'P' stands for Physical Perspective, and 'D' stands for Detailed Perspective.

**Table 2: M: Normalized Architectural Perspectives Constraints Strengths**

	X	C	L	P	D
X	0.8572	0.1428	0	0	0
C	0.0667	0.8	0.1333	0	0
L	0	0.0667	0.8	0.1333	0
P	0	0	0.0667	0.8	0.1333
D	0	0	0	0.0769	0.9231

Each row in M corresponds to an EA Perspective. A row shows the distribution of constraints strengths placed by a Perspective on itself and on all other adjacent Perspectives. Each Perspective predominantly constrains itself then it constrains the Perspectives immediately below and above it.

The constraints strengths placed on a Perspective indicate how much specification has been implicitly and explicitly created for that Perspective. When constraints are applied to an EA Perspective, they create an impetus to modify that Perspective's current artifacts in order to maintain a higher cohesion with the EA Perspectives' artifacts that generated those constraints (Anaya & Ortiz 2005; Avison et al. 2004).

This article defines alignment as the transformation process of a Perspective's artifacts in response to new constraints introduced by the modification of artifacts found either within that Perspective or inside contiguous Perspectives. Higher alignment is achieved when that transformation process results in higher congruence among a Perspective's set of artifacts and the artifacts found in neighboring Perspectives (Koffi 2010; Doucet et al. 2009).

Our model is best suited for exploring and understanding the behavior of the enterprise when it attempts to "change the business"; i.e., when it sets new strategic directions for the organization as opposed to "running the business" which is concerned with the routine execution of well-defined and pre-established activities (Bean 2013). Therefore, our model serves as an aid to a programmatic use of EA often associated with Program Portfolio Management and not to be confused with primarily prescriptive or descriptive applications of EA (Bean 2013; Korhonen 2013).

## PUTTING THE MODEL INTO PRACTICE

Many recent EA modeling efforts (Holst 2013) have recommended applying the Viable System Model (VSM) (Beer 1972) to better capture the dynamic behavior of an enterprise and its many components. This article uses a different approach and demonstrates how a Markov's Chains N-Step transition matrix (Winston 2004) can be employed to describe the evolution of constraints strengths distribution across EA Perspectives over time (Koffi 2010). The VSM was inspired by the similarity that organizations have to biological systems (Beer 1972). Our model uses Markov Chains as a quantitative analytical tool which has also been successfully employed to model the dynamic behavior of biological systems (Mosteller et al. 2012; Kim et al. 2002).

### Using the N-Step Matrix

As we have mentioned earlier, about 70% to 90% of all enterprise strategic initiatives have failed due to the enterprise inability to properly and timely implement them (Mintzberg 1994; Kaplan & Norton 2004). The

attributes of strategic initiatives are best described by EA artifacts found in the ZF Contextual and Conceptual Perspectives (TOGAF® 2011). One distinctive attribute of the Contextual Perspective is that it models the organization's environment by capturing its markets, customers, suppliers, partners, competitors, regulators, and shareholders. The primary mission of the organization is to respond to the expectations and constraints imposed by its environment (Campbell 2005). This fact is the main motivation behind illustrating the use of our model with the series of constraint distributions corresponding to a need for EA alignment initiated by the Contextual Perspective.

We also present in fewer details the series of constraint distributions corresponding to a need for EA alignment initiated by the Conceptual Perspective. This type of initiative would happen when the organization's environment remains rather stable but the organization embarks on the definition of a different Business Model to respond to it.

Figures 1 and 2 respectively chart these two distribution series for N varying from 1 up to 30. The upper range value of N is 30 for the total number of cells found on the first five rows of the ZF.

### EA Perspective Alignment Need Rate

We define the Alignment Need Rate of an EA Perspective from steps 2 to 30 by computing the difference of that Perspective's relative constraints distribution value over two consecutive steps.

These Alignment Need Rates are indicators of the speed with which each EA Perspective attempts to come into alignment with its constraining Perspectives from the reference point of the entire EA rather than that of each individual Perspective.

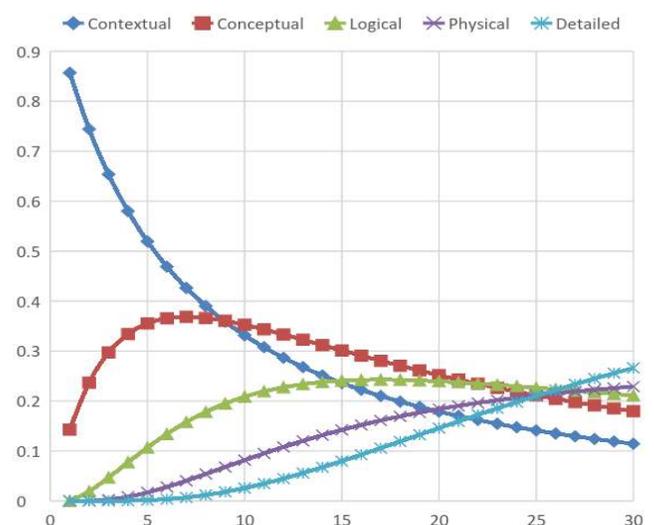


Figure 1: Contextual-Driven Need for EA Alignment

The sum of all five Perspectives' Alignment Need Rates is always equal to zero. This property results from the fact that the Perspectives' relative constraints strengths are a distribution that always adds up to one at any step. Figures 3 and 4 summarize our calculations.

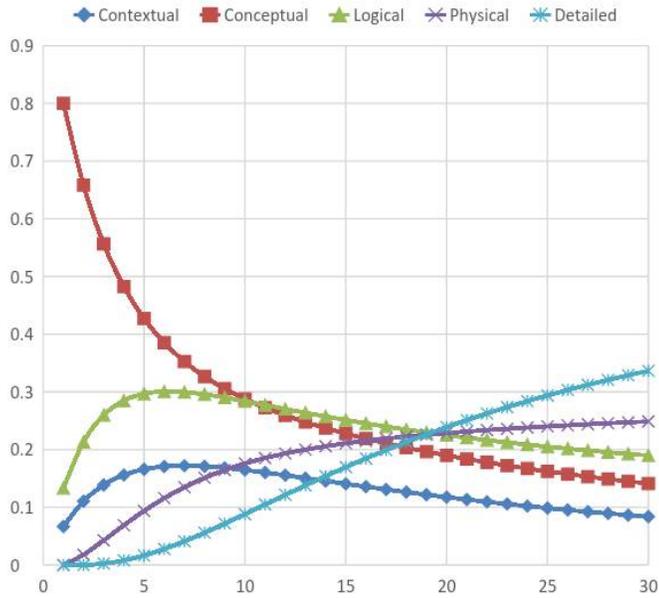


Figure 2: Conceptual-Driven Need for EA Alignment

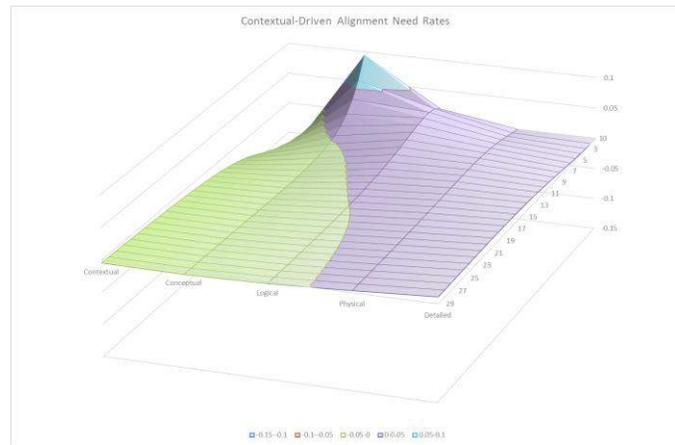


Figure 3: Contextual-Driven Alignment Need Rates

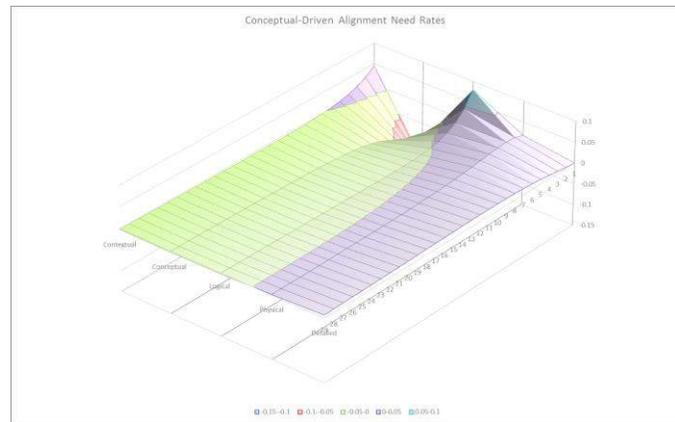


Figure 4: Conceptual-Driven Alignment Need Rates

**EA Perspective Controlling Force for Alignment**

We define the Controlling Force for Alignment of an EA Perspective from steps 3 to 30 by computing the difference of that Perspective's Alignment Need Rate over two consecutive steps. These Controlling Forces for Alignment are indicators of the force placed on each EA Perspective to motivate them to attempt to come into alignment with their constraining Perspectives. The magnitudes of these Controlling Forces are from the reference point of the entire EA rather than that of each individual Perspective.

The sum of all five Perspectives' Controlling Forces for Alignment is always equal to zero. This property results from the fact that the sum of all five Perspectives' Alignment Need Rates always adds up to zero at any step.

These Controlling Forces are similar to forces found in the field of dynamics where an object acceleration times its mass is equal to the force applied to it (Holzner 2005). Figures 5 and 6 summarize our calculations.

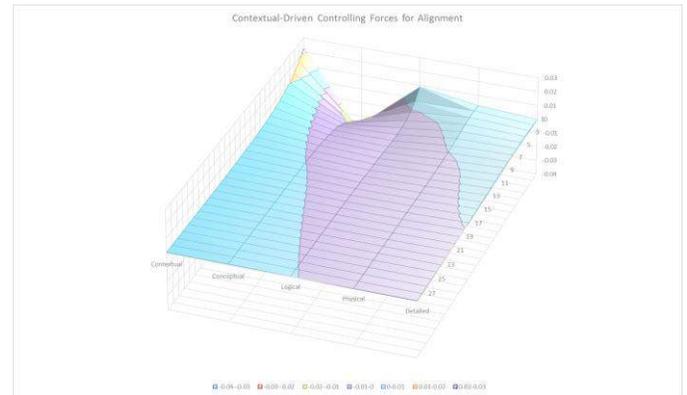


Figure 5: Contextual-Driven Controlling Forces for Alignment

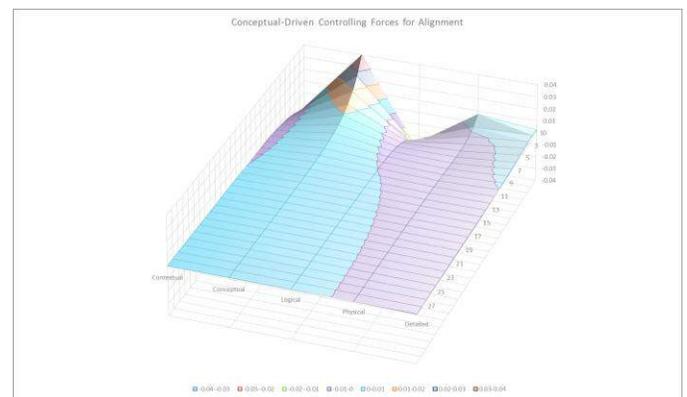


Figure 6: Conceptual-Driven Controlling Forces for Alignment

It is worth noticing that the EA Perspectives' Controlling Forces for Alignment get closer and closer to zero when approaching the 30<sup>th</sup> step.

### EA Perspectives Alignment Behavior Patterns

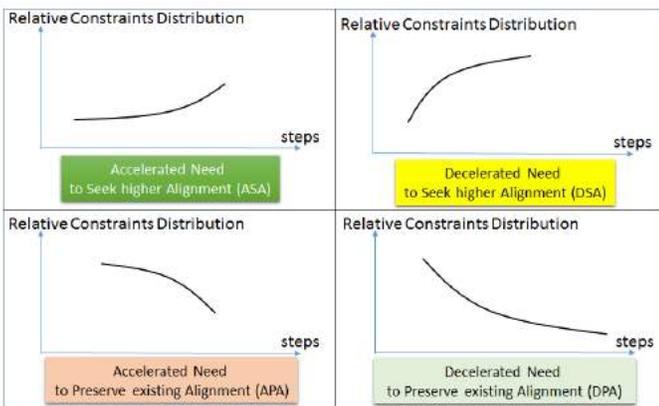
When analyzing an EA Perspective's Alignment Need Rate and its Controlling Force for Alignment, four Alignment Behavior Patterns can be identified (Laverdure & Conn 2013; Beer 1972). Each pattern is characterized by the sign of the Perspective's Alignment Need Rate and the sign of its Controlling Force for Alignment at a given step. The four patterns are explained next:

- An EA Perspective experiences an Accelerated Need to Seek higher Alignment (ASA) when it has a positive Alignment Need Rate and a positive Controlling Force for Alignment
- An EA Perspective experiences a Decelerated Need to Seek higher Alignment (DSA) when it has a positive Alignment Need Rate and a negative Controlling Force for Alignment
- An EA Perspective experiences an Accelerated Need to Preserve its existing Alignment (APA) when it has a negative Alignment Need Rate and a negative Controlling Force for Alignment
- An EA Perspective experiences a Decelerated Need to Preserve its existing Alignment (DPA) when it has a negative Alignment Need Rate and a positive Controlling Force for Alignment

**Table 3: EA Perspectives Alignment Behavior Patterns**

Controlling Force for Alignment	Alignment Need Rate	Alignment Behavior Pattern
Positive	Positive	Accelerated Need to Seek higher Alignment (ASA)
Negative	Positive	Decelerated Need to Seek higher Alignment (DSA)
Negative	Negative	Accelerated Need to Preserve existing Alignment (APA)
Positive	Negative	Decelerated Need to Preserve existing Alignment (DPA)

Figure 7 illustrates each Behavior Pattern.

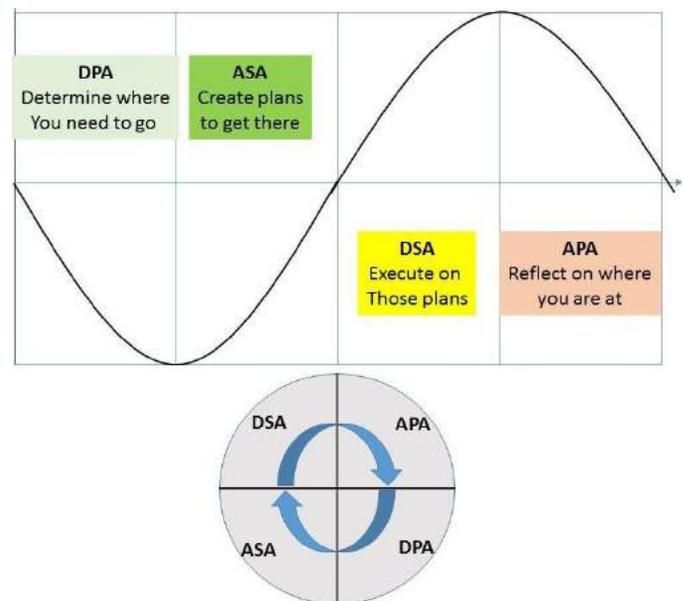


**Figure 7: EA Perspective Alignment Behavior Patterns**

Figure 8 shows how our four patterns can be mapped to four general process steps of EA (FEAPO 2014):

- The DPA pattern relates to “Determine where you need to go”
- The ASA pattern is similar to “Create plans to get there”
- The DSA pattern corresponds to “Execute on those plans”
- The APA pattern relates to “Reflect on where you are at”

In Figure 8, each pattern fits in a disk quadrant. If a point on the circumference circle was moving clockwise, its projection on the disk vertical axis would create the sine wave shown in Figure 8. This sine wave becomes alternatively concave or convex during phases that match the convexity or concavity of our four Alignment Behavior Patterns.



**Figure 8: EA Perspective Alignment Behavior Patterns and EA General Process Steps**

### Enterprise Transformation Cycle

Here we highlight four important organizational functions involved in organizational change and their link to the four EA general process steps that were previously presented. These four organizational functions are Governance, Strategy, Operations, and Lobbying.

- Governance hosts the “Reflect on where you are” and “Determine where you need to go” steps; Governance also ratifies and monitors Strategy
- Strategy hosts the “Determine where you need to go” and “Create plans to get there” steps; Strategy also contextualizes and directs Operations
- Operation hosts the “Create plans to get there” and “Execute on those plans” steps; Operation also motivates and characterizes Lobbying

- Lobbying hosts the “Execute on those plans” and “Reflect on where you are” steps; Lobbying also targets and influences Governance – it completes the cycle of organizational change by tying it back to Governance

It is important to notice that within our view of Enterprise Transformation, each one of the four EA general process steps is shared by two organizational functions. This suggests a strong dependency between the identified functions centered on a need to coordinate a shared transformation process step:

- The Governance and Strategy functions must integrate properly around the “Determine where we need to go” transformation process step
- The Strategy and Operations functions must integrate properly around the “Create plans to get there” transformation process step
- The Operations and Lobbying functions must integrate properly around the “Execute on those plans” transformation process step
- The Lobbying and Governance functions must integrate properly around the “Reflect on where you are” transformation process step

The four EA general process steps and the four functions involved in organizational change map to Kotter’s eight-step process for leading change (Kotter 2014) in the following manner, as depicted in Figure 9:

- Governance facilitates Kotter’s “Creating a sense of urgency” and “Building guiding coalition” steps
- Strategy facilitates Kotter’s “Form strategic vision and initiatives” and “Enlist volunteer army” steps
- Operations facilitates Kotter’s “Enable action by removing barriers” and “Generate short-term wins” steps
- Lobbying facilitates Kotter’s “Sustain acceleration” and “Institute change” steps

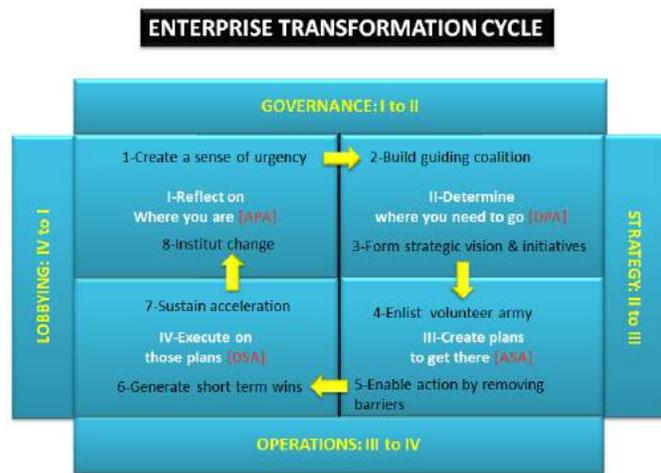


Figure 9: Enterprise Transformation Cycle and EA General Process Steps

### EA General Process Steps and EA Perspectives

A distinctive characteristic of our model is that it reveals a complex sequence of the four EA general process steps that can all happen simultaneously across several EA Perspectives in response to an organization’s need for alignment.

Tables 4 and 5 respectively show where Behavior Patterns are found in the EA implementation lifecycle when the Contextual Perspective and the Conceptual Perspective initiate the need for alignment.

Table 4: Contextual-Driven EA Perspectives Alignment Behavior Patterns

Step	X	C	L	P	D
3	DPA	DSA	ASA	ASA	
4	DPA	DSA	ASA	ASA	ASA
5	DPA	DSA	DSA	ASA	ASA
6	DPA	DSA	DSA	ASA	ASA
7	DPA	DSA	DSA	ASA	ASA
8	DPA	APA	DSA	ASA	ASA
9	DPA	APA	DSA	ASA	ASA
10	DPA	APA	DSA	DSA	ASA
11	DPA	APA	DSA	DSA	ASA
12	DPA	APA	DSA	DSA	ASA
13	DPA	APA	DSA	DSA	ASA
14	DPA	APA	DSA	DSA	ASA
15	DPA	DPA	DSA	DSA	ASA
16	DPA	DPA	DSA	DSA	ASA
17	DPA	DPA	DSA	DSA	ASA
18	DPA	DPA	APA	DSA	ASA
19	DPA	DPA	APA	DSA	ASA
20	DPA	DPA	APA	DSA	DSA
21	DPA	DPA	APA	DSA	DSA
22	DPA	DPA	APA	DSA	DSA
23	DPA	DPA	APA	DSA	DSA
24	DPA	DPA	APA	DSA	DSA
25	DPA	DPA	APA	DSA	DSA
26	DPA	DPA	APA	DSA	DSA
27	DPA	DPA	APA	DSA	DSA
28	DPA	DPA	APA	DSA	DSA
29	DPA	DPA	DPA	DSA	DSA
30	DPA	DPA	DPA	DSA	DSA

**Table 5: Conceptual-Driven EA Perspectives Alignment Behavior Patterns**

Step	X	C	L	P	D
3	DSA	DPA	DSA	ASA	
4	DSA	DPA	DSA	ASA	ASA
5	DSA	DPA	DSA	DSA	ASA
6	DSA	DPA	DSA	DSA	ASA
7	DSA	DPA	APA	DSA	ASA
8	APA	DPA	APA	DSA	ASA
9	APA	DPA	APA	DSA	ASA
10	APA	DPA	APA	DSA	ASA
11	APA	DPA	APA	DSA	ASA
12	APA	DPA	APA	DSA	DSA
13	APA	DPA	DPA	DSA	DSA
14	APA	DPA	DPA	DSA	DSA
15	DPA	DPA	DPA	DSA	DSA
16	DPA	DPA	DPA	DSA	DSA
17	DPA	DPA	DPA	DSA	DSA
18	DPA	DPA	DPA	DSA	DSA
19	DPA	DPA	DPA	DSA	DSA
20	DPA	DPA	DPA	DSA	DSA
21	DPA	DPA	DPA	DSA	DSA
22	DPA	DPA	DPA	DSA	DSA
23	DPA	DPA	DPA	DSA	DSA
24	DPA	DPA	DPA	DSA	DSA
25	DPA	DPA	DPA	DSA	DSA
26	DPA	DPA	DPA	DSA	DSA
27	DPA	DPA	DPA	DSA	DSA
28	DPA	DPA	DPA	DSA	DSA
29	DPA	DPA	DPA	DSA	DSA
30	DPA	DPA	DPA	DSA	DSA

**IMPACT OF EA PERSPECTIVES ALIGNMENT BEHAVIOR PATTERNS**

Each EA Perspective in the ZF has a set of specific artifacts found in its corresponding six cells (rows) (Hay 2003). Each Perspective also represents the total enterprise view for a given stakeholder group (Zachman 2009).

Each one of the four EA Perspective Alignment Behavior Patterns impacts the Perspectives’ artifacts and their owning stakeholders. We discuss next the nature of these impacts.

**Impact of Alignment Behavior Patterns on EA Artifacts and Stakeholders**

In this section we present general guidelines applicable to any EA Perspective about the impact that each one of the four Alignment Behavior Patterns has on an EA Perspective’s artifacts and stakeholders.

**Table 6: Impact of Alignment Behavior Patterns on EA Artifacts and Stakeholders**

Pattern	EA Artifacts	EA Stakeholder
Accelerated Need to Seek higher Alignment (ASA)	Frequent updates	Increasingly receptive to new constraints and new facts
Decelerated Need to Seek higher Alignment (DSA)	Initially high update frequency that keeps decreasing	Initially high but later decreasing receptiveness to new constraints and new facts
Accelerated Need to Preserve existing Alignment (APA)	Very stable with little to no updates	Preservation and active communication of existing artifacts
Decelerated Need to Preserve existing Alignment (DPA)	Moderate update frequency	Highly scrutinized acceptance of new constraints and new facts

Let’s illustrate these guidelines by looking at the Conceptual Alignment Behavior Patterns of a contextual-driven need for EA alignment. The Conceptual Perspective’s EA artifacts are Business Models such as Business Strategies, Business Capabilities, Business Requirements, Business Rules, Business Process Models, Business Entities or Business Data Objects, and offered Products and Services (Malik 2001). The Conceptual Perspective stakeholders are Business Owners such as: Business Architects, Product Owners, and Business Analysts (Hay 2003).

**Table 7: Alignment Behavior Patterns Impact on Conceptual Perspectives’ Artifacts and Stakeholders**

Steps	Pattern	EA Artifacts	EA Stakeholder
3 to 7	Decelerated Need to Seek higher Alignment (DSA)	Initially high update frequency that keeps decreasing	Initially high but later decreasing receptiveness to new constraints and new facts
8 to 14	Accelerated Need to Preserve existing Alignment (APA)	Very stable with little to no updates	Preservation and active communication of existing Business Models

Steps	Pattern	EA Artifacts	EA Stakeholder
15 to 30	Decelerated Need to Preserve existing Alignment (DPA)	Moderate update frequency	Highly scrutinized acceptance of new constraints and new facts

**Critical EA Implementation Alignment Coordination**

In our model illustration, each EA Perspective goes through different Alignment Behavior Patterns throughout the EA implementation lifecycle. In this section we identify Critical Alignment Coordination phases that simultaneously involve three or more EA Perspectives.

Table 8 presents six EA Alignment Coordination phases identified when the Contextual Perspective initiates the need for EA alignment. Each Critical Alignment Coordination phase is explained next.

The Critical Alignment Coordination phases can be mapped to very popular phases of Systems Engineering Processes (SEP) (Blanchard & Fabrycky 1998):

- Phase A is similar to SEP’s Identification of Needs
- Phase B resembles SEP’s Conceptual Design
- Phase C and D corresponds to SEP’s Preliminary and Detailed Design
- Phases E and F map to SEP’s Production/Construction

Software Development Processes phases such as the Rational Unified Process (RUP) (Royce 1998) can also be mapped to our model’s Critical Alignment Coordination phases:

- Phases A and B map to RUP’s Inception Phase
- Phases C and D map to RUP’s Elaboration Phase
- Phase E maps to RUP’s Construction Phase
- Phase F maps to RUP’s Transition Phase

**Table 8: Contextual-Driven EA Perspectives Alignment Patterns Coordination**

Step	Phase	X	C	L	P	D
3	A	DPA	DSA	ASA	ASA	
4		DPA	DSA	ASA	ASA	ASA
5		DPA	DSA	DSA	ASA	ASA
6		DPA	DSA	DSA	ASA	ASA
7		DPA	DSA	DSA	ASA	ASA
8	B	DPA	APA	DSA	ASA	ASA
9		DPA	APA	DSA	ASA	ASA
10		DPA	APA	DSA	DSA	ASA
11		DPA	APA	DSA	DSA	ASA
12		DPA	APA	DSA	DSA	ASA
13		DPA	APA	DSA	DSA	ASA

Step	Phase	X	C	L	P	D
14		DPA	APA	DSA	DSA	ASA
15	C	DPA	DPA	DSA	DSA	ASA
16		DPA	DPA	DSA	DSA	ASA
17		DPA	DPA	DSA	DSA	ASA
18	D	DPA	DPA	APA	DSA	ASA
19		DPA	DPA	APA	DSA	ASA
20		DPA	DPA	APA	DSA	DSA
21		DPA	DPA	APA	DSA	DSA
22		DPA	DPA	APA	DSA	DSA
23		DPA	DPA	APA	DSA	DSA
24		DPA	DPA	APA	DSA	DSA
25		DPA	DPA	APA	DSA	DSA
26	E	DPA	DPA	APA	DSA	DSA
27		DPA	DPA	APA	DSA	DSA
28		DPA	DPA	APA	DSA	DSA
29	F	DPA	DPA	DPA	DSA	DSA
30		DPA	DPA	DPA	DSA	DSA

It is important to keep in mind that the set of Critical Alignment Coordination phases described next are only valid when the Contextual Perspective triggers the need for alignment. Different Critical Alignment Coordination phases emerge when other EA Perspectives initiate the need for alignment (Korhonen 2013) as illustrated for the Conceptual Perspective in Table 5.

**Phase A: Planners, Owners, and Architects Critical Alignment Coordination**

The EA Implementation Alignment begins with this coordination phase that lasts up to step 7. The Contextual Perspective initiates the need for EA alignment and is in a Decelerated Need to Preserve its existing Alignment (DPA) pattern. The Conceptual Perspective remains in a Decelerated Need to Seek higher Alignment (DSA) pattern. The Logical Perspective starts in an Accelerated Need to Seek higher Alignment (ASA) pattern and turns into a DSA one. According to the impact of those patterns, the following happens:

- Owners have an initially high receptiveness to new or modified Enterprise Scope constraints originating from Planners  
Business Strategies, Business Capabilities, Business Requirements, Business Rules, Business Process Models, Business Entities, Products and Services definitions are updated to reflect the constraints imposed by Planners in the form of new Business Objectives and Goals, or new Organizational Structures. Owners gradually decrease their receptiveness to new constraints and new facts originating from the Planners as they become more and more aligned with the Planners’

initial demands. This results in increasingly stable new Business Models.

- Planners remain receptive to feedback from the Owners during that phase and if deemed appropriate they may revise their artifacts after great scrutiny as recommended under a DPA pattern
- Architects go first through an Accelerated Need to Seek higher Alignment (ASA) pattern during which they indiscriminately receive a large amount of new constraints from the quickly evolving Business Models

At step 5 they switch to a DSA pattern and begin the process of updating Enterprise Information System Models. The architect's new models are not yet stable and change frequently; their main value during this phase is to facilitate the provision of early feedback to Owners about the maturing Business Models.

#### ***Phase B: Owners, Architects, and Engineers Critical Alignment Coordination***

The second critical EA Implementation Alignment Coordination phase begins at step 8 and lasts up to step 14. The Contextual Perspective remains in a Decelerated Need to Preserve its existing Alignment (DPA) pattern. The Conceptual Perspective enters an Accelerated Need to Preserve its existing Alignment (APA) pattern. The Logical Perspective remains in a Decelerated Need to Seek higher Alignment (DSA) pattern. The Physical Perspective starts in an Accelerated Need to Seek higher Alignment (ASA) pattern but switches to a DSA pattern at step 10. According to the impact of those patterns, the following happens:

- Owners are in an APA pattern and actively communicate the stable new Business Models to Architects and Designers; owners avoid as much as possible modifications to the Business Models during that phase
- Architects and Designers are in a DSA pattern  
They are focused on incorporating the stable Business Models' constraints into the development of new Enterprise Information System Models.
- Engineers go first through an ASA pattern during which they indiscriminately receive a large amount of new constraints from the quickly evolving Enterprise Information System Models

At step 10 they switch to a DSA pattern and begin the process of updating existing Technologies, Tools, and Materials in order to realize the new Information System Models. These artifacts are not yet stable and change frequently; their main value during that phase is to facilitate the provision of early feedback about Enterprise Information System Models being developed by Architects.

#### ***Phase C: Architects, Engineers, Owners, and Planners Critical Alignment Coordination***

The third critical EA Implementation Alignment Coordination phase begins at step 15 and lasts up to step 17. It is worth noticing that during this phase no Perspective is in an Accelerated Need to Preserve its existing Alignment (APA) pattern. The Logical Perspective remains in a Decelerated Need to Seek higher Alignment (DSA) pattern. The Physical Perspective also is in a DSA pattern. The Owners and Planners are both in a Decelerated Need to Preserve existing Alignment (DPA) pattern. According to the impact of those patterns, the following happens:

- Architects and Designers have been and remain in a DSA pattern  
They have been focused on incorporating the stable Business Models' constraints into the development of new Enterprise Information System Models. They have also been receiving feedback from the Engineers. They now communicate more actively with Owners who are in a DPA pattern. Owners can receive valuable feedback from Architects as well as new constraints from Planners. When appropriate, Owners also revise their Business Models with great scrutiny.
- Revisions made to the Business Models may impact the Planners' artifacts  
Since the Contextual Perspective has remained in a DPA pattern, Planners can decide to incorporate feedback from Owners into their artifacts when necessary.

Phase C can be viewed as an opportunity to conduct an enterprise-wide sanity check where necessary alignment activities can occur simultaneously across all Perspectives. This phase can effectively address and mitigate the all-too-common problem of lag time in alignment due to constant changes occurring in the organization (Chan & Reich 2007). This phase ultimately concludes with the achievement of robust Enterprise Information System Models that will remain highly stable for the great majority of the subsequent EA implementation steps (Hoverstadt 2013).

#### ***Phase D: Architects, Engineers, and Technicians/Programmers Critical Alignment Coordination***

The fourth critical EA Implementation Alignment Coordination phase begins at step 18 and lasts up to step 25. The Logical Perspective remains in an Accelerated Need to Preserve its existing Alignment (APA) pattern. The Physical Perspective remains in a Decelerated Need to Seek higher Alignment (DSA) pattern. The Detailed Perspective starts in an Accelerated Need to Seek higher Alignment (ASA) pattern but switches to a DSA pattern at step 20. According to the impact of those patterns, the following happens:

- Architects are now in an APA pattern  
They actively communicate the robust Enterprise Information System Models to Engineers. Architects avoid as much as possible modifications to their own artifacts during that phase.
- Engineers are in a DSA pattern  
They are working on translating the stable Enterprise Information System Models' constraints into new Technologies, Tools, and Materials that could realize them.
- Technicians and Programmers begin in an ASA pattern during which they indiscriminately receive a large amount of new constraints from the quickly evolving Physical Perspective's Technologies, Tools, and Materials  
At step 20 they switch to a DSA pattern and begin the process of developing and implementing detailed specifications of Physical System Components. These artifacts are not yet stable and change frequently; their main value during that phase is to facilitate the provision of early feedback about Technologies, Tools, and Materials being developed by Engineers.

***Phase E: Technicians/Programmers, Engineers, and Architects Critical Alignment Coordination***

The fifth critical EA Implementation Alignment Coordination phase begins at step 26 and lasts up to step 28. The Logical, Physical, and Detailed Perspectives stay in the same patterns as the ones last experienced during phase D. The main difference is that Physical and Detailed Perspectives' artifacts are much more mature. The following happens:

- Architects are still in an APA pattern  
They actively communicate the robust Enterprise Information System Models to Engineers and also to Technicians and Programmers. Architects still avoid as much as possible modifications to the Enterprise Information System Models during that phase.
- Engineers are still in a DSA pattern  
They are now getting closer to completing translation of the stable Enterprise Information System Models' constraints into new Technologies, Tools, and Materials. Their efforts incorporate feedback from Technicians and Programmers who are developing and implementing more stable detailed specifications of Physical System Components.

***Phase F: Technicians/Programmers, Engineers, and Architects Critical Alignment Coordination***

The sixth and final critical EA Implementation Alignment Coordination phase begins at step 29 and lasts up to step 30. The Logical Perspective enters a Decelerated

Need to Preserve its existing Alignment (DPA) pattern. The Logical, Physical, and Detailed Perspectives stay in a Decelerated Need to Seek higher Alignment (DSA) pattern. According to the impact of those patterns, the following happens:

- Engineers are very close to completing translation of the Enterprise Information System Models' constraints into new Technologies, Tools, and Materials  
They keep receiving feedback from Technicians and Programmers. Engineers can communicate this valuable feedback to Architects who are in a DPA pattern. When appropriate, Architects can revise accordingly their artifacts with great scrutiny.
- Technicians/Programmers and Engineers work very closely during this final phase and make required updates to their artifacts in response to various verification and validation activities of the implemented final products and services (Boehm & Basili 2001; Boehm 1987).
- Like Architects, Owners and Planners are also in a Decelerated Need to Preserve their existing Alignment (DPA) pattern  
Feedback can be communicated from one Perspective's Stakeholder group to its ZF upper row. Equally, moderate new constraints can be propagated to lower ZF rows. Relevant updates can then be made to corresponding EA artifacts with great precaution.

**EA PERSPECTIVES' ALIGNMENT NEEDS MOMENTUM**

In our model, the size of a team associated with an EA Perspective Alignment Need is similar to the Mass of the Alignment Need. We define an EA Perspective's Alignment Need Momentum as the product of its size (Mass) and its Alignment Need Rate (Speed).

A Perspective has a positive Alignment Need Momentum when its Alignment Need Rate is positive. This implies that the Perspective's allocated staff is used to Seek higher levels of alignment.

A Perspective has a negative Alignment Need Momentum when its Alignment Need Rate is negative. In this situation, the Perspective's allocated staff is used to preserve the Perspective's existing levels of Alignment.

The sum of all five Perspectives Alignment Need Rates is always equal to zero. This property results from the fact that the Perspectives' relative constraints strengths are a distribution that always adds up to one at any step. If each Perspective has the same team size then the total enterprise Alignment Need Momentum remains at zero throughout the EA entire implementation lifecycle (steps 1 to 30). When that occurs, the alignment initiative as a whole directs its staff equally between seeking higher levels of alignment and preserving them once achieved.

If all Perspectives do not have the same team size, then the total enterprise Alignment Need Momentum can be either positive or negative at any given step.

When the total enterprise Alignment Need Momentum is positive at a given step, the alignment initiative is directing its staff towards seeking higher levels of alignment; i.e., people are mostly working on embracing new changes at that step.

If the total enterprise Alignment Need Momentum is negative then the alignment initiative is directing its staff towards preserving its current alignment levels; i.e., people are mostly working on resisting new changes at that step.

Figure 10 illustrates these observations.

Our model can be used to determine at each step what each Perspective's team size should be to ensure a balanced Total Alignment Initiative Momentum throughout the initiative's implementation. Balance is obtained when the Perspective's team size is proportional to its relative constraints strengths ratios at a given step.

For example, in Figure 10 we assume that the total weekly team size is constant and equals 1,100 man-hours per week. Let's use this value as a reference point for our computations as reported in Figure 11 when the Contextual Perspective initiates the need for alignment.

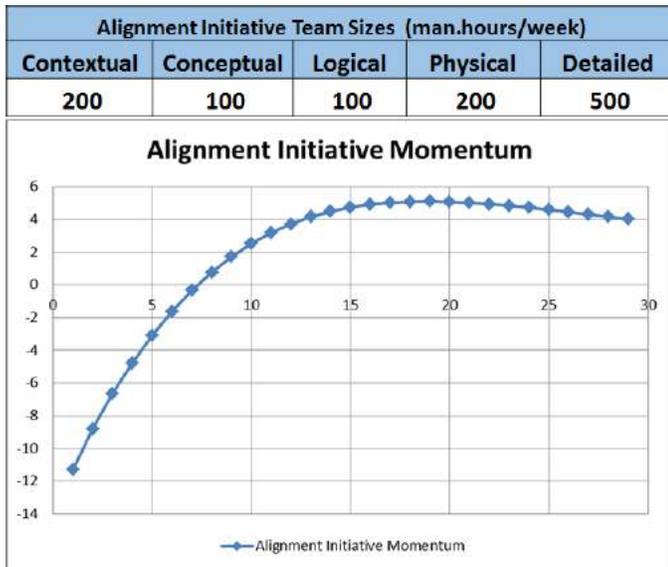


Figure 10: Total Alignment Initiative Momentum

Figure 11 reveals where the initial individual team sizes reported in Figure 10 would have been either overestimated or underestimated throughout the EA alignment lifecycle if they were repeated each week.

Figure 12 shows that the organization's Total Alignment Initiative Momentum gradually shifts away from being negative and becomes positive after step 23 during the Critical Alignment Coordination phase D. Afterwards, the

momentum curve remains positive and close to zero which would be indicative of an organization that balances well its alignment efforts between embracing change and preserving it once achieved.

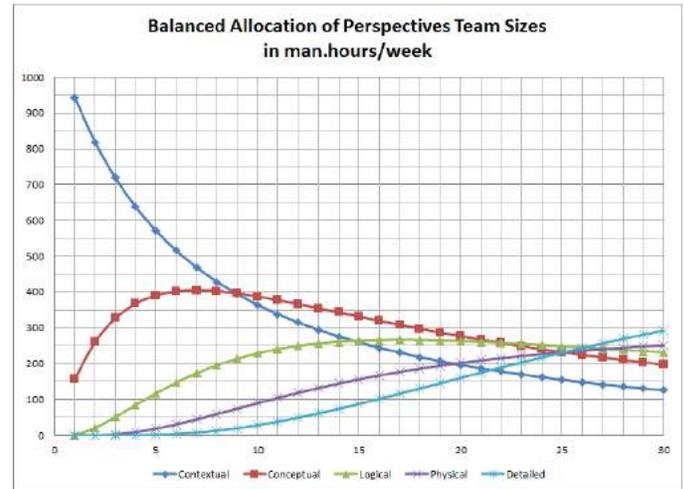


Figure 11: Balanced Allocation of Perspective's Team

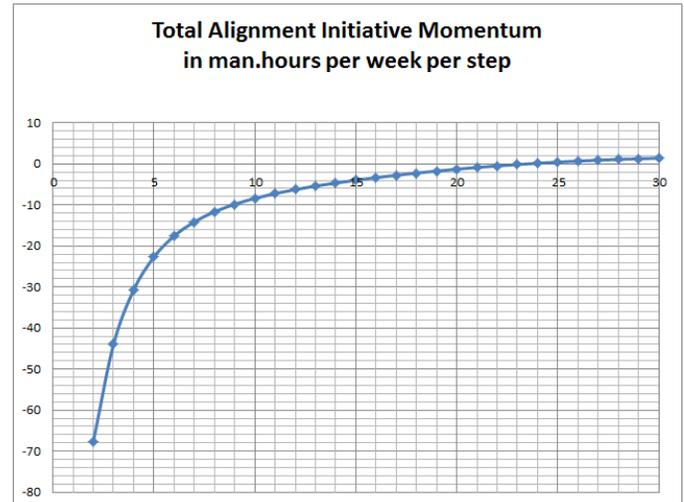


Figure 12: Balanced Total Alignment Initiative Momentum

## CONCLUSION

An organization's fundamental need to respond to influencing forces in its environment is very likely to require some transformation of the enterprise to align itself with new business strategies. EA can play a crucial role to increase the chances of implementing such initiatives in a timely and effective manner throughout all layers of the organization.

We have presented a dynamic EA alignment model which can be a valuable aid to a programmatic application of EA. Our model predicts over the EA implementation lifecycle four fundamental dynamic patterns induced by the various EA components and the influence that they have on each other. Each pattern shares a strong similarity to each of the following four common EA process steps: reflect on where you are at; determine where you want to go; create plans to get

there; and execute those plans. Our model shows how to map and coordinate these patterns across the Zachman Framework's first five EA Perspectives throughout an EA implementation lifecycle based on the EA Perspective that triggers the need for organizational alignment.

Another useful application of our model suggests upper bounds to the relative size of each main EA stakeholder's group involved in bringing about a successful execution of their organizational transformation endeavor.

## ABOUT THE AUTHOR

Atiogbe Didier Koffi is a Business Architect and Business Systems Analyst with 22 years of professional experience in the IT Industry. He is the founder of Pragmatic Cohesion Consulting LLC. His career has covered government and private sectors with services to the Department of Defense, the Department of Labor, leading biomedical research and development organizations, leading pay-media companies, and Fortune 100 healthcare and retail organizations. His published work is listed in the ACM Enterprise Architecture Tech Pack. Atiogbe holds a Master of Science degree in Systems Engineering from Virginia Tech. He is an active member of the Association of Enterprise Architects (AEA), the Association for Computing Machinery (ACM), and the International Council on Systems Engineering (INCOSE). You can contact [didier@PragmaticCohesion.com](mailto:didier@PragmaticCohesion.com) for comments or questions.

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