

# Chapter 3

## Complex Adaptive Systems Thinking Approach to Enterprise Architecture

Marc Rabaey  
Open-Raxit, Belgium

### ABSTRACT

*Complex systems interact with an environment where a high degree of uncertainty exists. To reduce uncertainty, enterprises (should) create intelligence. This chapter shows that intelligence has two purposes: first, to increase and to assess (thus to correct) existing knowledge, and second, to support decision making by reducing uncertainty. The chapter discusses complex adaptive systems. Enterprises are not only complex systems; they are also most of the time dynamic because they have to adapt their goals, means, and structure to survive in the fast evolving (and thus unstable) environment. Crucial for enterprises is to know the context/ecology in which they act and operate. The Cynefin framework makes the organization and/or its parts aware of the possible contexts of the organization and/or its parts: simple, complicated, complex, chaotic, or disordered. It is crucial for the success of implementing and using EA that EA is adapted to function in an environment of perpetual change. To realize this, the chapter proposes and elaborates a new concept of EA, namely Complex Adaptive Systems Thinking – Enterprise Architecture (CAST-EA).*

### INTRODUCTION

The aim of this chapter is to introduce Complex Adaptive System (CAS) and Systems Thinking (ST) into Enterprise Architecture (EA). The combination of CAS and ST is called Complex Adaptive Systems Thinking (CAST) (Lowe & Ng, 2006).

DOI: 10.4018/978-1-4666-4518-9.ch003

Systems Thinking has many forms, but we are basing our concept on the ST defined by Gharajedaghi (2011). In the context of Enterprise Architecture, ST is, in essence, a holistic approach to an enterprise and its environment. Sterman (2010) defines ST as “the ability to see the world as a complex system, in which we understand that ‘you can’t just do one thing’ and that ‘everything is connected to everything else’” (p. 4). In this light, we will propose a new concept of EA, which will

not only incorporate the Information Technology (IT) view but also a global (holistic) view of the enterprise.

Sterman (2010) wants us to see the world as a complex system, so we will first give a brief overview of complex systems. Senge (2006) states that complex systems have to do with dynamic complexity and not detail complexity. The latter arises where there are many variables, which are difficult (almost impossible) to hold in mind simultaneously to appreciate them as a whole. The former arises where effects over time of interrelatedness are subtle and the results of actions are not obvious, or where short-term and long-term effects are significantly different, or where effects locally are different from effects on a wider scale (Flood, 1999).

Complex systems are interacting with an environment where much uncertainty exists. To reduce the uncertainty, the enterprise will create intelligence. In our discussion, however, we will show that intelligence has two purposes: to increase and to assess (thus to correct) the existing knowledge and to support decision making by reducing the uncertainty. Rabaey and Mercken (2012) are proposing the system of 'Intelligence Base' to organize the intelligence process and the exploitation of knowledge.

After the section on uncertainty and intelligence, we will discuss Complex Adaptive Systems. Enterprises are not only complex systems, but they are also most of the time CAS because they have to adapt their goals, means and structure to survive in the fast evolving (and thus unstable) environment. In this section, we will show the consequence of wanting to implement EA for a CAS.

Crucial for enterprises is to know in which context they are acting and reacting. The Cynefin framework makes the organization and/or its parts aware of the possible contexts of the organization and/or its parts: simple, complicated, complex, chaotic or disordered. Dettmer (2011) uses the Cynefin framework to determine which management methods and tools can be used in

which context. Important to note is that systems can move from one context to another without the enterprise knowing about it (necessity to have an intelligence system).

As a consequence, it is crucial for the success of implementing and using EA, that EA is adapted to function in a context that may permanently change. Therefore, we are proposing a new concept of EA, namely Complex Adaptive Systems Thinking – Enterprise Architecture (CAST-EA).

## **SYSTEMS**

### **Open Systems**

An enterprise or any other organization cannot be a closed system, if it wants to interact with its environment, therefore, it is an open system. Although we will discuss Complex Adaptive Systems (CAS) in more depth later, we will first define what a system is. Russell Ackoff is a Systems Thinking pioneer and organizational theorist. He (Joyce, 2011; Matthews, 2012) states that a system is a whole, that consists of parts, each of which can affect the behavior of the whole or its properties. The parts do not necessarily do it all the time, but they can. Furthermore, each part of the system, when it affects the system, is dependent for its effect on some other parts. In other words, the parts are interdependent; therefore, no part of the system or a collection of parts has an independent effect on it.

As such, a system is a whole that cannot be divided into independent parts. Moreover, the essential or defining properties of a system are properties of the whole which none of its parts have and thus when a system is taken apart it loses its essential properties. As an example, if one takes all of the different cars on the market today, and asks a group of engineers who have the best engine, which has the best transmission, which has the best alternator, etc., and they take these best parts and try to put them together, it is

49 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

[www.igi-global.com/chapter/complex-adaptive-systems-thinking-approach-to-enterprise-architecture/80909](http://www.igi-global.com/chapter/complex-adaptive-systems-thinking-approach-to-enterprise-architecture/80909)

## Related Content

---

### A Literature Review of Data Mining Techniques for Enhancing Digital Customer Engagement

Mona Mosa, Nedaa Agami, Ghada Elkhayat and Mohamed Kholief (2020). *International Journal of Enterprise Information Systems* (pp. 80-100).

[www.irma-international.org/article/a-literature-review-of-data-mining-techniques-for-enhancing-digital-customer-engagement/265126](http://www.irma-international.org/article/a-literature-review-of-data-mining-techniques-for-enhancing-digital-customer-engagement/265126)

### Analysis of the Web Pages as a Strategic Tool of the Most Popular Hotels Worldwide and Their Comparison in Different Countries

Martina Asenova, Juan Llopis, Jose Gascó and Reyes González (2020). *International Journal of Enterprise Information Systems* (pp. 1-19).

[www.irma-international.org/article/analysis-of-the-web-pages-as-a-strategic-tool-of-the-most-popular-hotels-worldwide-and-their-comparison-in-different-countries/259368](http://www.irma-international.org/article/analysis-of-the-web-pages-as-a-strategic-tool-of-the-most-popular-hotels-worldwide-and-their-comparison-in-different-countries/259368)

### An Approach for Recovering the Connections between Business Process and Software System

Lerina Aversano, Fiammetta Marulli and Maria Tortorella (2012). *Organizational Integration of Enterprise Systems and Resources: Advancements and Applications* (pp. 250-267).

[www.irma-international.org/chapter/approach-recovering-connections-between-business/66982](http://www.irma-international.org/chapter/approach-recovering-connections-between-business/66982)

### Process Integration Through Hierarchical Decomposition

A. Manzer (2007). *Enterprise Architecture and Integration: Methods, Implementation and Technologies* (pp. 92-106).

[www.irma-international.org/chapter/process-integration-through-hierarchical-decomposition/18363](http://www.irma-international.org/chapter/process-integration-through-hierarchical-decomposition/18363)

### Unleashing the Potential of SCM: The Adoption of ERP in Large Danish Enterprises

Charles Møller (2007). *Modelling and Analysis of Enterprise Information Systems* (pp. 167-182).

[www.irma-international.org/chapter/unleashing-potential-scm/26848](http://www.irma-international.org/chapter/unleashing-potential-scm/26848)