Chapter 4
Importance of Systems Engineering in the Development of Information Systems

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ABSTRACT

The interrelationship between Information Systems (IS), Systems Engineering (SE), and Information Systems Development (ISD) is discussed from past, present, and future perspectives. While SE is relatively a well-established discipline based upon an interdisciplinary approach to enable the realization of successful systems, ISD has evolved to a variant of SE applied mainly for the development of IS. Given the growth in complexity, need for enterprise wide solutions, and the cost and schedule overruns that have be common place for modern software centric systems, well-established tools, techniques, and processes are needed for the development of good IS. Similarities and differences of methodology as well as their evolution and perspectives are also presented herein. We found a positive trend in the evolution of research methodology and published material in SE and its use in IS.

INTRODUCTION

Our task for this chapter is to analyze the significance of IS for SE and its methods as well as the relevance of systems approach (SA) and SE for the development of IS. It is impossible to utilize SE and SA methods without proper IS, and conversely you cannot develop cost effective and efficient IS without disciplined SE or SA. All of them are mutually dependent. However, there has historically been a difference in the SE methods used for the IS development and other socio-technical problems. These differences in tools, techniques, and processes were caused by user experience, traditional domain stovepipes. Fortunately, established domain centric stovepipe practices will ultimately converge because of economic forces. Our aim in this article is to generalize and highlight these different methodologies and their relevance for research of the vast variety of processes where IS and system's methodologies are essential conditions. Evidently, IS are an essential part of any real process: biological, organizational

and technical that enable data collection, processing, storing and retrieving, while SE and SA are general methodology for system "construction" and deployment. Although IS has its' own uniqueness and logic of functioning it is always part of the systems; to enable communications and are inseparable from systems itself. In general, IS has properties and function developed trough evolution as a part of the organizational systems as the results of the social relationship, technology development, and methodology. Presently, the advances in net information technology and software science have been tremendously impact on the organizations structure and functioning as well as implementation of IS. Various kinds of IS, such as Enterprises Resource Planning systems, Decision Support Systems, Group Decision Support, and Knowledge Management Systems, have become recognized as indispensable in enabling organizations to survive. In order to cope with huge variety of IS produced by the Internet, the www ontology of IS was developed. A formal concepts of the sets of objects of interest and the relationships that hold among them. A conceptualization is an abstract, simplified view of the world that we wish to represent for some purpose (Gruber, 1995). This definition is in turn similar to yet more specific to the context of domain of interest. This concept is similar to the definition of abstract general systems (Mesarović and Takahara, 1989) and has origin in it and philosophy yet more pragmatic. In the article we will try to highlight the relation between these two important phenomena: IS and their methodologies.

The world is rapidly changing with outsourcing, globalization, network centricity, and complexity being the mantra for 21st century engineering. Services dominant the economies of most countries (see Figure 1) with IS being the key business enabler. Also, as shown in Figure 2, the operating environment is also changing. Gone are the days of an engineer working at the component level in a stovepipe organization. In fact, a more relevant definition of all engineering

should be " in today's global business environment, engineers integrate hardware, software, people, and interfaces and to produce economically viable and innovative applications while ensuring that all pieces of the system are working together." (Farr, 2007)

As shown by Figures 1 and 2, one can conclude how important are IS and methodologies to handle IS in order to cope with complex society. The world crisis just started could be caused by structure change in world economy as shown in Figure 1 and our limited knowledge to cop with new reality. In the rest of the paper we will try to highlight systematically the role of methodology (SE and SA) for development of IS and vice versa.

The word "system" can broadly be defined as an integrated set of elements that accomplish a defined objective (INCOSE 2004). Simply put, a system is a whole consisting of parts and being more than sum of its parts. That was an axiom of ancient philosophers, which accurately anticipated the contemporary definition of systems. Only order, structure, and behavior were added to the meaning of systems in cybernetics and general systems theory. Complex systems are usually understood intuitively, as a phenomena consisting of a large number of elements organized in a multi-level hierarchical structure where elements themselves could represent systems (Mesarović and Takahara, 1989). The word "complex" is used only to indicate that the problem treated here cannot be expressed only in hard (quantitative) relations and those many relevant characteristics are qualitative. With a conception of complex systems, we think about a system within which a main role is played by a complexity of control and information processes. We also now understand that for a system to operate at optimum efficiency that the components or sub-systems must operate sub-optimally. Undoubtedly, existing SE methodology is applied to small, medium, large scale and complex process but with complex systems, SE moves to a SA methodology. Fortunately, these

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