

Chapter VIII

Systems Engineering Modeling and Design

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ABSTRACT

System theories, analysis and design have been deployed within every corporate function and within a broad section of businesses and markets. Systems thinking involve changing paradigms about the way the world works, the way corporations function, and the human role in each. In systems thinking, analysis and design we look for interrelationships among the elements of a system. The chapter reflects the core insights of system modeling. This chapter addresses the core issues of system engineering, analysis, design, Simulation and modeling of real-world objects. It tells everything one needs to know to be a successful system thinker, modeler, technical manager and forecaster. The chapter focuses on: the real-world goals for, services provided by, and constraints on systems; the precise specification of system structure and behavior; and the implementation of specifications; the activities required in order to develop an assurance that the specifications and real-world goals have been met; the evolution of systems over time and across system families. It is also concerned with the processes, methods and tools for the development of systems in an economic and timely manner.

1. INTRODUCTION

This widespread acceptance and deployment of system theories means System engineering, analysis and design and modeling are now more on the critical path than ever before.

This chapter should be an interesting source of information both for people who want to experi-

ment with their thinking and simulating the real world who face the need to deal with the inner levels of system engineering concepts. We hope this chapter is useful as a starting point for people who want to become system analyst and architect but don't know where to start.

On the technical side, this text should offer a hands-on approach to understanding the sys-

tem theory and thinking, modeling, simulation, knowledge management, system analysis and design, system forecasting and different types of real world modeling techniques like technosocio-economic modeling and some of the design choices made by the system developers for auditing and output designs from scratch.

The first part of the chapter deals system engineering, analysis, design theories and thinking concepts. This part visualizes an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, and then proceeding with design synthesis and system validation while considering the complete problem. Second part works with the system analysis design modeling concepts and its types. It reflects that computer model, as used in modeling and simulation science, is a mathematical representation of something—a person, a building, a vehicle, a tree—any object and a model also can be a representation of a process. Third part will give the inputs to understand the dynamics of the system. This chapter is based on system dynamics that is a computer-based simulation modeling methodology tool for managers to analyze complex problems. Using system dynamics simulations allows us to see not just events, but also patterns of behaviour over time. The behaviour of a system often arises out of the structure of the system itself, and behaviour usually changes over time.

This chapter will give you the knowledge of important sections from the scratch, step-by-step procedures, and the skills necessary to effectively system thinker, modeler, Analyst, technical and solution architect.

2. SYSTEM THEORY AND THINKING

One of the biggest breakthroughs in how we understand and guide change in organizations

is systems theory and systems thinking. To understand how they are used in organizations, we first must understand a system. Many of us have an intuitive understanding of the term. However, we need to make the understanding explicit in order to use systems thinking and systems tools in organizations.

Simply put, a system is an organized collection of parts (or subsystems) that are highly integrated to accomplish an overall goal. The system has various inputs, which go through certain processes to produce certain outputs, which together, accomplish the overall desired goal for the system. So a system is usually made up of many smaller systems, or subsystems. For example, an organization is made up of many administrative and management functions, products, services, groups and individuals. If one part of the system is changed, the nature of the overall system is often changed, as well -- by definition then, the system is systemic, meaning relating to, or affecting, the entire system. (This is not to be confused with systematic, which can mean merely that something is methodological. Thus, methodological thinking -- systematic thinking -- does not necessarily mean systems thinking.)

2.1 System Theory

History and Orientation

Hegel developed in the 19th century a theory to explain historical development as a dynamic process. Marx and Darwin used this theory in their work. System theory (as we know it) was used by L. von Bertalanffy, a biologist, as the basis for the field of study known as ‘general system theory’, a multidisciplinary field (1968). Some influences from the contingency approach can be found in system theory.

Core Assumptions and Statements

System theory is the trans-disciplinary study of the abstract organization of phenomena, in-

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