

## Chapter 2

# Understanding Systems

### ABSTRACT

*A System is an intentionally designed, systematically organized, whole entity (e.g., an automobile, computer, smart building, etc.) that has one or more essential functions so that an individual and/or groups of people are thereby able to accomplish a set of important purposes. Furthermore, the functions, not the parts, are critical in defining a System. By means of their functions, the parts exist to allow people to accomplish significant purposes, not the other way around. A critical distinction is that a System's parts have functions while only humans as purposive individuals have purposes.*

*“A system is never the sum of its parts; it's the product of their interaction.” – Russell Ackoff*

### Learning Objectives

- Define ‘system’
- List the attributes of a SocioTechnical System
- Explain ‘systems thinking’
- Describe an E3 error

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## INTRODUCTION

We cannot overemphasize the importance of Systems and Systems Thinking. It's at the very core of this entire book. In a series of seminal books spanning a lifetime, no one has done a more commanding job than Russ Ackoff and his colleagues in identifying and laying out the precise definition and nature of Systems ((Ackoff, 1999) (Ackoff, 1999) (Ackoff & Rovin, 2003) (Ackoff & Greenberg, 2008) (Gharajedaghi, 2006) (Mitroff & Linstone, 1993)).

## SYSTEMS

First, we start with an overview of Systems. Ackoff describes Systems as more than a concept. It is an intellectual way of life, a worldview, a concept of the nature of reality and how to investigate it. A system is defined as a set of two or more elements that satisfies the following three conditions (Ackoff, 1999):

- *The behavior of each element has an effect on the behavior of the whole;*
- *The behavior of the elements and their effects on the whole are interdependent;*
- *However subgroups of the elements are formed, each has an effect on the behavior of the whole and none has an independent effect on it.*

The first condition is that a System cannot accomplish its defining function(s) without its essential parts, and persons. A car engine is an essential part for locomotion but a cigarette lighter is not. Similarly, the brain, heart, and lungs are essential parts of humans, but as Ackoff notes, the appendix is not. This is in fact why it is termed an "appendix."

The second condition is that by itself an essential part cannot affect a System independently of at least one other essential part. The essential parts are not only interconnected, but they interact. Thus, the heart affects the lungs and vice versa. Indeed, they don't exist without the other. In other words, without interactions and interdependencies, there is no System.

The third condition is that no group of a System's essential parts—that is, no subsystem—has an independent effect on the whole System. Once again, the nervous and metabolic subsystems of humans do not have independent effects on the whole human body as a System.

By means of their functions, the parts exist to allow people to accomplish significant purposes, not the other way around. That is, people do not exist for the parts or the System(s) in which they are embedded, although the parts can certainly give rise to new functions and purposes than the System's designers anticipated or

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