
PART I

FOUNDATIONS OF SYSTEMS ENGINEERING

Part I provides a multidimensional framework that interrelates the basic principles of systems engineering, and helps to organize the areas of knowledge that are required to master this subject. The dimensions of this framework include

1. a hierarchical model of the structure of complex systems;
2. a set of commonly occurring functional and physical system building blocks;
3. a systems engineering life cycle, integrating the features of the U.S Department of Defense, ISO/IEC, IEEE, and NSPE models;
4. four basic steps of the systems engineering method that are iterated during each phase of the life cycle;
5. three capabilities differentiating project management, design specialization, and systems engineering;
6. three different technical orientations of a scientist, a mathematician, and an engineer and how they combine in the orientation of a systems engineer; and
7. a concept of “materialization” that measures the degree of transformation of a system element from a requirement to a fully implemented part of a real system.

Chapter 1 describes the origins and characteristics of modern complex systems and systems engineering as a profession.

Chapter 2 defines the “systems engineering viewpoint” and how it differs from the viewpoints of technical specialists and project managers. This concept of a systems viewpoint is expanded to describe the domain, fields, and approaches of the systems engineering discipline.

Chapter 3 develops the hierarchical model of a complex system and the key building blocks from which it is constituted. This framework is used to define the breadth and depth of the knowledge domain of systems engineers in terms of the system hierarchy.

Chapter 4 derives the concept of the systems engineering life cycle, which sets the framework for the evolution of a complex system from a perceived need to operation and disposal. This framework is systematically applied throughout Parts II–IV of the book, each part addressing the key responsibilities of systems engineering in the corresponding phase of the life cycle.

Finally, Chapter 5 describes the key parts that systems engineering plays in the management of system development projects. It defines the basic organization and the planning documents of a system development project, with a major emphasis on the management of program risks.