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HANDBOOK OF SYSTEMS ENGINEERING AND MANAGEMENT

Second Edition

ANDREW P. SAGE
WILLIAM B. ROUSE

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Second Edition

Edited by

Andrew P. Sage and William B. Rouse



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**HANDBOOK OF SYSTEMS
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AND MANAGEMENT**

PREFACE

The primary purpose of this handbook is to support use of the theory and practice of systems engineering and systems management. There are many ways in which we can describe systems engineering. It can be described according to structure, function, and purpose. It can be characterized in terms of efforts needed at the levels of systems management, life-cycle processes, and methods and tools. We can explain systems engineering in terms of the knowledge principles, practices, and perspectives necessary for present and future success in systems engineering. We can describe systems engineering in terms of the human dimensions associated with the stakeholders within systems—that is, investors, developers, users, maintainers, and the like. We can describe systems engineering in terms of a large variety of relevant applications. We can speak of systems engineering organizations in terms of their organizational management facets, business processes or product lines, or specific products or services. Systems engineering is clearly a multidimensional transdisciplinary endeavor.

This handbook presents this multifaceted view of systems engineering. It describes systems engineering in terms of this relatively large number of dimensions, and especially from process and systems management perspectives. Systems engineering methods and tools are discussed, as are a variety of specific products that have been fielded from a systems engineering perspective. However, it is not our intent to produce a catalog of either systems engineering methods and tools or products. Our focus is on a process and management view of systems engineering. We expand this view in some detail within the context of the structure of systems engineering and management.

Within this framework, a large number of necessary roles for systems engineering and management are described. The 34 numbered chapters in the handbook, as well as the introductory chapter, present definitive discussions of systems engineering from many of this wide array of perspectives. The needs of systems engineering and systems management practitioners in industry and government, as well as students aspiring to careers in systems engineering and management, provide the motivation for the majority of the chapters.

The handbook begins with a comprehensive introduction to the coverage that follows. This was written by the editors after receiving and editing individual contributions to the handbook. It provides not only an introduction to systems engineering and management but also a brief overview and integration of the 34 chapters that follow in terms of a knowledge map. This framework is intended to be used as a “field guide” that indicates why, when, and how to use the material contained in these 34 chapters.

There are many roles for systems engineers in industry and government. Among the common and not-so-common names used for those who do systems engineering are Systems Engineers, Systems Architects, Systems Integrators, Systems Management Engineers, Systems Infrastructuralists, Systems Quality Assurance Engineers, Systems Theorists, and Systems Reengineers. There are also a number of closely associated professions, such as Operations Research and Management Science, that have much in

common with systems engineers. The handbook contains chapters describing knowledge principles and practices from each of these perspectives.

The major themes and objectives addressed by the handbook are the following:

1. To develop an appreciation and understanding of the role of systems engineering processes and systems management in producing products and services that meet user needs and are reliable, trustworthy, and of high quality.
2. To document systematic measurement approaches for generally cross-disciplinary development efforts, and to discuss capability assessment models that allow organizations to first evaluate and then improve their systems engineering maturity or capability.
3. To document the knowledge base of effective systems engineering processes and systems management strategies and expand the knowledge base needed to support these processes.
4. To advance understanding of the complexity and roles of advanced information technologies and new organizational structures in enhancing productivity and quality of systems for both products and services.
5. To discuss tools, methods, and technologies available for support of complex high technology systems engineering efforts.
6. To provide perspectives on systems engineering and management for the twenty-first century.

The handbook also is intended for systems engineers in industry and government, and to serve as a university reference handbook in systems engineering and management. In particular, the handbook will be useful for a wide range of professionals involved in systems engineering and management efforts:

- Systems Engineers in Government and Industry
- Software Engineers in Government and Industry
- Human Factors Engineers in Government and Industry
- Systems and Software Development Managers in Government and Industry
- Systems Engineering Graduate Programs
- Software Engineering Graduate Programs
- Computer Science and Engineering Graduate Programs
- Business Administration and Management Programs in Information Technology
- Business Administration and Management Programs in Technology Development and Management
- Organizational and Enterprise Computing Programs

The handbook is reasonably self-contained. It is focused primarily on systems engineering and systems management for fielding systems of all types, especially systems that are information technology and knowledge intensive. Thus, the handbook is not primarily focused on traditional systems analysis, theory, and operations research concerns. Instead, these topics are addressed in the broader context of systems engineering and systems management processes. In this way, we have designed the handbook to

be of much value for those concerned with the technical direction, development, and management of complex projects of large scale and scope.

This is the second edition of the handbook, made possible by the success of the first edition. Several new chapters have been added to the handbook to reflect new efforts in this transdisciplinary endeavor. Existing retained chapters have been updated, often considerably, to reflect contemporary progress in systems engineering and management. The editors wish to extend heartfelt thanks to the authors and to our publisher, John Wiley & Sons, for their many efforts.

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