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SYSTEMS ENGINEERING HANDBOOK SCOPE

1.1 PURPOSE

This handbook defines the discipline and practice of systems engineering (SE) for students and practicing professionals alike and provides an authoritative reference to understand the SE discipline in terms of content and practice.

1.2 APPLICATION

This handbook is consistent with ISO/IEC/IEEE 15288:2015, *Systems and software engineering—System life cycle processes* (hereafter referred to as ISO/IEC/IEEE 15288), to ensure its usefulness across a wide range of application domains—man-made systems and products, as well as business and services.

ISO/IEC/IEEE 15288 is an international standard that provides generic top-level process descriptions and requirements, whereas this handbook further elaborates on the practices and activities necessary to execute the processes. Before applying this handbook in a given organization or project, it is recommended that the tailoring guidelines in Chapter 8 be used to remove conflicts with existing policies, procedures, and standards already in use within an organization. Processes and activities in this handbook do not supersede any international, national, or local laws or regulations.

This handbook is also consistent with the *Guide to the Systems Engineering Body of Knowledge* (SEBoK, 2014) (hereafter referred to as the SEBoK) to the extent practicable. In many places, this handbook points readers to the SEBoK for more detailed coverage of the related topics, including a current and vetted set of references.

For organizations that do not follow the principles of ISO/IEC/IEEE 15288 or the SEBoK to specify their life cycle processes (including much of commercial industry), this handbook can serve as a reference to practices and methods that have proven beneficial to the SE community at large and that can add significant value in new domains, if appropriately selected and applied. Section 8.2 provides top-level guidance on the application of SE in selected product sectors and domains.

1.3 CONTENTS

This chapter defines the purpose and scope of this handbook. Chapter 2 provides an overview of the goals and value of using SE throughout the system life cycle.

INCOSE Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities, Fourth Edition.
Edited by David D. Walden, Garry J. Roedler, Kevin J. Forsberg, R. Douglas Hamelin and Thomas M. Shortell.

Chapter 3 describes an informative life cycle model with six stages: concept, development, production, utilization, support, and retirement.

ISO/IEC/IEEE 15288 identifies four process groups to support SE. Each of these process groups is the subject of an individual chapter. A graphical overview of these processes is given in Figure 1.1:

- *Technical processes* (Chapter 4) include business or mission analysis, stakeholder needs and requirements definition, system requirements definition, architecture definition, design definition, system analysis, implementation, integration, verification, transition, validation, operation, maintenance, and disposal.
- *Technical management processes* (Chapter 5) include project planning, project assessment and control, decision management, risk management, configuration management, information management, measurement, and quality assurance.
- *Agreement processes* (Chapter 6) include acquisition and supply.
- *Organizational project-enabling processes* (Chapter 7) include life cycle model management, infrastructure management, portfolio management, human resource management, quality management, and knowledge management.

This handbook provides additional chapters beyond the process groups listed in Figure 1.1:

- *Tailoring processes and application of systems engineering* (Chapter 8) include information on how to adapt and scale the SE processes and how to apply those processes in various applications. Not every process will apply universally. Careful selection

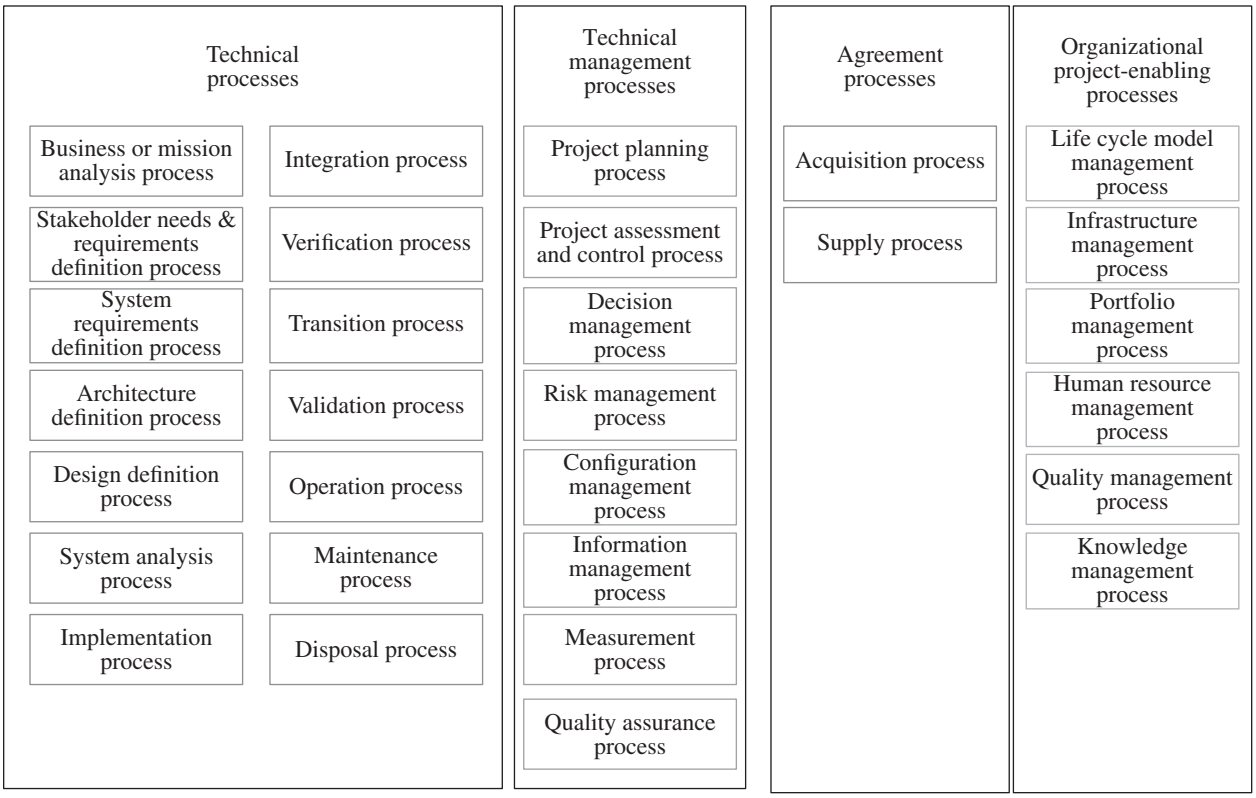

FIGURE 1.1 System life cycle processes per ISO/IEC/IEEE 15288. This figure is excerpted from ISO/IEC/IEEE 15288:2015, Figure 4 on page 17, with permission from the ANSI on behalf of the ISO. © ISO 2015. All rights reserved.

from the material is recommended. Reliance on process over progress will not deliver a system.

- *Crosscutting systems engineering methods* (Chapter 9) provide insights into methods that can apply across all processes, reflecting various aspects of the iterative and recursive nature of SE.
- *Specialty engineering activities* (Chapter 10) include practical information so systems engineers can understand and appreciate the importance of various specialty engineering topics.

Appendix A contains a list of references used in this handbook. Appendices B and C provide a list of acronyms and a glossary of SE terms and definitions, respectively. Appendix D provides an N^2 diagram of the SE processes showing where dependencies exist in the form of shared inputs or outputs. Appendix E provides a master list of all inputs/outputs identified for each SE process. Appendix F acknowledges the various contributors to this handbook. Errors, omissions, and other suggestions for this handbook can be submitted to the INCOSE using the comment form contained in Appendix G.

1.4 FORMAT

A common format has been applied in Chapters 4 through 7 to describe the system life cycle processes found in ISO/IEC/IEEE 15288. Each process is illustrated by an input–process–output (IPO) diagram showing key inputs, process activities, and resulting outputs. A sample is shown in Figure 1.2. Note that the IPO

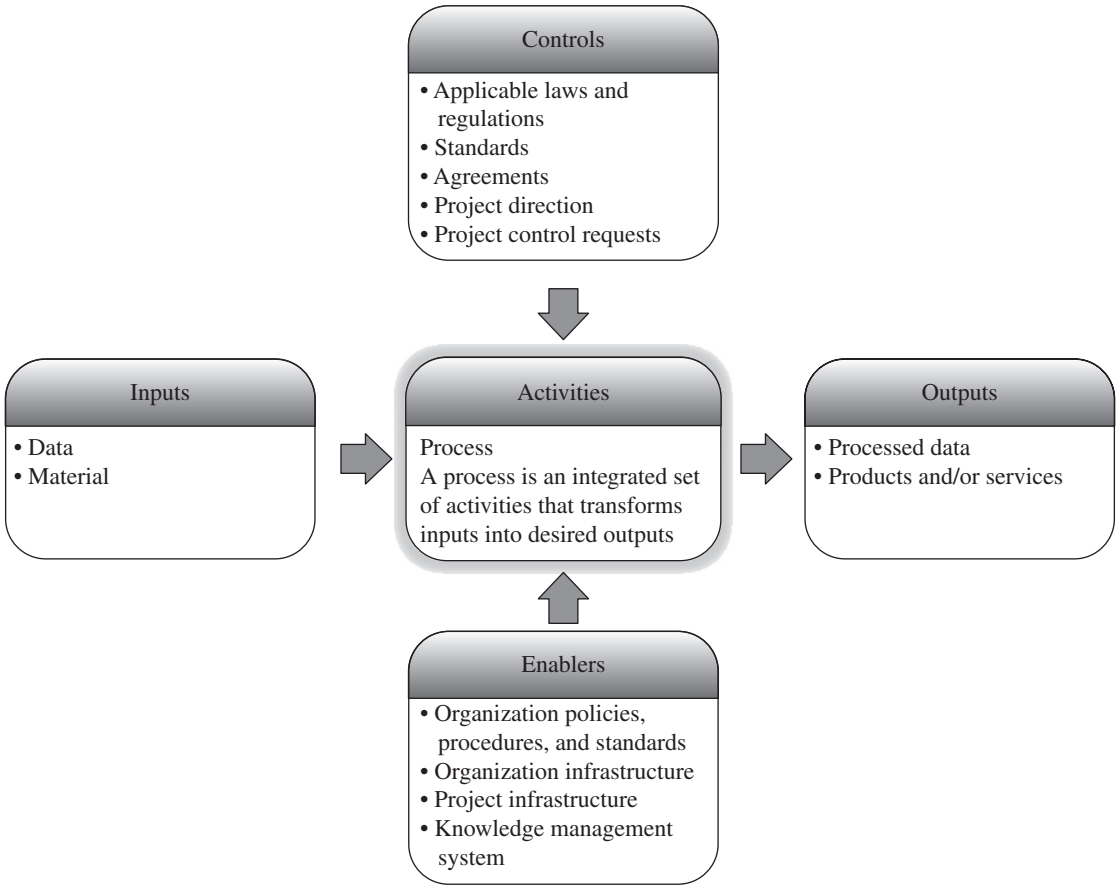

FIGURE 1.2 Sample of IPO diagram for SE processes. INCOSE SEH original figure created by Shortell and Walden. Usage per the INCOSE Notices page. All other rights reserved.

diagrams throughout this handbook represent "a" way that the SE processes can be performed, but not necessarily "the" way that they must be performed. The issue is that SE processes produce "results" that are often captured in "documents" rather than producing "documents" simply because they are identified as outputs. To understand a given process, readers are encouraged to study the complete information provided in the combination of diagrams and text and not rely solely on the diagrams.

The following heading structure provides consistency in the discussion of these processes:

- Process overview
- Purpose
- Description
- Inputs/outputs
- Process activities
- Process elaboration

To ensure consistency with ISO/IEC/IEEE 15288, the purpose statements from the standard are included verbatim for each process described herein. Inputs and outputs are listed by name within the respective IPO diagrams with which they are associated. A complete list of all inputs and outputs with their respective descriptions appears in Appendix E.

The titles of the process activities listed in each section are also consistent with ISO/IEC/IEEE 15288. In some cases, additional items have been included to provide summary-level information regarding industry best practices and evolutions in the application of SE processes.

The controls and enablers shown in Figure 1.2 govern all processes described herein and, as such, are not repeated in the IPO diagrams or in the list of inputs associated with each process description. Typically, IPO diagrams do not include controls and enablers, but since they are not repeated in the IPO diagrams throughout the rest of the handbook, we have chosen to label them IPO diagrams. Descriptions of each control and enabler are provided in Appendix E.

1.5 DEFINITIONS OF FREQUENTLY USED TERMS

One of the systems engineer's first and most important responsibilities on a project is to establish nomenclature and terminology that support clear, unambiguous communication and definition of the system and its elements, functions, operations, and associated processes. Further, to promote the advancement of the field of SE throughout the world, it is essential that common definitions and understandings be established regarding general methods and terminology that in turn support common processes. As more systems engineers accept and use common terminology, SE will experience improvements in communications, understanding, and, ultimately, productivity.

The glossary of terms used throughout this book (see Appendix C) is based on the definitions found in ISO/IEC/IEEE 15288; ISO/IEC/IEEE 24765, *Systems and Software Engineering—Vocabulary* (2010); and SE VOCAB (2013).