



SYSTEMS MANAGEMENT STANDARD

SAE1001™

Issued

2018-10

Integrated Project Processes for Engineering a System

RATIONALE

This standard provides updated and expanded guidelines for an integrated set of fundamental technical processes to aid a project in the engineering or reengineering of a system. The release of this standard is intended to replace/supersede SAE/EIA-632, "Processes for Engineering a System" (formerly TechAmerica EIA-632) and includes format changes required to bring it into conformance with the publishing requirements of SAE Technical Standards.

FOREWORD

This standard is an evolution and rethinking of the ANSI/EIA-632, "Processes for Engineering a System." The original EIA-632 Interim Standard was essentially a released version of the unreleased MIL-STD-499 Revision C. That interim standard was followed by ANSI/EIA-632, "Processes for Engineering a System," which was released January 7, 1999. User feedback indicated some issues with that standard, as well as with the organization and presentation of the information in the standard:

- Outputs and work products were in a separate Annex and not in context with the related processes or requirements, causing confusion;
- Requirements development and management was the focus, with the engineering of systems primarily a requirements-based endeavor relying on decomposition of requirements;
- Problem definition (identifying stakeholder concerns, defining life cycle stages, developing a system concept, and developing a system architecture) was not addressed;
- Determining the technological feasibility and investment suitability of establishing a new project was not addressed;
- Support activities after the system was put in operation was not addressed;
- Integration was not sufficiently depicted or described by the processes;
- Some requirements (processes) were repeated multiple times in the standard, with the differences among the requirements only the particular context for them; and
- The relationship and flow among the requirements (processes) was not described or adequately depicted.

This standard began life as a Revision A to that EIA-632 standard, with the intent to address user feedback and concerns, and has gone through several iterations of development. More recently, there was significant work to ensure compatibility between this draft standard and the ISO/IEC/IEEE 15288 "Systems and software engineering – System life cycle processes" standard; that work resulted in improvements to both the ISO/IEC/IEEE 15288 standard released in 2015 and to this draft standard. Although this standard may be considered a successor to the original ANSI/EIA-632, it has changed significantly, so it is now considered a new standard and titled as such.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2018 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
<http://www.sae.org>

SAE WEB ADDRESS:

Full document details: SAE SAE1001

SAE values your input. To provide feedback on this
Technical Report, please visit
<http://standards.sae.org/SAE1001>

Documents
Document Sharing Hub

This SAE1001 standard is compatible with ISO/IEC/IEEE 15288, with the mapping depicted in Annex B of this standard. Key distinctions are that SAE1001:

- Is a project-focused standard, detailing the requirements that a given project performs in engineering a system, in the context and terms for a project;
- Adds additional detail to the requirements in ISO/IEC/IEEE 15288 that are mapped, providing the next level of tasking detail performed by a project;
- Adds notional interconnected inputs and outputs that may be used and generated by a project in executing the detailed tasking performed in engineering a system.

TABLE OF CONTENTS

1.	SCOPE AND PURPOSE	5
1.1	Scope	5
1.2	Purpose	5
1.3	Limitations	6
2.	NORMATIVE REFERENCES	6
3.	TERMS AND DEFINITIONS	6
3.1	Key Terms	6
3.2	Acronyms	7
3.3	Terminology	7
4.	SYSTEM AND LIFE CYCLE CONCEPTS	7
4.1	System Concepts	7
4.2	System Life Cycle Concepts	12
4.3	Considerations	13
4.3.1	Interfaces	13
4.3.2	System of Interest	13
4.3.3	Architecture Definition	14
4.3.4	Technical Focus	15
4.3.5	Inputs and Outputs	15
4.3.6	Project Structures	15
4.3.7	Traceability	15
4.3.8	Generation of Multiple Data Items	15
4.3.9	Supplier and Acquirer	16
4.3.10	Process Modularity, Recursion, and Iteration	16
5.	PROCESS REQUIREMENTS	16
5.1	Project Framework Processes	18
5.1.1	Project Definition Process	18
5.1.2	Project Enabling Process	23
5.1.3	Project Acquisition Process	29
5.1.4	Project Supplier Process	33
5.1.5	Project Closure Process	37
5.2	Technical Management Processes	41
5.2.1	Project Planning Process	42
5.2.2	Project Assessment and Control Process	52
5.2.3	Requirements Management Process	59
5.2.4	Interface Management Process	62
5.2.5	Information Management Process	64
5.2.6	Configuration Management Process	66
5.2.7	Quality Assurance Process	70
5.2.8	Risk and Opportunity Management Process	73
5.2.9	Measurement Process	77
5.3	System Definition Processes	81
5.3.1	System Requirements Definition Process	82
5.3.2	Architecture Definition Process	91
5.3.3	Design Definition Process	107
5.4	System Implementation and Integration Processes	114
5.4.1	Implementation Process	114
5.4.2	Integration Process	119
5.5	System Evaluation Processes	128
5.5.1	System Analysis Process	129
5.5.2	Decision Management Process	135
5.5.3	Verification Process	142
5.5.4	Validation Process	150
5.6	System Utilization Processes	157
5.6.1	Transition Process	157
5.6.2	Operations Process	161

5.6.3	Maintenance Process.....	164
5.6.4	Disposal Process	167
6.	NOTES	171
6.1	Revision Indicator.....	171
ANNEX A	TERMS AND DEFINITIONS (NORMATIVE)	124
ANNEX B	MAPPING OF SAE1001 TO EIA 632 AND ISO/IEC/IEEE 15288	129
Figure 1	Conceptual depiction of a system and its elements.....	7
Figure 2	Example of a simple system and its elements	8
Figure 3	Depiction of a system in the transportation environment.....	8
Figure 4	Illustration of a system element considered as a system	8
Figure 5	Illustration of the structure of a complex system.....	9
Figure 6	System-of-interest and interactions with operating environment.....	10
Figure 7	System-of-interest and enabling systems relationships.....	11
Figure 8	Illustration of a system life cycle	12
Figure 9	Examples of life cycles	12
Figure 10	Example interactions for a process-focused system	12
Figure 11	Operational concept and concept of operations	14
Figure 12	High level diagram of processes	17
Figure 13	Detailed diagram of processes	17
Figure 14	Project framework processes.....	18
Figure 15	Technical management processes (Part A).....	41
Figure 16	Technical management processes (Part B).....	42
Figure 17	System definition processes	81
Figure 18	System implementation and integration processes	114
Figure 19	System evaluation processes	128
Figure 20	System utilization processes.....	157

1. SCOPE AND PURPOSE

1.1 Scope

This standard is applicable to the engineering or the reengineering of:

- a. Commercial or non-commercial systems, or portions thereof;
- b. Any system, small or large, simple or complex, software-intensive or not, preceded or unpreceded;
- c. Systems made up of hardware, software, firmware, personnel, facilities, data, materials, services, techniques, or processes (or combinations thereof);
- d. A new system or a legacy system, or portions thereof.

NOTE: The specific tasks and implementation methods for applying the processes required by this standard can vary, for example, between commercial and government projects, or between customer-involved and internally developed projects. The fundamental processes, however, are the same in all cases.

The requirements of this standard, or a designated subset, are intended to be applied by projects establishing policies and procedures for project implementation of the adopted process and process elements of this standard.

The requirements of this standard may be tailored as follows:

- a. Processes – Processes may be tailored to be applicable for a given type of project or system. For example, the System Utilization Processes typically don't apply for conceptual or prototype systems in the same manner as for full-volume production systems.
- b. Activities – Activities may be tailored to reflect the specific approach established by a project, where the modified Activities still achieve the intended Process Purpose and Process Outcomes.
- c. Tasks, Inputs, and Outputs – Tasks, Inputs, and Outputs may be tailored to reflect the specific approach or methods established by a project, including different life cycle approaches for a given project or system, where the modifications still achieve the intended purpose of the Activity.

1.2 Purpose

The purpose of this standard is to provide an integrated set of fundamental technical processes to aid a project in the engineering or reengineering of a system. These processes are intended to help organizations improve:

- a. Project processes, in particular the connections and interactions among them;
- b. Interactions with other projects and supporting organizations; and
- c. The development of experienced Systems Engineers.

This standard is especially intended to help projects in an organization inexperienced with systems engineering that are now developing or starting to develop systems more involved or complex than developed before. It can also help projects with immature processes or that are seeing challenges in the execution of their defined processes. Use of this standard is intended to help projects:

- a. Define the problem to be solved, which entails identifying and defining the technical considerations for the system including stakeholder concerns, system concept, and system architecture;
- b. Determine the technical feasibility and investment suitability of establishing a project to create and realize a system solution;
- c. Manage the technical aspects of system creation and realization with emphasis on engineering integration;

- d. Establish and evolve a complete and consistent set of requirements supporting feasible and cost-effective system solutions;
- e. Satisfy requirements within cost, schedule, and risk constraints;
- f. Provide systems and system elements that satisfy stakeholders over the life cycle of the system;
- g. Provide for the safe and cost-effective disposal or retirement of a system.

NOTE: The terms system and system element used in this standard apply to any combination of the following: people (*humans* performing as an integral element of the system); product (a *hardware item*, such as an automobile or satellite, or any component parts thereof, or a *software item* such as a stand-alone application to run within an existing system); or process (*service*, such as telecommunications, and including process documentation).

1.3 Limitations

This standard does not specify the details of “how to” implement process requirements for engineering a system. Nor does it specify the methods or tools a project would use to implement the process requirements. It is intended that the project select or define methods and tools that are applicable to the characteristics of the system, and consistent with applicable policies and procedures.

This standard does not prescribe the name, format, content, structure, or medium of documentation.

2. NORMATIVE REFERENCES

The following standards contain provisions that, through reference in this text, constitute provisions of this standard. At the time of publication, the editions (where indicated) were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

ANSI/AIAA G-043-200	Guide for the Preparation of Operational Concept Documents
ANSI/EIA-649B	Configuration Management Standard
ANSI/EIA-748C	Earned Value Management Systems
INCOSE	Systems Engineering Body of Knowledge
ISO/IEC/IEEE 15288:2015	Systems and software engineering – System life cycle processes
ISO/IEC/IEEE 15939:2017	Systems and software engineering – Measurement Process
ISO/IEC 16085:2006	Systems and software engineering – Life cycle processes – Risk management
ISO/IEC/IEEE 24748-1:2016	Systems and software engineering – Life cycle management – Part 1: Guidelines for life cycle management
ISO/IEC/IEEE 24748-4:2016	Systems and software engineering – Life cycle management – Part 4: Systems engineering planning

3. TERMS AND DEFINITIONS

3.1 Key Terms

Definitions for terms used in this standard are consistent with the definitions used in ISO/IEC/IEEE 15288 and/or the INCOSE Systems Engineering Body of Knowledge. Additional information to enhance understanding or further expand on the application of terms in this standard is contained in Annex A, Terms and Definitions.

3.2 Acronyms

Key acronyms used in this standard are shown below.

AIAA	American Institute of Aerospace and Astronautics
ANSI	American National Standards Institute
EIA	Electronic Industries Alliance
GEIA	Government Electronics and Information Technologies Association
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
INCOSE	International Council on Systems Engineering
ISO	International Organization for Standardization

NOTE: Acronyms that are spelled out in the text and not used elsewhere in the document are not listed above.

3.3 Terminology

The word **shall** identifies mandatory provisions of this standard. The word **should** identifies recommended provisions of this standard. The word **may** identifies permissive provisions of this standard.

4. SYSTEM AND LIFE CYCLE CONCEPTS

This section describes system and life cycle concepts for application of the processes of Section 5 to the engineering or reengineering of a system.

4.1 System Concepts

The system to which the processes of Section 5 apply are man-made and consist of elements that provide operational capabilities in defined environments to accomplish defined mission objectives by providing services for the benefit of users and other stakeholders.

These systems can be composed of any mix of one or more of the following: hardware, software, services, humans, data, processes (e.g., processes for providing services to users), procedures (e.g., operator instructions), facilities and naturally occurring entities (e.g., water, organisms, minerals). A conceptual depiction of a system and its elements is given in Figure 1.

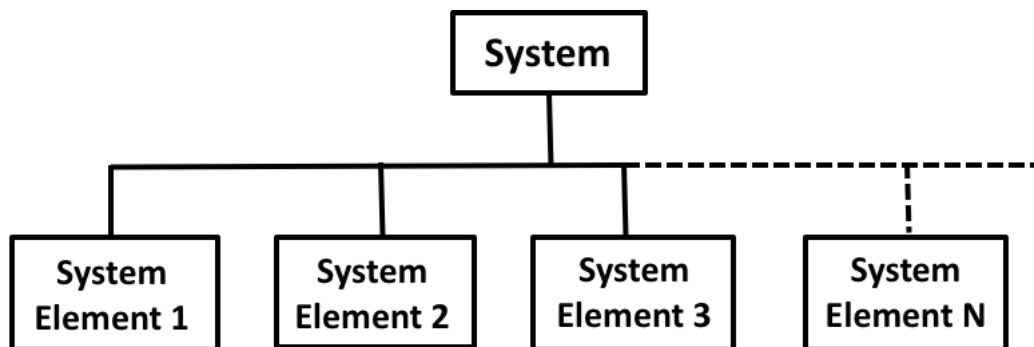


Figure 1 - Conceptual depiction of a system and its elements

An example of a simple system and its elements is shown in Figure 2. A top-level depiction of a system in the transportation environment is shown in Figure 3.

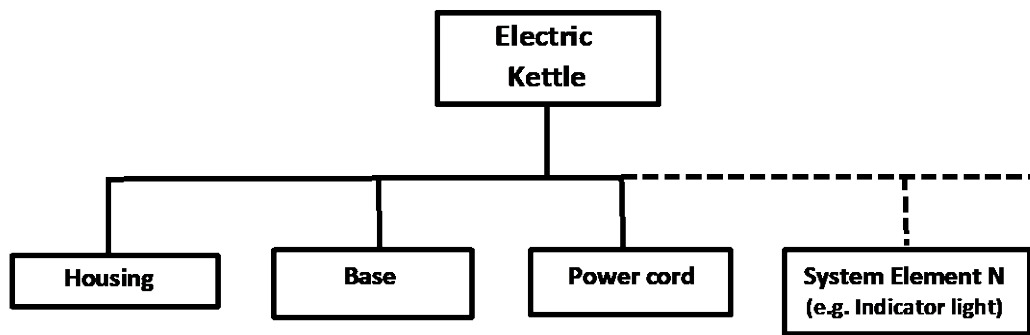


Figure 2 - Example of a simple system and its elements

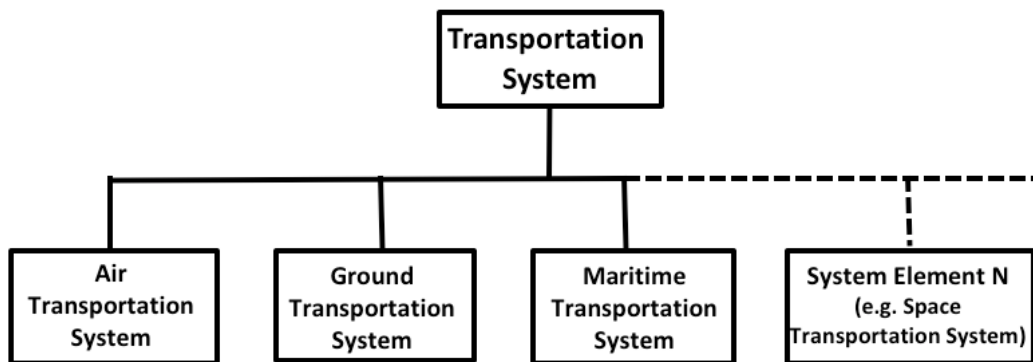


Figure 3 - Depiction of a system in the transportation environment

The system elements of a given system could themselves comprise a system, as is indicated in Figure 4.

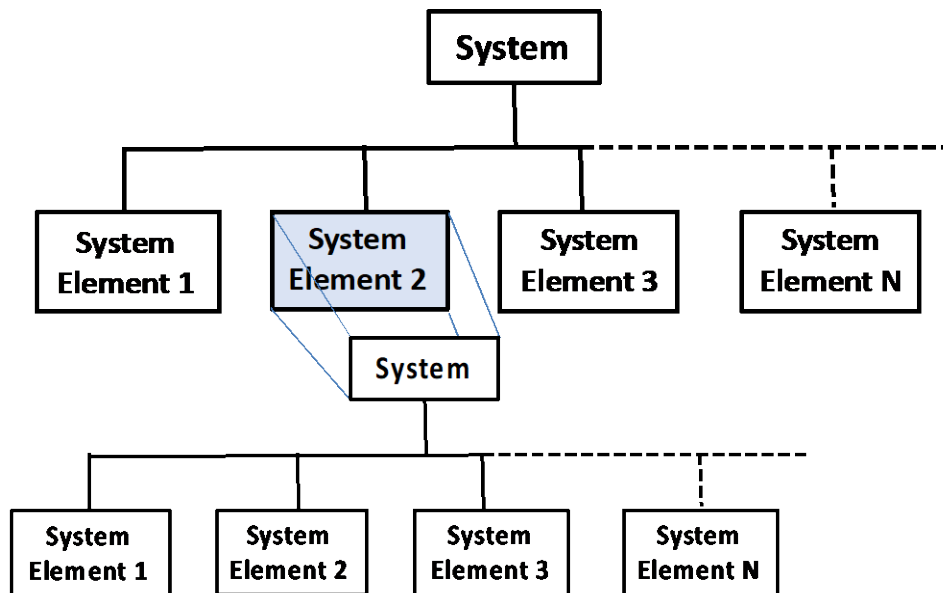


Figure 4 - Illustration of a system element considered as a system

In the case of the electric kettle, the base could contain the heating element, which in turn could have a Nichrome resistance coil and ceramic insulators. Each one of these could be the focus of effort—contractual or project—hence considered as a system-of-interest. More complex systems, such as the one shown in Figure 3, will have elements that are clearly systems of interest, with the same continuing through several levels, such as is illustrated in Figure 5.

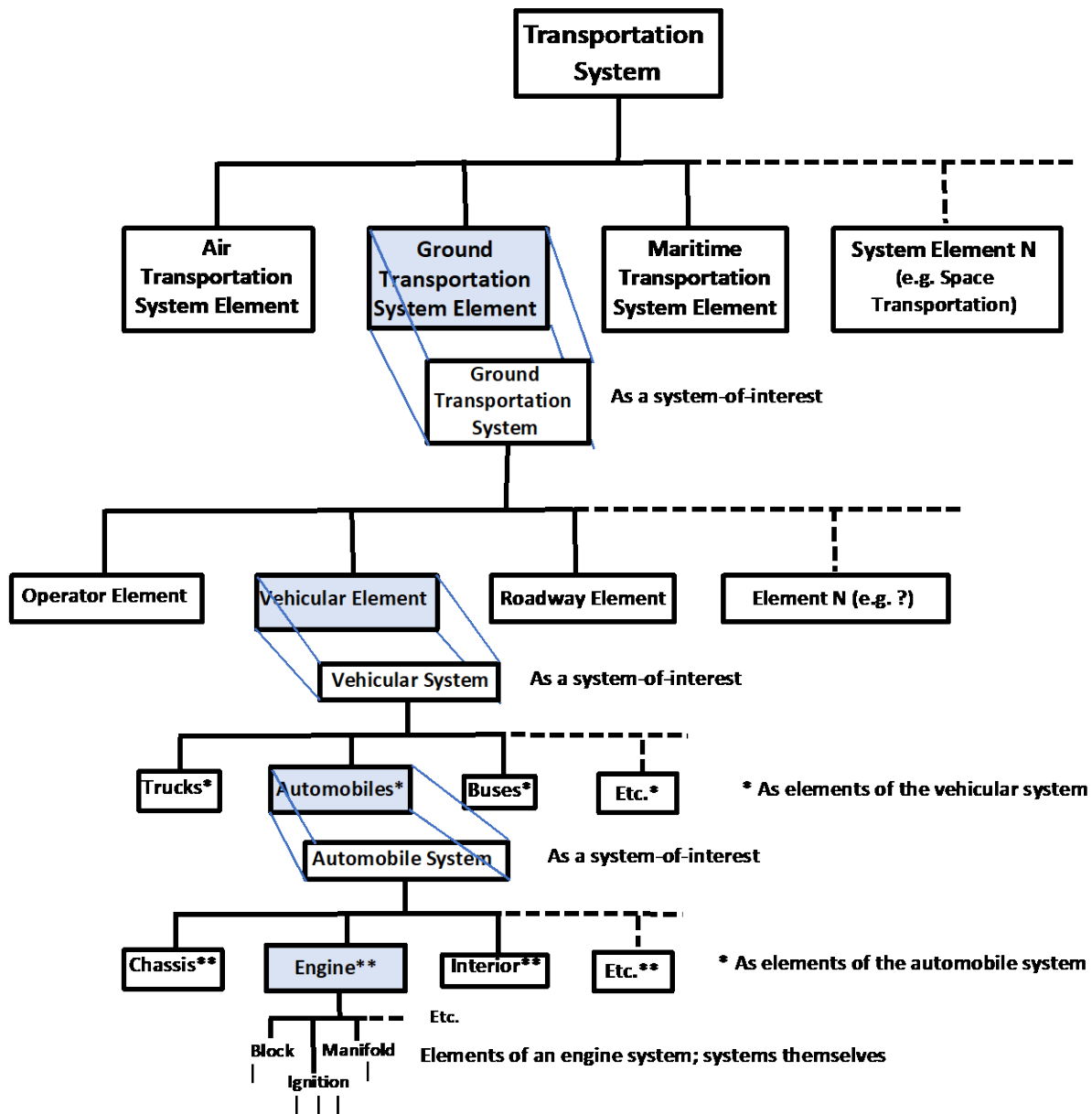


Figure 5 - Illustration of the structure of a complex system

Whatever the complexity of a system, that part of it that is under consideration for some purpose is termed a system-of-interest. Systems-of-interest interact with the operational environment. This is depicted in Figure 6.

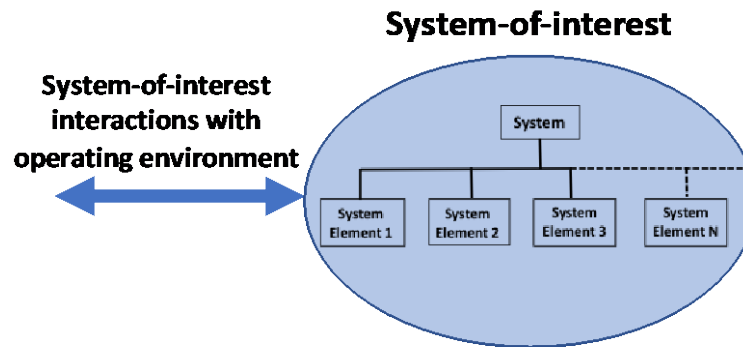


Figure 6 - System-of-interest and interactions with operating environment

The perception and definition of a particular system, its architecture and its system elements depend on an observer's interests and responsibilities. One person's system-of-interest can be viewed as a system element in another person's system-of-interest. Conversely, it can be viewed as being part of the environment of operation for yet another person's system-of-interest.

The system structure allows associating the following information with each element (this is not an exhaustive list):

- a. Configuration identification;
- b. Associated costs;
- c. Identifications of internal and external interfacing elements;
- d. Stakeholder concerns and requirements;
- e. Definition of work to be done; and
- f. Other relevant agreement information.

The discussion above illustrates:

- a. The importance of defined boundaries that encapsulate meaningful needs and practical solutions;
- b. The perception of system structure (in this case, the physical structure, hierarchical in this instance);
- c. An entity at any level in a system structure can be viewed as a system;
- d. A system is comprised of a fully integrated, defined set of subordinate systems;
- e. Characteristic properties at a system's boundary arise from the interactions between subordinate systems;
- f. Humans can be viewed as users external to a system (e.g., automobile drivers and engine) and as system elements within a system (e.g., drivers and automobile);
- g. A system can be viewed as an isolated entity (that is, a product), or as an ordered collection of functions capable of interacting with its surrounding environment, (i.e., a set of services); and
- h. A system can be viewed as part of a larger system of systems and that a system of systems can be viewed as a system.

Systems that are not directly a part of the operational environment of the system-of-interest but provide essential services to it over some portion of the life cycle, thereby facilitating progression of the system through its life cycle, are termed “enabling systems.” Enabling systems can include those necessary for developing, producing, utilizing, supporting, deploying, and retiring the operational system; or training the operators and maintainers. The processes of Section 5 also apply to the enabling systems. Both the operational systems-of-interest and enabling systems are either developed or reused, as appropriate. Figure 7 illustrates the interaction of a system-of-interest and its enabling systems.

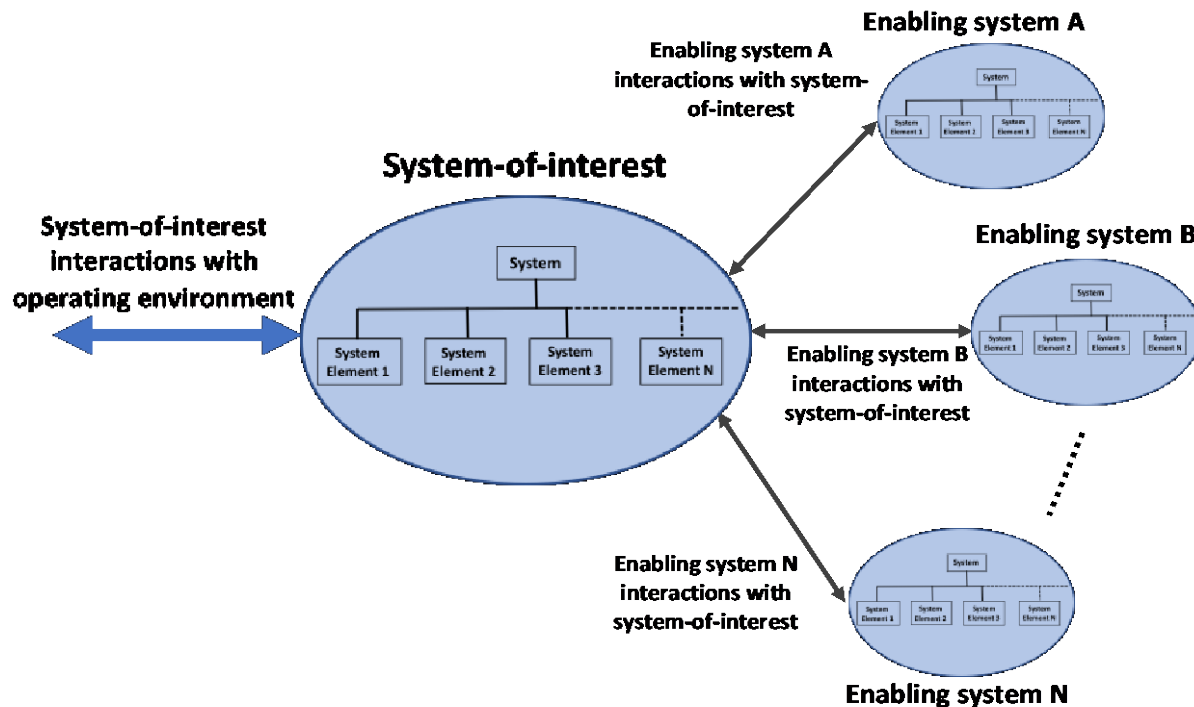


Figure 7 - System-of-interest and enabling systems relationships

For a given system, in practice, the line between operational and enabling capabilities may not always be distinct and, in particular, an enabling system, at different points in the system-of-interest's life cycle, may provide operational capabilities. In addition, enabling capabilities may be already in place or defined for a system, whether because they are shared with other systems or for other reasons, and thus for a given project are not part of development except for their impact on the system-of-interest. The key point is for the project to understand the full system and the interactions among the elements, whether they are in the operational environment or enabling the system or part of it to function in the operational environment.

NOTE 1: The *system* is the focus of the processes set forth in this standard. This *system* is the system element that is the *system of interest* for the project that will apply the processes. It is important to note that the processes in 5.3 are also applied to the enabling systems. Text and depictions are included in 5.3 to help the reader understand how the processes are applied at each level of the system hierarchy.

NOTE 2: The enabling systems can include the people who develop, produce, use, support, and retire the system, as well as both those who train others involved with these system functions, and the human factors issues and concerns associated with these personnel. Such personnel and human factors issues are included in the applications of the processes of this standard to the system.

4.2 System Life Cycle Concepts

As a system evolves from a concept to reality, then is placed in use and eventually retired, it is useful to place decision points along the way to control the progression of effort so that each step of the way progresses satisfactorily according to some criteria. The entire set of steps, sequential or otherwise, is termed a system life cycle and each step is called a stage in the system life cycle. System elements in systems-of-interest can have their own life cycles and enabling systems have life cycles as well. A simple illustration of a system life cycle is given in Figure 8.

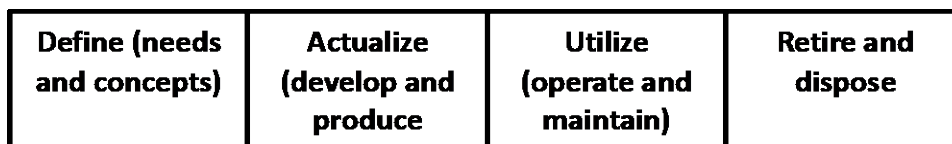
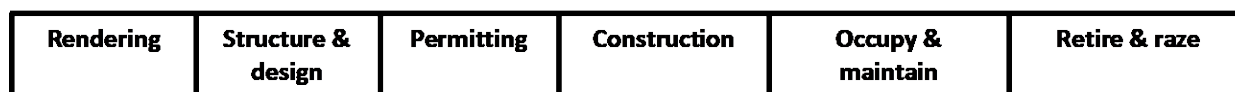


Figure 8 - Illustration of a system life cycle

For any given system, the actual stages and their relationships can be different. For example, a system that is essentially hardware or software could have life cycles like those shown in Figure 8, while systems that focus on facility or natural entities, for example, could have life cycles with stages like those depicted in Figure 9. Systems based on human, resource, processes, services, or data could have yet different life cycle stages, as described in ISO/IEC/IEEE 24748-1.

Facility



Naturally Occurring Entity



Figure 9 - Examples of life cycles

The stages of any life cycle are, in practice, not uniform in scope or duration of effort, nor do they occur in a simple time sequence. In fact, they often overlap, with feedback, iteration and recursion for any progression, as illustrated in Figure 10 for a process-focused system.

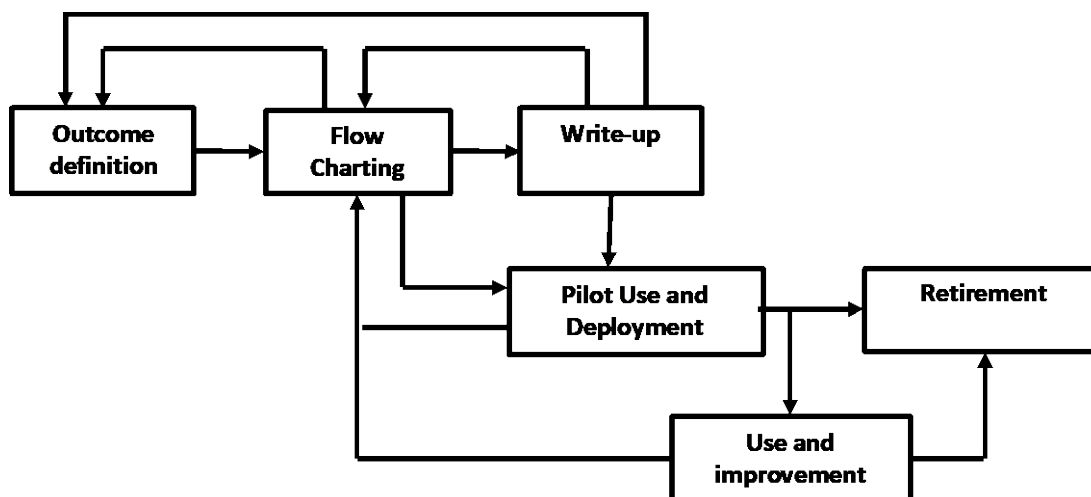


Figure 10 - Example interactions for a process-focused system

Regardless of the type of system, the number and nature of stages, and their interactions, key points are:

- a. The reason to have a life cycle consisting of stages is to help ensure that decisions are made at key points before pressing on with the effort. These decision points, with their criteria for successful completion of a stage, are essential control points;
- b. There is generally a strong tie between the life cycle of a system and the projects that accompany it. For example, there can be one or more projects for each stage of the system's life cycle;
- c. Each element of a system can have projects that carry it through its life cycle; and
- d. Many of the processes in this standard can be applied at any stage in a system's life cycle (e.g., Configuration Management Process).

4.3 Considerations

4.3.1 Interfaces

Interfaces, in the context of this standard, are the connections between each Element of the System, and of the System to its external environment. These interfaces are critical to the successful interactions among the Elements and the System itself. Their characteristics may include information passed between Elements, mechanical mounting locations, as well as electrical characteristics, among many other aspects of interfaces. Model-based methods may be useful in addressing interface characteristics and can help a project improve development and management of the flow or exchange of data, energy, or matter among interfaces. In this standard, the term "interfaces" when used in developing requirements, managing interfaces, etc., should be read in a comprehensive manner and not just a single aspect or characteristic of an interface.

4.3.2 System of Interest

The phrase "System of Interest" as used in this standard refers to the top-level system the Project is developing, integrating, sustaining, etc. It should be noted that exactly what that is depends on the Project's own context and scope and is not meant to be interpreted as some ultimate top-level system or system of systems. In addition, the operational capability (and elements) and the enabling capability (elements), at some level of the system structure, may be handled by separate projects.

In addition, this standard addresses (in 5.3) the development of the Concept of Operations for the system the Project is developing, integrating, sustaining, etc., but does not address the development of the Operational Concept which is broader in scope and generally developed at a different level than the Project level. These two artifacts are related but address different perspectives about the system; the Concept of Operations is from a user's eye view, while the Operational Concept is from a satellite or high-level view. The notional relationship between these is illustrated in Figure 11.

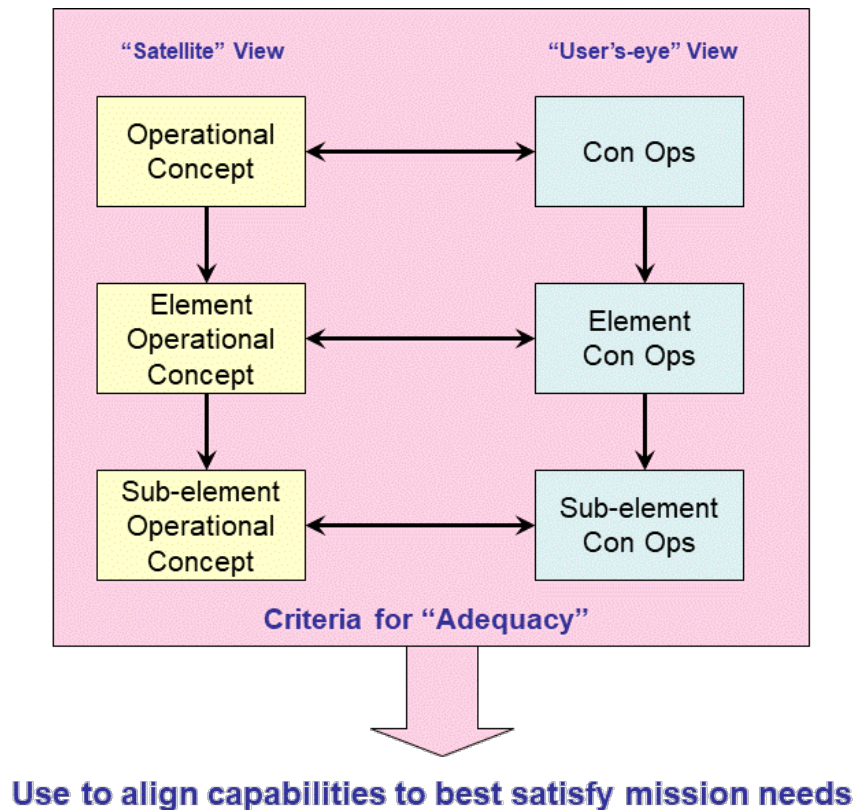


Figure 11 - Operational concept and concept of operations

4.3.3 Architecture Definition

A number of different approaches, generally referred to as frameworks or models, have been defined and documented to describe methods in developing a system architecture. These different approaches exist to support the needs of projects developing systems for different customers as well as for developing different types of systems. The best or most appropriate approach for a particular project to use may depend on the type of system, the customer(s), what architecture documentation already exists for prior or legacy systems, as well as the experience and knowledge of the project team and tools available to the project.

In this standard, there is not a selection of any particular or single approach, or an attempt to generate a melded or blended approach, but instead to use a simple construct, consistent with how this subject has been dealt with in past standards and is intended to help in understanding the relation of architecture definition with the broader processes a project performs in developing and supporting systems over their life cycle.

The construct used in this standard is defined by the System Logical Definition Process and System Physical Definition Process, which develop the logical and physical architectures for the system. This does not mean these are the only types of architectural representations or views, or that these are completely distinct for all systems. In practice, there often is not a clear distinction between a purely logical representation of an architecture and a purely physical representation of an architecture; a particular architectural representation may address both logical aspects as well as physical aspects of the system. Thus, the logical and physical architectures and their definition in this standard are modular and complementary processes and are intended to be tailored by the project based on the particular architecture definition approach chosen by the project.

4.3.4 Technical Focus

Throughout this standard, the focus of the processes is on technical aspects related to the engineering of systems. In the text describing some processes, the boundary, if such a thing existed, between technical aspects and non-technical aspects, can be uncertain. Rather than add “technical” as a qualifying adjective repetitively in this standard, the choice was made to limit this addition and instead remind the reader the emphasis is on those technical aspects even if it is not explicitly stated each and every time. Throughout this standard, it must be emphasized that when referring to system requirements (functional, performance, etc.), system analyses, and other system considerations, this should be read as including various sub-system and specialty considerations, even if those are not explicitly spelled out in this standard. These can include electrical, software, mechanical, safety, human factors, reliability, maintainability, producibility, to list just some of the discipline and specialty considerations comprehended as part of system considerations.

4.3.5 Inputs and Outputs

Throughout this standard, the purpose of including inputs and outputs with the processes is to detail and describe the interactions and associated workflow among the processes; just as with the System itself, those interactions and interfaces are what allow the processes to work and achieve the goal of engineering a system. This standard does not impose a particular format or title of the inputs and outputs but identifies them for informational use and as an aid in applying this standard. Where appropriate, the interactions between the processes of this standard at the Project level and the processes an Enterprise would perform (consistent with the Enterprise processes of ISO/IEC/IEEE 15288) are indicated by Enterprise process inputs to the Project processes, and outputs from the Project processes to the Enterprise processes.

4.3.6 Project Structures

The system structure(s) described in 4.1 constitute a hierarchical depiction of the relationships of the elements that constitute a system, often referred to as a system breakdown structure (SBS). To aid project execution, the work breakdown structure (WBS) for a project should be related to the system breakdown structure, though the relationship may not be exactly 1-to-1 in all cases. This is because a WBS organizes the project's work into manageable portions, typically in a hierarchical structure, to enable planning and executing a project. In addition to accounting practices and requirements for the project, organizations may do this to support cost estimation systems and support continuous improvement activities. When the SBS and WBS are related or aligned, these objectives are supported to a much greater degree. Additional information may be found in ANSI/EIA-748 “Earned Value Management Systems” and ISO/IEC/IEEE 24748-4 “Systems Engineering and Software Engineering – Life cycle management – Part 4: Systems Engineering Planning”.)

4.3.7 Traceability

There are numerous tasks in this standard that refer to capturing and/or maintaining traceability information. This refers to information that relates one particular data entity, as appropriate, to another; e.g., a trace from a lower level requirement to a higher-level requirement. This traceability information is used to ensure that as the project progresses, any changes to a data entity may be efficiently and effectively evaluated for impact, and the appropriate changes relayed throughout the project's information base. Note that the traceability information often is not just hierarchical but may depict dependencies at the same level of the system hierarchy; e.g., budgets.

4.3.8 Generation of Multiple Data Items

The notion of developing multiple data items – concepts, architectures, etc. – is contained in this standard, in particular during system definition. This is included since in the process of developing information, exploring and evaluating different options is very helpful, if not vital, to identifying the most suitable alternative among different options. The information produced for these different options should be retained and captured by the project. This is not intended to be treated as a requirement to develop unneeded data items for these options or to develop the data for each option to an equal extent, but it is important for the project to ensure the options developed are documented and retained. This is done to support the project's later activities; as an example, changes – in customer needs, in requirements, in design, etc. – later in project execution may result in that additional information proving to be useful. As an additional example, retaining this information can help project personnel better understand the options and rationale of choices made previously, or may be useful to other projects that develop related systems or choose to develop one of the options further for a different application.

4.3.9 Supplier and Acquirer

In ISO/IEC/IEEE 15288, the terms Supplier and Acquirer depend on the context, as an Enterprise may be both a Supplier and an Acquirer, depending on the particular context and relationship involved. For simplicity, and since this standard is centered on a Project perspective in the engineering of a system, throughout this standard, the term Supplier refers to an organization that provides (supplies) something to the Project, such as parts, subassemblies, etc. The term Acquirer refers to an organization that obtains (acquires) something from the Project, generally the System itself, though it would also include such items as spares, maintenance, documentation, etc. This does not mean a Project does not acquire items from a Supplier, or supply items to an Acquirer, only that for the purposes of this standard the relationships between a Project, its Acquirer(s), and its Suppliers, is simplified to aid in understanding the relationships.

4.3.10 Process Modularity, Recursion, and Iteration

The depictions of the processes in this standard are representative and are not intended to show an arrangement and organization for every single project without tailoring. The processes in this standard are intended to be tailored by the project according to project needs and are written to help with understanding of project application and tailoring. They are intended to be modular in application and as a result of tailoring; as an example, the processes in 5.5 System Evaluation Processes may be used throughout the project and system life, even as support to the 5.1.1 Problem Evaluation Process. While this standard does not identify all potential input and output interactions for this modularity, this does not preclude the tailoring and use of the processes in this standard in such a manner.

Recursion and iteration of processes in practice is very common, consistent with the different system life cycle models. Understanding the interactions among the processes in this standard should be driven by the input and output connections described in the text, rather than just through the diagrams. The diagrams throughout this standard do not depict all interactions, in order to retain clarity for readers. In particular, feedback interactions, as well as interactions that might show recursion and iteration, cannot be practically depicted in the diagrams.

In addition, while the interactions may generally imply a one-way interaction, in practice initial outputs may need to be updated as a result of new or changed information that was an input to a process. This standard describes and includes many of those iterations and refinement of outputs but does not depict all possible scenarios that may occur in practice.

5. PROCESS REQUIREMENTS

This Clause provides requirements for processes used in engineering a system and is applicable to any system regardless of its place in the hierarchy of the system structure (see Section 4) or the applicable life cycle stage. The processes are applicable for the engineering of operational systems and system elements, as well as the engineering of enabling systems and their system elements required to provide life-cycle support to their associated operational systems. Figure 12 and Figure 13 show the notional relationships between the processes of this standard. (Note that the relationships are not intended to imply a fixed unchanging sequence. In addition, not all interactions and relationships among the processes are depicted; it is not practical to depict all interactions, recursions, feedback loops, etc., in a diagram of this size and retain a reasonable degree of simplicity and clarity. See also 4.3 for additional information on the process interactions.)

The project **should**: (1) decide which of the processes in this standard apply to the project; (2) decide which activities and tasks from this standard apply for the processes selected; (3) establish appropriate policies and procedures that govern project implementation; and (4) establish the methods and tools to support task implementation.

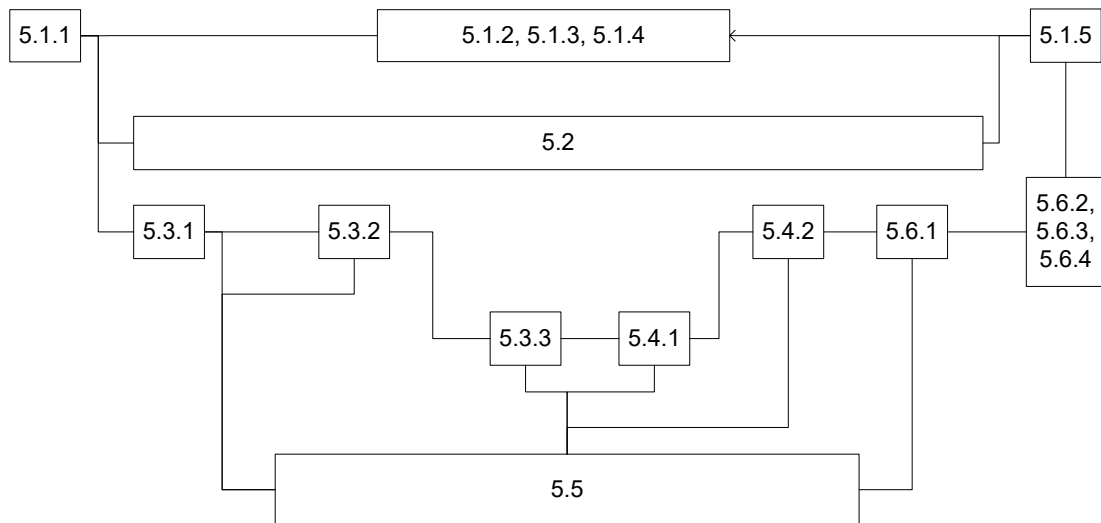


Figure 12 - High level diagram of processes

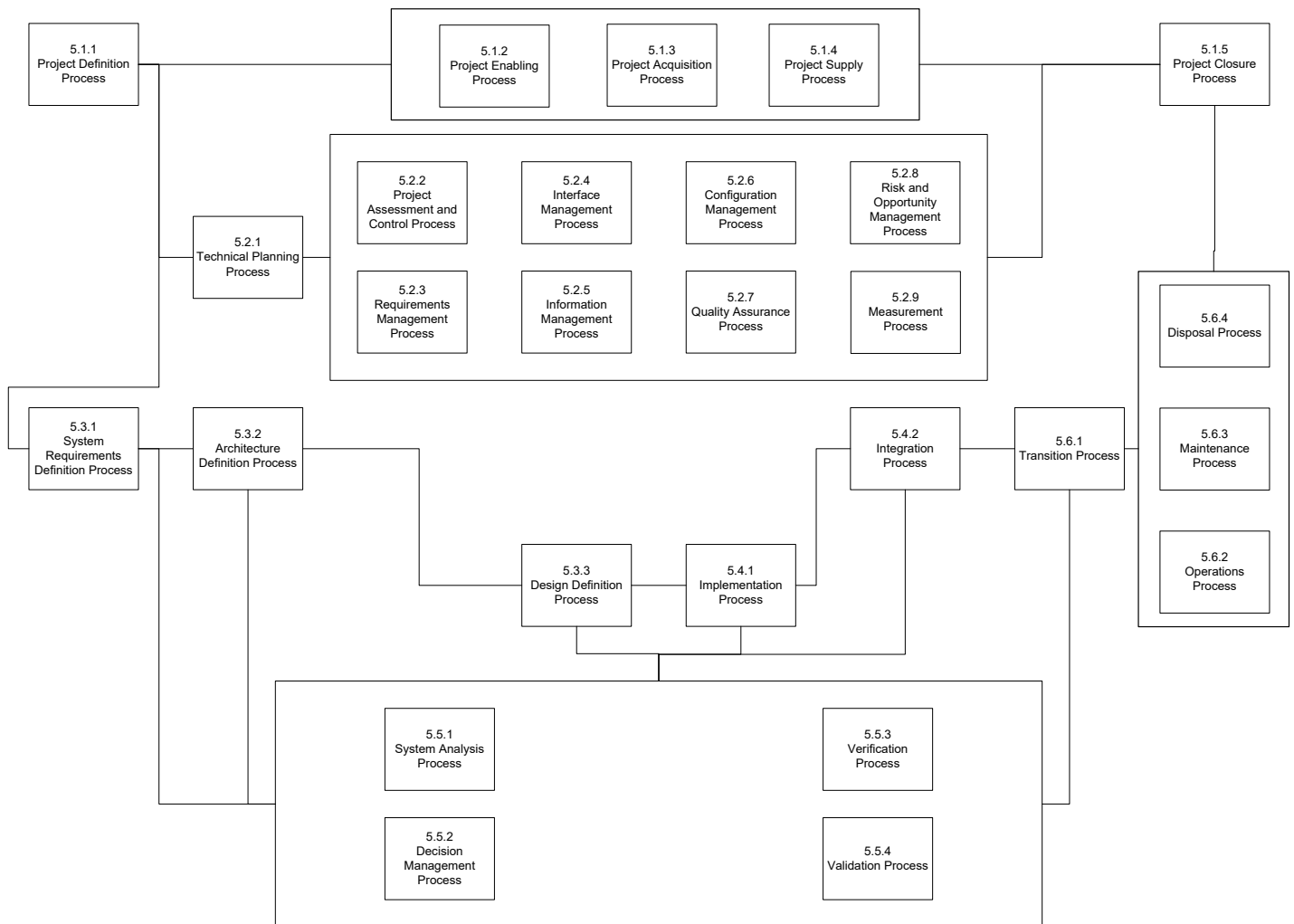


Figure 13 - Detailed diagram of processes

5.1 Project Framework Processes

The Project Framework Processes shown in Figure 14 are performed to: (1) define the customer expectations and objectives for the identified opportunity, along with the project technical context, acquisition strategy and life cycle stages applicable to the project; (2) establish and operate the defined project, including the support infrastructure, resources, policies/processes/procedures, improvements, supplier agreements and supplier management, resulting in a system that meets the stakeholder expectations and objectives; and (3) close (end) a project when the stakeholder expectations and objectives have been achieved, or when project continuation is no longer desired by the stakeholders.

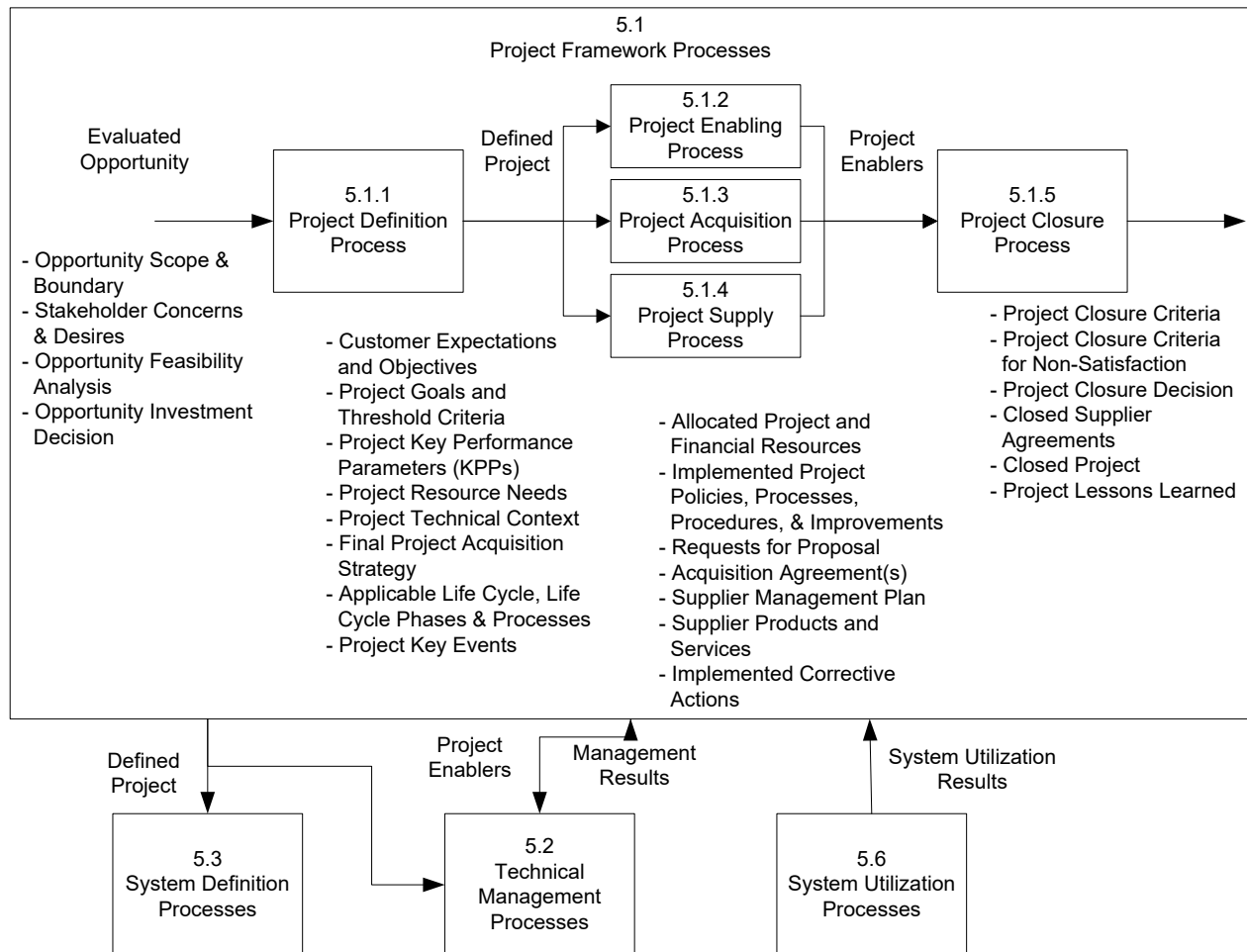


Figure 14 - Project framework processes

5.1.1 Project Definition Process

Purpose: The Project Definition Process is performed to define the expectations and objectives, context, strategy, and life cycle approach for a project to address an identified opportunity.

Requirement: Implement the following activities in order to achieve the expected outcomes to the extent necessary for the identified life-cycle stage.

Risks: Failure to perform or inadequate performance of the Project Definition Process may result in incorrect understanding of customer expectations, customer objectives, and project technical context; an inappropriate acquisition strategy and inappropriate identification of project life cycle stages and key events.

NOTE: Entry to the Project Definition Process is initiated when an organization has determined a project is needed; entrance criteria to this Process are as follows:

- a. The appropriate scope of the opportunity is determined by the organization;
- b. The feasibility of the opportunity is evaluated, and a starting system concept is defined;
- c. The stakeholders of the opportunity are identified, and their concerns and desires for a project are established; and
- d. The resource investment needed for the opportunity is evaluated and a decision to proceed is made. (If the decision is not to proceed, the Project Definition Process is not initiated.)

Expected Outcomes:

- a. The customer expectations and objectives are determined
- b. The technical context for the project is established
- c. The appropriate acquisition strategy for the project is determined
- d. The appropriate life cycle stages and key events for the project is determined from the acquisition strategy

Key Outputs:

- a. Customer Expectations and Objectives
- b. Project Goals and Threshold Criteria
- c. Project Key Performance Parameters (KPPs)
- d. Project Resource Needs
- e. Project Technical Context
- f. Final Project Acquisition Strategy
- g. Applicable Life Cycle, Life Cycle Stages and Processes
- h. Project Key Events

5.1.1.1 Define Customer Expectations and Objectives

5.1.1.2

Tasks	
Inputs	Outputs
a. Establish the customer expectations and objectives for the project using the integrated and prioritized stakeholder needs, expectations, and concerns.	
- Integrated Stakeholder Concerns and Desires - Prioritized Stakeholder Concerns and Desires - Opportunity Scope and Boundary (Final) - Viable Candidate System Alternatives	Customer Expectations and Objectives
b. Establish goals and threshold criteria for satisfying customer expectations and objectives, including business expectations and objectives.	
- Customer Expectations and Objectives - Opportunity Investment Decision - Viable Candidate System Alternatives	- Project Goals and Threshold Criteria - Business Expectations and Objectives
c. Derive the Key Performance Parameters (KPPs) to be used by the project.	
Project Goals and Threshold Criteria	Project Key Performance Parameters (KPPs)

5.1.1.3 Define Project Technical Context

Tasks	
Inputs	Outputs
a. Define the project's anticipated resource needs and sources, including funding, personnel, facilities, equipment.	
- Project Resource Availability Analysis - Opportunity Scope and Boundary (Final) - Project Strategies and Objectives - Opportunity Investment Analysis - Viable Candidate System Alternatives	Project Resource Needs
b. Determine how the new project will interact with existing and known future projects.	
- Opportunity Scope and Boundary (Final) - Project Strategies and Objectives	Project-to-Project Interactions
c. Develop the approach to establish the project, including considerations for impacts on other existing projects.	
- Opportunity Scope and Boundary (Final) - Project Strategies and Objectives - Opportunity Investment Decision	Project Establishment Approach
d. Define the project's technical context, including business and customer expectations and objectives, project responsibilities, resources and schedules.	
- Customer Expectations and Objectives - Business Expectations and Objectives - Project Goals and Threshold Criteria - Project Key Performance Parameters (KPPs) - Project-to-Project Interactions - Project Establishment Approach - Project Resource Availability Analysis - Opportunity Scope and Boundary (Final) - Project Strategies and Objectives - Opportunity Investment Analysis	Project Technical Context

5.1.1.4 Define Acquisition Strategy

Tasks	
Inputs	Outputs
a. Define the project acquisition strategy to develop, produce, field and support a system, to satisfy the defined customer expectations and objectives.	
• Customer Expectations and Objectives • Project Goals and Threshold Criteria • Project Key Performance Parameters (KPPs) • Opportunity Scope and Boundary (Final) • Project Context • System Concept • System Description • Supplier Strategy	• Project Acquisition Strategy
b. Ensure the project acquisition strategy is consistent with business expectations and objectives.	
• Project-to-Project Interactions • Project Strategies and Objectives • Opportunity Investment Analysis • Project Context	• Aligned Project Acquisition Strategy
c. Ensure the project acquisition strategy is consistent with available resources.	
• Project Resource Availability Analysis • Project Context	• Final Project Acquisition Strategy

5.1.1.5 Define Life Cycle Stages

NOTE: There are multiple relevant Life Cycles defined, each with specified stages unique to the system being realized and its governing environment. The processes in this standard for the engineering of a system may be applied in each stage of the applicable life cycle. See Section 4 for additional information and references.

Tasks	
Inputs	Outputs
a. Identify the applicable policies that govern or may affect execution of the project.	
External Policies	Applicable Policies
b. Determine the applicable life cycle(s), life cycle stages, and associated Key Events based on the project context, project acquisition strategy, and governing policies.	
- Final Project Acquisition Strategy - Project Context - Applicable Policies	- Applicable Life Cycle - Applicable Life Cycle Stages - Project Key Events
c. Identify the applicable processes for each specified life cycle stage.	
- Applicable Life Cycle Stages - Applicable Life Cycle - Project Key Events - Applicable Policies	Applicable Life Cycle Processes

5.1.2 Project Enabling Process

Purpose: The Project Enabling Process is performed to establish and support the defined project, enabling the execution of the project, and resulting in a system that meets the stakeholder expectations and objectives.

Requirement: Implement the following activities in order to achieve the expected outcomes to the extent necessary for the identified life-cycle stage.

Risks: Failure to perform or inadequate performance of the Project Enabling Process may result in an inappropriate project infrastructure; inadequate resources; inappropriate policies, processes, and procedures; missing or inappropriate improvements, suppliers, and supplier agreements; and inappropriate supplier management.

Expected Outcomes:

- The appropriate infrastructure (staff, training, finances, facilities, and equipment) for executing and supporting the project is established.
- The resources for execution of the project are established.
- The applicable policies, processes and procedures for execution of the project are established.
- Improvements needed for successful execution of the project are performed.
- The suppliers for the project are selected.
- Agreements for the selected suppliers are implemented.
- The performance of the project suppliers is evaluated and corrective actions completed



Key Outputs:

- a. Allocated Project Resources
- b. Allocated Financial Resources
- c. Implemented Project Policies, Processes, and Procedures
- d. Implemented Project Improvement Actions
- e. Supplier Management Plan
- f. Final Negotiated Supplier Agreements
- g. Supplier Systems or Products and Services
- h. Implemented Supplier Corrective Actions

5.1.2.1 Establish Project Support Infrastructure

Tasks	
Inputs	Outputs
a. Define the required project support infrastructure, including support staff, training, finances, facilities, tools, and equipment.	
- Project Key Events - Project Resource Availability Analysis - Opportunity Scope and Boundary (Final) - Applicable Life Cycle Processes	Project Support Infrastructure Resource Needs
b. Establish and maintain the project support infrastructure needed to meet project requirements.	
Project Support Infrastructure Resource Needs	Allocated Project Support Infrastructure Resources

5.1.2.2 Identify and Acquire Project Resources

Tasks	
Inputs	Outputs
a. Define the resources required to enable system definition and realization.	
• Project Support Infrastructure Resource Needs • Project Key Events • Project Resource Availability Analysis • Opportunity Scope and Boundary (Final) • Applicable Life Cycle Processes	• Project Resource Needs
b. Allocate financial resources to meet project requirements.	
• Project Support Infrastructure Resource Needs	• Allocated Financial Resources
c. Acquire and maintain the required project resources.	
• Project Resource Needs	• Allocated Project Resources
d. Establish support projects as needed to obtain enabling systems that meet requirements related to the system. Support projects may develop the enabling systems, subcontract the effort, or procure existing enabling systems.	
• Project Context • Project Key Events • Project Resource Availability Analysis • Opportunity Scope and Boundary (Final) • Applicable Processes	• Support Project Context and Support Project Resource Needs

5.1.2.3 Initiate Project

Tasks	
Inputs	Outputs
a. Initiate project execution; assemble the project resources and support infrastructure and establish the required financial systems for the project to begin operations.	
Allocated Project Resources	Initiated Project
b. Conduct project kickoff(s) to orient personnel resources to the project and initiate project execution.	
- Project Context - Project Key Events - Project Resource Availability Analysis - Opportunity Scope and Boundary (Final) - Project Technical Context - Applicable Processes	Project Kickoff(s)

5.1.2.4 Establish and Maintain Technical Policies, Processes, and Procedures

Tasks	
Inputs	Outputs
a. Evaluate the Processes, Activities, and Tasks of this standard and identify those applicable for the project. Determine applicable policies, standards and other regulatory requirements for the project.	
• Policies, Standards, and Regulatory Requirements	• Applicable Policies, Standards, and Regulatory Requirements
b. Define applicable project policies, processes, and procedures, including project location in the organizational structure.	
• Applicable Policies, Standards, and Regulatory Requirements • Applicable Standard Processes • Applicable Life Cycle Processes • Applicable Policies	• Applicable Project Policies, Processes, and Procedures
c. Define project reporting requirements, both internal and external.	
• Applicable Standard Processes • Applicable Life Cycle Processes • Applicable Policies	• Project Reporting Requirements
d. Define applicable project responsibilities, authority, and accountability (RAA) matrices.	
• Applicable Project Policies, Processes, and Procedures • Applicable Standard Processes • Applicable Life Cycle Processes • Applicable Policies	• Project Responsibilities, Authority, and Accountability Matrices
e. Implement and maintain the project policies, processes and procedures, and the project RAA matrices.	
• Applicable Project Policies, Processes, and Procedures	• Implemented and Maintained Project Policies, Processes, and Procedures

5.1.2.5 Identify and Implement Project Improvements

Tasks	
Inputs	Outputs
a. Evaluate the effectiveness of the implemented project policies, processes, and procedures in meeting project expectations and objectives.	
• Implemented Project Policies, Processes, and Procedures • Project Goals and Threshold Criteria • Project Key Performance Parameters (KPPs) • Project Strategies and Objectives	• Project Policies, Processes, and Procedures Performance Assessment
b. Evaluate the effectiveness of the support infrastructure in meeting project expectations and objectives.	
• Allocated Project Support Infrastructure Resources • Project Goals and Threshold Criteria • Project Key Performance Parameters (KPPs) • Project Strategies and Objectives	• Project Support Infrastructure Performance Assessment
c. Identify opportunities and recommended actions for project improvements, including external improvements that may affect the project, and prioritize the opportunities and actions.	
• Project Policies, Processes and Procedures Performance Assessment • Project Support Infrastructure Performance Assessment • External Improvements	• Project Improvement Opportunities • Project Improvement Action Recommendations
d. Select and implement the appropriate project improvement actions.	
• Project Improvement Opportunities • Project Improvement Action Recommendations	• Implemented Project Improvement Actions

5.1.3 Project Acquisition Process

Purpose: The Project Acquisition Process is performed to establish and support acquisition agreements between the defined project and other projects, including other internal operations (activities, committees, task forces, etc.) within an organization.

Requirement: Implement the following activities in order to achieve the expected outcomes to the extent necessary for the identified life-cycle stage.

Risks: Failure to perform or inadequate performance of the Project Acquisition Process may result in missing or inappropriate acquisition agreements, as well as problems in completing acquisition agreements.

NOTE 1: An acquisition agreement can be between projects or between organizational elements (i.e., between projects, between projects and functional units, and between units within a project).

NOTE 2: An acquisition agreement can take the form of a work authorization, a project memorandum of agreement, or other non-contractual (informal) means.

NOTE 3: Acquisition agreements can take the form of a formal contract for the delivery of a system, or a memorandum of agreement that establishes the working relationship between two or more projects.

NOTE 4: Whether formal or informal, an acquisition agreement is nevertheless useful to ensure all parties involved understand the purpose, goals, and expectations of the work.

NOTE 5: The term “system” used in this Project Acquisition Process generally refers to system elements provided by a supplier external to the organization; these are typically viewed as products and/or services from a supplier.

NOTE 6: The term “supplier” refers to an organization external to the project that provides products and/or services to the project. A supplier may be within the same higher level organization the project is in, or may be from an external organization.

Expected Outcomes:

- a. A request is prepared to obtain acquirer responses;
- b. An acquirer is selected (or acquirers are selected);
- c. The establishment of an acquisition agreement, or acquisition agreements, between the project and other parties, consistent with:
 - i. Applicable legal and regulatory policies, procedures, and practices
 - ii. The type of acquisition;
 - iii. Acquisition strategy;
 - iv. Current conditions and constraints concerning the work effort.
- d. Products and/or services per agreements are provided; and
- e. Acquisition activities between the project and other parties executed in accordance with the established agreement(s).

Key Outputs:

- a. Request(s) for Proposal
- b. Documented Acquisition Agreement(s)
- c. Completed Acquisition Agreement(s)

5.1.3.1 Negotiate Scope and Terms of the Acquisition Agreement

Tasks	
Inputs	Outputs
a. Establish the strategy for negotiating an acquisition agreement.	
• Implemented and Maintained Project Policies, Processes, and Procedures • Work to be performed • Known constraints	• Acquisition agreement strategy
b. Develop the request for proposal and communicate to candidate suppliers or other parties for solicitation of proposals.	
• Acquisition agreement strategy • Statement of Work • Deliverables • Schedules • Operational Concept • Requirements • Financial constraints • Technical Plans • Requirements Management Plan • Configuration Management Plan • Information Management Plan • Project Work Packages	• Request for Proposal
c. Review submitted proposals and select the supplier or other parties best suited to meet the requirements.	
• Request for Proposal • Submitted Proposal(s)	• Selected Supplier/Other Party

Tasks	
Inputs	Outputs
d. Negotiate with selected supplier or other parties to establish a satisfactory acquisition agreement.	
- Request for Proposal - Submitted Proposal(s) - Selected Supplier/Other Party	Negotiated acquisition agreement scope and content
NOTE: Regardless of the form or purpose of the acquisition agreement, the following information should be included as appropriate: - Work to be performed; - Cost and schedule constraints; - Operational Concept; - Requirements to be satisfied, including known functional, performance, and interface requirements, attributes, and characteristics; - Product and information to be delivered; - Information pertaining to cost, schedule, planning, delivery information, product structure, packaging and handling instructions, or installation instructions; - Reference to appropriate technical plans; - Applicable financial structure, management and authority provisions; - Exit criteria for relevant life cycle stages; - Identification of applicable engineering life cycle stages; - Required technical reviews; - Operational support requirements.	
e. Capture the acquisition agreement in a form and medium appropriate to the effort.	
Negotiated agreement scope and content	Documented Acquisition Agreement
f. Update the acquisition agreement to reflect negotiated changes to the effort.	
- Negotiated agreement scope and content - Negotiated agreement changes	Updated Documented Acquisition Agreement

5.1.3.2 Execute Acquisition Agreement

Tasks	
Inputs	Outputs
a. Implement the negotiated acquisition agreement consistent with the requirements of the agreement.	
Negotiated Acquisition Agreement	Defined work effort
b. Develop or obtain/exchange systems per the acquisition agreement.	
Negotiated Agreement	Required systems and other deliverables
c. Monitor the supplier or other party activities against the acquisition agreement and identify corrective actions for resolution as needed. Exchange information as needed to support identification of corrective actions and resolution.	
- Negotiated Agreement - Supplier/Other Party Activities	Corrective Actions
d. Evaluate systems and other deliverables received for compliance to requirements. If accepted, remit payment or other consideration per the acquisition agreement. If not accepted, pursue corrective actions as needed.	
- Completed work effort - Delivered systems and other deliverables	- Accepted systems and other deliverables - Payment or other consideration - Corrective Actions
e. When all deliverables have been accepted, and funding completed, close out the acquisition agreement.	
- Completed work effort - Delivered and accepted systems and other deliverables	Closed out acquisition agreement

5.1.4 Project Supplier Process

Purpose: The Project Supplier Process is performed to establish and manage suppliers, including the management of supplier agreements between the defined project and other projects, including other internal operations within an organization.

Requirement: Implement the following activities in order to achieve the expected outcomes to the extent necessary for the identified life-cycle stage.

Risks: Failure to perform or inadequate performance of the Project Supplier Process may result in inappropriate supplier management procedures and protocols, missing or inappropriate supplier agreements, as well as problems in completing supplier agreements.

Expected Outcomes:

- a. A request is prepared to obtain supplier responses;
- b. A viable supplier is selected (or multiple suppliers are selected);
- c. The establishment of procedures and protocols for the management of suppliers to the project, consistent with:
 - i. Project acquisition strategy;
 - ii. Supplier management procedures and practices;
 - iii. Current conditions and constraints concerning the work effort.
- d. Establishment of supplier agreements;
- e. Products and/or services per agreements are provided; and
- f. Supply activities between the project and suppliers executed in accordance with the established agreement(s).

Key Outputs:

- a. Supplier Management Plan;
- b. Negotiated Supplier Agreements;
- c. Supplied Products and Services;

5.1.4.1 Develop Supplier Management Plan

Tasks	
Inputs	Outputs
a. Develop the Supplier Management Plan based on the project acquisition strategy.	
- Project Acquisition Strategy - Supplier Strategy	Supplier Management Plan
b. Determine the applicable work scope and requirements for each supplier.	
Supplier Management Plan	Supplier Work Scope and Requirements
c. Determine the applicable processes and procedures to be performed by the supplier.	
- Implemented Project Policies, Processes, and Procedures - Supplier Work Scope and Requirements - Supplier Management Plan	Applicable Supplier Policies, Processes, and Procedures
d. Determine the required interaction with each supplier.	
- Applicable Supplier Policies, Processes, and Procedures - Supplier Work Scope and Requirements - Supplier Management Plan	Supplier Interaction Procedures
e. Determine any applicable Supply Chain Strategy requirements for each supplier.	
- Supplier Work Scope and Requirements - Supplier Management Plan - Supplier Strategy - Project Strategies and Objectives	Applicable Project Supplier Requirements
f. Develop the applicable documentation for each supplier, consistent with project processes.	
- Supplier Work Scope and Requirements - Supplier Management Plan - Applicable Project Supplier Requirements - Supplier Interaction Procedures - Applicable Supplier Policies, Processes, and Procedures	Initial Supplier Agreement Requirements

Tasks	
Inputs	Outputs
g. Develop the supplier selection criteria for use in obtaining candidate supplier proposals.	
• Supplier Work Scope and Requirements • Supplier Management Plan • Supplier Strategy • Project Strategies and Objectives	• Supplier Selection Criteria

5.1.4.2 Develop and Establish Supplier Agreement

Tasks	
Inputs	Outputs
a. Evaluate supplier proposals and recommend the best-qualified candidate(s).	
• Supplier Proposals • Initial Supplier Agreement Requirements • Supplier Selection Criteria	• Supplier Recommendations
b. Establish the strategy for negotiating the supplier agreement.	
• Supplier Management Plan • Supplier Strategy • Project Strategies and Objectives • Supplier Proposals • Initial Supplier Agreement Requirements	• Supplier Negotiations Strategy
c. Negotiate supplier proposal(s) with best-qualified candidate(s) and recommend preferred supplier(s).	
• Supplier Negotiations Strategy • Supplier Proposals • Initial Supplier Agreement Requirements • Supplier Selection Criteria	• Negotiated Supplier Proposals • Preferred Supplier Recommendations
d. Complete negotiations as required and document the final supplier agreement(s).	
• Supplier Negotiations Strategy • Negotiated Supplier Proposals • Initial Supplier Agreement Requirements • Supplier Selection Criteria • Preferred Supplier Recommendations	• Final Negotiated Supplier Agreements

5.1.4.3 Monitor Supplier Performance

Tasks	
Inputs	Outputs
a. Implement the negotiated supplier agreement(s).	
Final Negotiated Supplier Agreements	Implemented Supplier Agreements
b. Develop products and services per the supplier agreement(s).	
Implemented Supplier Agreements	Supplier Products and Services Development Reports
c. Manage the supplier's requirements – communicate changes that may affect the supplier, and control supplier changes that may affect the project or related systems, system elements, or services.	
- Implemented Supplier Agreements - Requirements Changes	- Supplier Agreement Changes - Updated Supplier Agreements
d. Monitor supplier performance against the identified requirements, measures, and schedules, including conduct of or participation in appropriate reviews. Identify any supplier issues for corrective actions.	
- Implemented Supplier Agreements - Updated Supplier Agreements - Supplier Products and Services Development Reports	- Supplier Performance Reports - Supplier Issues
e. Obtain products and services per the supplier agreement(s).	
- Implemented Supplier Agreements - Updated Supplier Agreements	Supplier Products and Services
f. Verify supplied products and services meet the acceptance criteria prior to integration with other system elements.	
- Supplier Products and Services - Implemented Supplier Agreements - Updated Supplier Agreements	- Supplier Products and Services Verification Results - Supplier Issues
g. Recommend closure of the supplier agreement(s) when all supplier agreement requirements have been met, deliverables have been accepted, and funding completed.	
- Implemented Supplier Agreements - Updated Supplier Agreements - Supplier Products and Services Verification Results	Supplier Agreement Closure Recommendation

5.1.4.4 Define and Implement Supplier Corrective Action

Tasks	
Inputs	Outputs
a. Define corrective actions and responsible parties to resolve project issues.	
Supplier Issues	Supplier Corrective Actions and Responsibilities
b. Implement the identified corrective actions.	
Supplier Corrective Actions and Responsibilities	Implemented Supplier Corrective Actions
c. If corrective actions are insufficient to achieve required project results and meet the agreement requirements, the project can terminate the supplier agreement(s) and develop and establish an agreement with a new or alternative supplier.	
- Implemented Supplier Agreements - Updated Supplier Agreements - Supplier Products and Services Development Reports - Implemented Supplier Corrective Actions	Supplier Agreement Closure Recommendation
d. Develop the supplier selection criteria for use in obtaining new candidate supplier proposals.	
- Supplier Work Scope and Requirements - Supplier Management Plan - Supplier Strategy - Project Strategies and Objectives	Supplier Selection Criteria

5.1.5 Project Closure Process

Purpose: The Project Closure Process is performed to end a project when the stakeholder expectations and objectives have been achieved, or when project continuation is no longer desired by the stakeholders.

Requirement: Implement the following activities in order to achieve the expected outcomes to the extent necessary for the identified life-cycle stage.

Risks: Failure to perform or inadequate performance of the Project Closure Process may result in problems keeping projects that should be closed or problems closing projects that should not be closed, and problems closing projects whether successful or not.

Expected Outcomes:

- The appropriate closure criteria to determine successful completion of the project or the basis for termination of the project are defined.
- The performance of the project, relative to the closure criteria, is determined.
- The project is closed or terminated, consistent with the closure criteria.

Key Outputs:

- a. Project Closure Criteria
- b. Project Closure Criteria for Non-Satisfaction
- c. Project Closure Decision
- d. Closed Supplier Agreements
- e. Closed Project
- f. Project Lessons Learned

5.1.5.1 Establish Criteria for Project Closure

Tasks	
Inputs	Outputs
a. Define the exit criteria for closure of the project on meeting the customer and business expectations and objectives, and the associated plan for closure, including closure of supplier agreements.	
- Customer Expectations and Objectives - Project Goals and Threshold Criteria - Project Key Performance Parameters (KPPs) - Project Strategies and Objectives - Implemented Project Policies, Processes, and Procedures	Project Closure Criteria
b. Define the exit criteria for closure of the project if it will not or does not meet the customer and business expectations and objectives, and the associated plan for closure, including closure of supplier agreements.	
- Customer Expectations and Objectives - Project Goals and Threshold Criteria - Project Key Performance Parameters (KPPs) - Project Strategies and Objectives - Implemented Project Policies, Processes and Procedures	Project Closure Criteria for Non-Satisfaction

5.1.5.2 Determine Compliance with Project Closure Criteria

Tasks	
Inputs	Outputs
a. Monitor project status and determine if the project can continue to progress satisfactorily and meet the established project closure exit criteria.	
- Project Status - Project Closure Criteria	Project Closure Evaluation Results
b. Determine if corrective actions are needed so the project can progress and meet customer and business expectations and objectives and implement the identified corrective actions.	
- Project Status - Project Closure Criteria	- Project Closure Evaluation Results - Corrective Actions
c. Determine if the established project closure exit criteria have been met; implement project closure if exit criteria have been met.	
- Project Status - Project Closure Criteria	- Project Closure Evaluation Results - Project Closure Decision
d. Implement the identified corrective actions or determine if the project meets the established exit criteria for non-satisfactory projects and proceed to implement project closure.	
- Project Status - Project Closure Criteria for Non-Satisfaction	- Project Closure for Non-Satisfaction Evaluation Results - Project Closure Decision

5.1.5.3 Implement Project Closure

NOTE: If the project closure determination made in 5.1.6.2 is that the project is non-satisfactory, then only Tasks (a) and (b) are performed in 5.1.6.3. If the project closure determination made in 5.1.6.2 is that the project is satisfactory, then only Tasks (c) and (d) are performed in 5.1.6.3.

Tasks	
Inputs	Outputs
a. Implement project closure for non-satisfactory projects, including closure of supplier agreements.	
- Project Closure for Non-Satisfaction Evaluation Results - Project Closure Decision - Implemented Supplier Agreements - Updated Supplier Agreements	- Closed Supplier Agreements - Closed Project
b. Identify the reasons and causes for non-satisfactory project performance. Document lessons learned and implement appropriate organizational corrective actions.	
- Project Closure for Non-Satisfaction Evaluation Results - Project Status - Project Information Database	- Non-Satisfactory Project Performance Analysis Report - Non-Satisfactory Project Lessons Learned - Organizational Corrective Actions
c. Implement project closure for completed projects, including closure of supplier agreements.	
- Project Closure Evaluation Results - Project Closure Decision - Implemented Supplier Agreements - Updated Supplier Agreements	- Closed Supplier Agreements - Closed Project
d. Identify the reasons and causes for successful project performance. Document lessons learned and implement appropriate organizational actions.	
- Project Closure Evaluation Results - Project Status - Project Information Database	- Project Performance Analysis Report - Project Lessons Learned - Organizational Corrective Actions

5.2 Technical Management Processes

The Technical Management Processes shown in Figure 15 and Figure 16 are performed to: (1) develop the project's technical strategy, plan, schedule, organization, work packages and directives for the effort to be performed in developing and fielding systems and system elements; (2) measure project progress, perform reviews and audits at key project transition points, and implement corrective actions; (3) plan the approach to manage requirements, and then manage the definition and evolution of the requirements and architecture for the project; (4) plan the approach to manage system internal and external interfaces, and then manage the definition and evolution of those interfaces for the project; (5) plan the approach to manage project technical data, identify required data, and manage project data; (6) plan the approach to manage configuration baselines, identify system and system elements to manage, manage changes to the identified system and system elements, maintain product definition data, and perform configuration audits and verifications; (7) plan the quality assurance approach for the project and perform quality assurance tasks for the project; and (8) plan the risk and opportunity management approach for the project, identify and analyze risks and opportunities, and manage those risks and opportunities, including handling of prioritized risks and opportunities, in order to maximize project success.

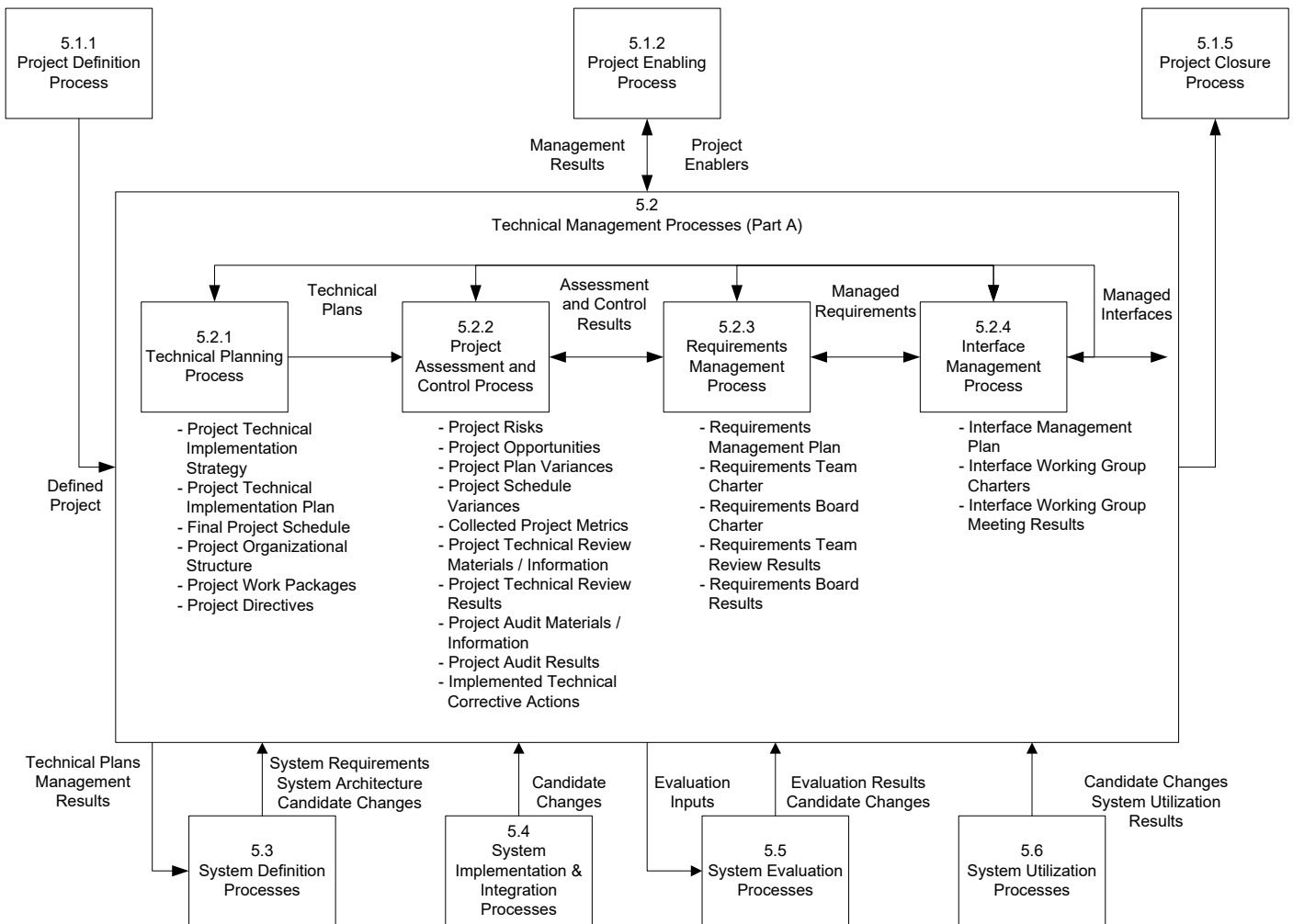


Figure 15 - Technical management processes (Part A)

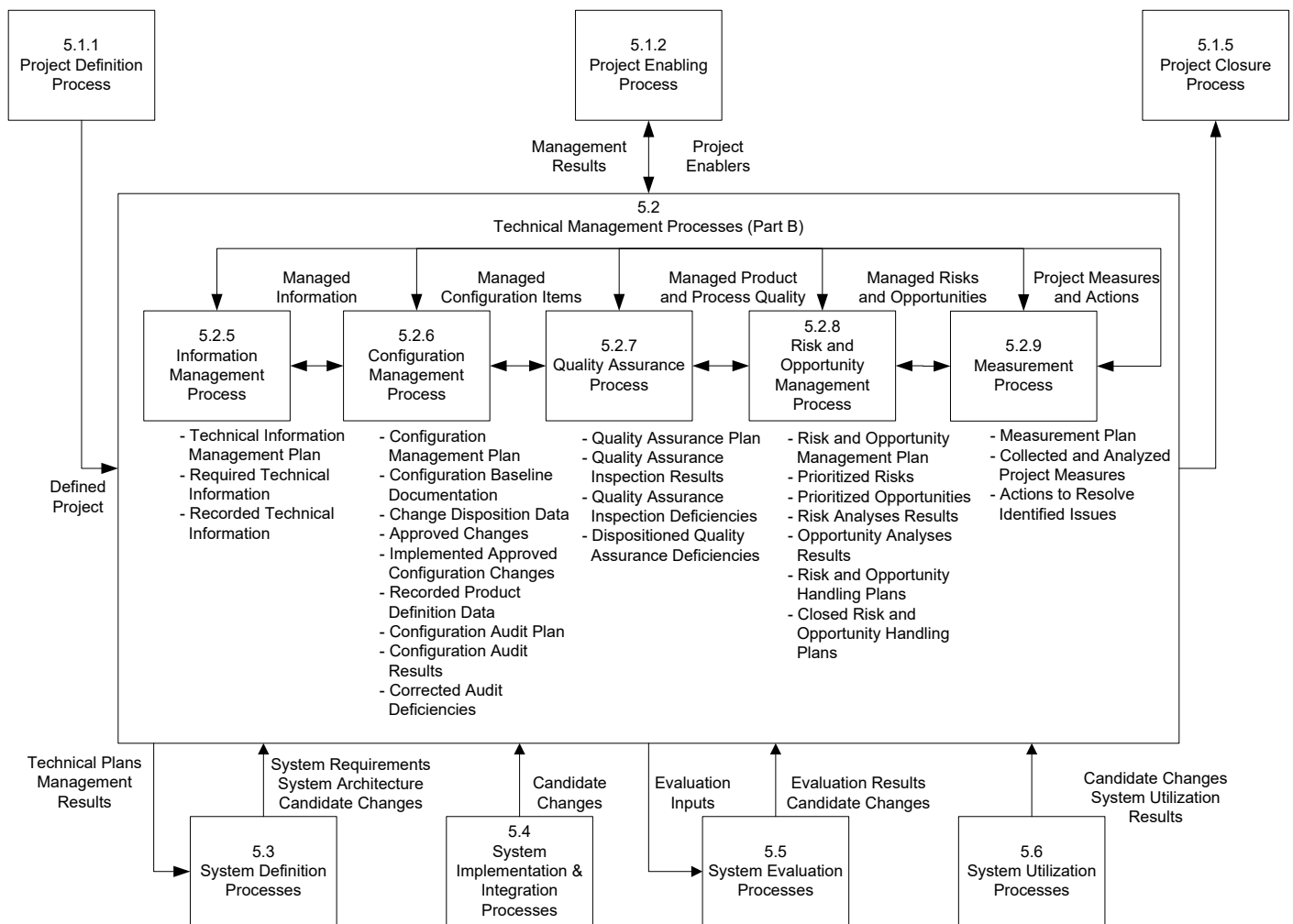


Figure 16 - Technical management processes (Part B)

5.2.1 Project Planning Process

Purpose: The Project Planning Process is performed to develop the project's technical strategy, plan, schedule, organization, work packages and directives for the effort to be performed in developing and fielding systems and system elements.

Requirement: Implement the following activities in order to achieve the expected outcomes to the extent necessary for the identified life-cycle stage.

Risks: Failure to perform or inadequate performance of the Project Planning Process may result in an incomplete or inappropriate project strategy, project plan, project schedule, project structure, or project work packages and directives; each of which can result in problems during project execution.

Expected Outcomes:

- The project's strategy for technical implementation of the system is defined;
- The project's plan for technical implementation of the system is defined;
- The project's schedule for technical activities is defined;

- d. The appropriate structure for organizing the project resources is defined, including role(s), responsibility, accountability, and authority (RRAA) for each position in the project structure; and
- e. The work packages and associated directives, consistent with the technical implementation plan and schedule, are defined.

Key Outputs:

- a. Project Technical Implementation Strategy
- b. Project Technical Implementation Plan
- c. Final Project Schedule
- d. Project Organizational Structure
- e. Project Work Packages
- f. Project Directives

5.2.1.1 Define Project Technical Implementation Strategy

Tasks	
Inputs	Outputs
a. Update the list of external and internal stakeholders.	
- External Stakeholders - Internal Stakeholders	- Updated External Stakeholders - Updated Internal Stakeholders
b. Determine the project's strategy for obtaining the identified system elements and enabling system elements, based on the Project Acquisition Strategy.	
- Final Project Acquisition Strategy - Project Technical Context - Project Context - System Concept - System Description - Supplier Strategy	Initial Project Technical Implementation Strategy

Tasks	
Inputs	Outputs
c. Define the Project Technical Implementation Strategy that implements the applicable processes and integrates internal and external projects, along with entry and exit criteria for project Key Events, based on the project context. The Project Technical Implementation Strategy includes the Project Development Strategy as well as the Project Integration, Verification, and Validation Strategy and Project Utilization Strategy.	
• Initial Project Technical Implementation Strategy • Project Context • Project Technical Context • System Concept • System Description • Project Key Events • Applicable Life Cycle Processes • Support Project Context and Support Project Resource Needs • Supplier Strategy • Constraints and Assumptions	• Project Technical Implementation Strategy • Project Development Strategy • Project Integration, Verification, and Validation Strategy • Project Utilization Strategy
d. Define the work products that will be produced by the project and their nominal timing by the project Key Events, including any update or refinement of the work products by Key Events.	
• Project Technical Implementation Strategy • System Concept • System Description • Project Key Events • Applicable Life Cycle Processes • Supplier Strategy	• Project Work Products by Key Events

Tasks	
Inputs	Outputs
e. Develop the Work Breakdown Structure (WBS) based on the Project Technical Implementation Strategy, System Concept/System Description and applicable processes.	
- Project Technical Implementation Strategy - System Concept - System Description - Project Key Events - Applicable Life Cycle Processes - Supplier Strategy - Project Work Products by Key Events	Work Breakdown Structure (WBS)
f. Determine the required effort (resources and types) based on the applicable life cycle stage and applicable processes.	
- Applicable Life Cycle Stages - Applicable Life Cycle Processes	Technical Implementation Resource Requirements
g. Define the product-oriented measures and process-oriented measures for the project based on the KPPs.	
System Key Performance Parameters (KPPs)	- Project Product Measures - Project Process Measures

NOTE: The process implementation strategy includes requirements for the processes to be used, applicable constraints, assumptions, completion criteria, and feasibility of each process, considering resources (personnel, materials, technology) and project execution environment. This strategy can be a part of the project plan or a stand-alone document.

5.2.1.2 Develop Technical Implementation Plan

Tasks	
Inputs	Outputs
a. Identify the applicable project tasks to be performed, based on the Project Technical Implementation Strategy, including appropriate technical reviews.	
- Project Technical Implementation Strategy - Project Development Strategy - Project Integration, Verification, and Validation Strategy - Project Key Events - Applicable Life Cycle Processes - Work Breakdown Structure (WBS)	Initial Project Technical Implementation Plan
b. Define the project cost and schedule goals, based on customer and business expectations and objectives.	
- Customer Expectations and Objectives - Project Goals and Threshold Criteria - Work Breakdown Structure (WBS) - System Key Performance Parameters (KPPs) - Project Key Events	- Project Cost Goals - Project Schedule Goals
c. Identify project risks and opportunities, including technology constraints, and determine applicable project tasks to be performed.	
- Project Technical Implementation Strategy - Project Context - System Concept - System Description - Project Key Events - Support Project Context and Support Project Resource Needs - Supplier Strategy	- Project Risks and Opportunities - Project Risk and Opportunity Tasks

Tasks	
Inputs	Outputs
d. Identify the resources – personnel, facilities and equipment; associated training; and appropriate methods and tools – required for the project tasks.	
• Supplier Strategy • Project Technical Implementation Strategy • Project Risk and Opportunity Tasks • Project Resource Needs • Work Breakdown Structure (WBS)	• Project Resource Requirements
e. Develop the Technical Implementation Plan that integrates the project tasks, measures and goals, and required resources to achieve customer and business expectations and objectives. The Technical Implementation Plan includes the System Evaluation Plan.	
• Customer Expectations and Objectives • Project Goals and Threshold Criteria • System Key Performance Parameters (KPPs) • System Technical Performance Measures (TPMs) • Initial Technical Implementation Plan • Project Resource Requirements	• Technical Implementation Plan • System Evaluation Plan

5.2.1.3 Develop Support Tools Plan and Acquire Support Tools

Tasks	
Inputs	Outputs
a. Define intended uses and characteristics of support tools consistent with the Technical Implementation Plan.	
• Project Technical Implementation Strategy • Technical Implementation Plan • Project Context • System Concept • System Description	• Intended Support Tool Uses • Support Tool Characteristics
b. Identify support tools to develop or procure, including review of standard organizational tools.	
• Intended Support Tool Uses • Support Tool Characteristics • Technical Implementation Plan • System Concept • System Description	• Support Tools to Develop • Support Tools to Procure
c. Identify support tool development methodologies and procedures.	
• Implemented Project Policies, Processes and Procedures • Standard Organizational Tools • Support Tools to Develop	• Tool Development Methods and Procedures
d. Acquire required support tools.	
• Technical Implementation Plan • Standard Organizational Tools • Support Tools to Procure	• Acquired Support Tools
e. Update the Technical Implementation Plan to include the development of support tools as appropriate.	
• Intended Support Tool Uses • Support Tool Characteristics • Support Tools to Develop • Tool Development Methods and Procedures • Technical Implementation Plan	• Updated Technical Implementation Plan

5.2.1.4 Develop Technical Schedule

Tasks	
Inputs	Outputs
a. Develop the event-based, logical technical schedule for the applicable life cycle stage, including key events, technical reviews and milestones.	
• Technical Implementation Plan • Project Key Events • Applicable Life Cycle Stage • Applicable Processes • Work Breakdown Structure (WBS)	• Technical Schedule
b. Develop the calendar-based project schedule based on expected task durations and logical relationships.	
• Technical Schedule • Technical Implementation Plan • Project Schedule Goals • Project Cost Goals	• Initial Project Schedule
c. Adjust the calendar-based project tasks to remove resource conflicts and balance resource needs consistent with the Technical Implementation Plan.	
• Resource-Loaded Project Schedule • Resource Conflicts • Technical Implementation Plan • Project Schedule Goals • Project Cost Goals	• Final Project Schedule

5.2.1.5 Develop Organizational Structure

Tasks	
Inputs	Outputs
a. Identify the personnel and other resources required to complete the project tasks.	
- Initial Project Schedule - Project Resource Requirements - Technical Implementation Plan - Project Schedule Goals - Project Cost Goals	- Resource-Loaded Project Schedule - Resource Conflicts
b. Define the project team and organizational structure to use, consistent with the Technical Implementation Plan and the project schedule.	
- Final Project Schedule - Technical Implementation Plan - Project Resource Requirements	- Project Team Structure - Project Organizational Structure
c. Evaluate deficiencies or other issues between resources available and project plans and develop corrective action recommendations.	
- Project Team Structure - Project Organizational Structure - Final Project Schedule	Project Technical Corrective Action Recommendations
d. Submit recommendations to approval authority.	
Project Technical Corrective Action Recommendations	Submitted Technical Corrective Action Recommendations
e. Document approval authority decision relative to reported deficiencies.	
Submitted Technical Corrective Action Recommendations	- Approval Authority Decision on Submitted Technical Corrective Action Recommendations - Approved Technical Corrective Actions
f. Implement the corrective actions.	
Approved Technical Corrective Actions	- Implemented Technical Corrective Actions - Technical Corrective Actions Results
g. Verify the corrective actions are completed.	
- Implemented Technical Corrective Actions - Technical Corrective Actions Results	- Verified Technical Corrective Actions - Project Technical Deficiencies