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Partie 7: Application de l'ingénierie des systèmes aux programmes de défense

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Institute of Electrical and Electronics Engineers, Inc
3 Park Avenue, New York
NY 10016-5997, USA

Email: stds.ipr@ieee.org
Website: www.ieee.org

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IEEE Standard for Application of Systems Engineering on Defense Programs

Sponsor

Software & Systems Engineering Standards Committee
of the
IEEE Computer Society

Approved 10 December 2014

IEEE-SA Standards Board

Abstract: The requirements for the application of ISO/IEC/IEEE 15288, System Life Cycle Processes for defense systems engineering needs are provided in this standard. This standard implements ISO/IEC/IEEE 15288 for use by United States Department of Defense (DoD) organizations and other defense agencies in acquiring systems or systems engineering support. While primarily supporting the acquirer-supplier agreement mode, this standard also can be used to support the other modes: use by organizations, projects, and process assessors. This standard provides the basis for selection, negotiation, agreement, and performance of necessary systems engineering activities and delivery of products, while allowing flexibility for both innovative implementation and tailoring of the specific systems engineering process(es) to be used by system suppliers, either contractors or government system developers, integrators, maintainers, or sustainers.

Keywords: 15288, acquisition, agreement processes, allocated baseline, attributes, defense program, Department of Defense, functional baseline, IEEE 15288.1™, information management, life cycle processes, organizational project-enabling processes, outputs, process activities, process outcomes, process tasks, product baseline, project assessment, system life cycle, systems engineering, technical management processes, technical processes

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

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Introduction

This introduction is not part of IEEE Std 15288.1-2014, IEEE Standard for Application of Systems Engineering on Defense Programs.

For effective and efficient application of ISO/IEC/IEEE 15288 on defense programs, additional application requirements are needed. ISO/IEC/IEEE 15288 is written in a general manner to address all types of systems and different modes of application. Thus, it does not have requirements specific to the use by defense projects that facilitate effective implementation of an acquirer-supplier agreement, such as use in defense contracts.

This standard implements ISO/IEC/IEEE 15288 for application on defense programs, providing the defense-specific language and terminology to help ensure the correct application of acquirer-supplier requirements for a defense program. This standard includes the expected/required outputs and associated attributes.

Contents

IEEE Standard for Application of Systems Engineering on Defense Programs

1. Overview

1.1 Scope

This standard establishes the requirements for systems engineering activities to be performed on projects of the United States (US) Department of Defense (DoD) and other defense agencies across the entire system life cycle, including the planning, acquisition, modification, and sustainment of defense systems. It provides the foundation for systems engineering within the context of ISO/IEC/IEEE 15288[1] and the acquisition environment of DoD and other defense agencies at all levels of system hierarchy. This standard provides detailed requirements for the application of the life cycle processes, activities, and tasks of ISO/IEC/IEEE 15288 for use on any defense system and includes the effective integration of agreement processes, technical processes, technical management processes, and essential specialty engineering requirements.

1.2 Purpose

This standard provides requirements for the application of ISO/IEC/IEEE 15288 for defense systems engineering needs. This standard implements ISO/IEC/IEEE 15288 for use by DoD organizations and other defense agencies in acquiring systems or systems engineering support. While primarily supporting the

[1]Information on normative references can be found in Clause 2.

acquirer-supplier agreement mode, this standard also can be used to support the other modes: use by organizations, projects, and process assessors. This standard provides the basis for selection, negotiation, agreement, and performance of necessary systems engineering activities and delivery of products, while allowing flexibility for both innovative implementation and tailoring of the specific systems engineering process(es) to be used by system suppliers, either contractors or government system developers, integrators, maintainers, or sustainers.

1.3 Conformance

1.3.1 Intended usage

ISO/IEC/IEEE 15288:2015 2.1 “Intended usage” shall apply.

1.3.2 Full conformance

1.3.2.1 Full conformance to outcomes

ISO/IEC/IEEE 15288:2015 2.2.1 “Full conformance to outcomes” shall apply.

1.3.2.2 Full conformance to tasks

ISO/IEC/IEEE 15288:2015 2.2.2 “Full conformance to tasks” shall apply.

1.3.3 Tailored conformance

ISO/IEC/IEEE 15288:2015 2.3 “Tailored conformance” shall apply with the following additions:

The agreement between the acquirer and supplier shall include the systems engineering requirements based on the tailoring (or other adaptation) of the requirements of this standard to address the program situation.

The assessment of the supplier is based on the compliance to the agreement. The agreement shall include the means by which compliance will be determined (which may include accomplishment of outcomes, completion of tasks, or delivery of outputs).

NOTE—The acquirer request for proposal may include the intended tailoring (or other adaptation) of the systems engineering requirements from this standard. The supplier may propose changes or alternatives during the steps to finalize the agreement.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEEE Std 15288.2™-2014, IEEE Standard for Technical Reviews and Audits on Defense Programs.[2]

ISO/IEC/IEEE 15288:2015(E), Systems and software engineering—System life cycle processes.[3]

SAE/EIA-649-1 (2014), Configuration Management Requirements for Defense Contracts.[4]

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause. [5]

allocated baseline: The approved requirements for a product, subsystem or component, describing the functional, performance, interoperability, and interface requirements that are allocated from higher-level requirements and the verifications required to demonstrate achievement of those requirements, as established at a specific point in time and documented in the allocated configuration documentation. (SAE/EIA-649-1).

baseline: **(A)** *noun:* A formally controlled and maintained set of data that serves as the basis for defining change. **(B)** *verb:* To establish and approve a set of data. (Adapted from SAE/EIA-649-1.)

NOTE—This standard uses the noun form of baseline to refer only to configuration baselines managed by the configuration management process, including the functional baseline, allocated baseline, and product baseline. It does not refer to other baselines used in DoD such as the acquisition program baseline.[6]

configuration item: Any system element or aggregation of system elements that satisfies an end use function and is designated by the acquirer for separate configuration control. (Adapted from SAE/EIA-649-1.)

functional baseline: Describes the system's performance (functional, interoperability, and interface characteristics) and the verification required to demonstrate the achievement of those specified characteristics. (SAE/EIA-649-1)

NOTE—The functional baseline is directly traceable to the operational requirements contained in the initial capabilities document or equivalent document.

product baseline: Describes the detailed design at a specific point in time, for production, fielding/deployment, and operations and support. (SAE/EIA-649-1)

[2] IEEE publications are available from The Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08854, USA (http://standards.ieee.org/).
[3] ISO/IEC publications are available from the ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland (http://www.iso.org/). ISO/IEC publications are available in the United States from the American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (http://www.ansi.org/).
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[5] *IEEE Standards Dictionary Online* subscription is available at: http://www.ieee.org/portal/innovate/products/standard/standards_dictionary.html.
[6] Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

NOTE 1—The product baseline prescribes all necessary physical (form, fit, or function) characteristics and selected functional characteristics designated for production acceptance testing and production test requirements.

NOTE 2—The product baseline is also known as the product configuration baseline. It is intended as the production configuration.

system effectiveness analysis: An analytical approach used to determine how well a system performs in its intended utilization environment.

3.2 Acronyms and abbreviations

The following acronyms and abbreviations appear in this standard:

CAPE	cost assessment and program evaluation
CDR	critical design review
CDRL	contract data requirements list
CI	configuration item
CM	configuration management
CWBS	contract work breakdown structure
DEMIL	demilitarization
DIA	Defense Intelligence Agency
DISR	DoD Information Technology Standards Registry
DoD	Department of Defense
DoDAF	DoD architecture framework
DT&E	developmental test and evaluation
ECP	engineering change proposal
ECR	engineering change request
ESOH	environment, safety, and occupational health
EVM	earned value management
FMECA	failure mode, effects, and criticality analysis
GFE	government-furnished equipment
GFI	government-furnished information
IMP	integrated master plan
IMS	integrated master schedule
IOT&E	initial operational test and evaluation
JCIDS	Joint Capabilities Integration and Development System
LCSP	life cycle sustainment plan
NDI	non-development item
OpsCon	operational concept
PDR	preliminary design review
PSA	product support analysis
SEMP	systems engineering management plan
SEP	systems engineering plan
SIP	system integration plan

SOO	statement of objectives
SoS	system of systems
SOW	statement of work
TPM	technical performance measures
US	United States
WBS	work breakdown structure

4. This clause is a placeholder to align clauses with ISO/IEC/IEEE 15288

5. Key concepts and application of this international standard

5.1 Introduction

ISO/IEC/IEEE 15288:2015 5.1 “Introduction” applies as stated.

5.2 System concepts

5.2.1 Systems

ISO/IEC/IEEE 15288:2015 5.2.1 “Systems” applies as stated.

5.2.2 System structure

ISO/IEC/IEEE 15288:2015 5.2.2 “System structure” applies as stated.

5.2.3 Enabling systems

ISO/IEC/IEEE 15288:2015 5.2.3 “Enabling systems” applies as stated.

5.3 Organization and project concepts

5.3.1 Organizations

ISO/IEC/IEEE 15288:2015 5.3.1 “Organizations” applies as stated.

5.3.2 Organization and project-level adoption

ISO/IEC/IEEE 15288:2015 5.3.2 “Organization and project-level adoption” applies as stated.

5.4 Life cycle concepts

5.4.1 System Life Cycle Model

ISO/IEC/IEEE 15288:2015 5.4.1 “System Life Cycle Model” applies as stated.

NOTE—For use in US DoD programs, see *Operation of the Defense Acquisition System* (DoDI 5000.02) [B4][7] for a discussion of the DoD System Life Cycle Model. For use on other defense programs, refer to the applicable life cycle model of the acquisition organization.

5.4.2 System life cycle stages

ISO/IEC/IEEE 15288:2015 5.4.2 “System life cycle stages” applies as stated.

NOTE—For use in US DoD programs, see *Operation of the Defense Acquisition System* (DoDI 5000.02) [B4] for a discussion of the DoD system life cycle stages. For use on other defense programs, refer to the applicable life cycle model of the acquisition organization.

5.5 Process concepts

5.5.1 Criteria for processes

ISO/IEC/IEEE 15288:2015 5.5.1 “Criteria for processes” applies as stated.

5.5.2 Description of processes

ISO/IEC/IEEE 15288:2015 5.5.2 “Description of processes” applies as stated with the following addition:

For the DoD application, each process includes systems engineering outputs with attributes.

5.5.3 General characteristics of processes

ISO/IEC/IEEE 15288:2015 5.5.3 “General characteristics of processes” applies as stated.

5.5.4 Tailoring

ISO/IEC/IEEE 15288:2015 5.5.4 “Tailoring” applies as stated.

5.6 Processes in this standard

5.6.1 Introduction

ISO/IEC/IEEE 15288:2015 5.6.1 “Introduction” applies as stated.

[7] The numbers in brackets correspond to those of the bibliography in Annex H.

5.6.2 Agreement processes

ISO/IEC/IEEE 15288:2015 5.6.2 “Agreement processes” applies as stated.

5.6.3 Organizational project-enabling processes

ISO/IEC/IEEE 15288:2015 5.6.3 “Organizational project-enabling processes” applies as stated.

5.6.4 Technical management processes

ISO/IEC/IEEE 15288:2015 5.6.4 "Technical management processes" applies as stated.

5.6.5 Technical processes

ISO/IEC/IEEE 15288:2015 5.6.5 “Technical processes” applies as stated.

5.7 Process application

ISO/IEC/IEEE 15288:2015 5.7 “Process application” applies as stated with the following addition:

Project Planning, System Analysis, and Project Assessment and Control are key systems engineering processes, with emphasis on their contribution to enabling technical decision making. These processes coordinate and control the performance of the other processes across the life cycle for the systems engineering application. This set of process applications:

- Identifies the work to be performed and develops schedules and costs estimates for the effort.
- Coordinates the other process activities and helps ensure that all are operating from the same set of agreements and system definition iteration.
- Evaluates the outputs of the other activities and conducts independent studies to determine which alternate approach is best suited to the application.
- Determines when results of one activity require the action of another activity and directs the action to be performed.
- Documents the results of analyses and studies, maintains control of the evolving configuration, and measures and reports progress.

The success of any project or program is dependent upon the systems engineering planning and control of the project and its processes. Project Planning not only contributes to planning the work to be performed and the schedule for the effort, it is used to plan how all the other technical and technical management processes will be employed throughout the system life cycle. Planning and control of the systems engineering processes includes all of the other technical management processes.

The systems engineering control function is dependent upon the analyses (requirements analysis, tradeoff studies, or design analysis) of the data and information upon which to base decisions. These analyses, conducted for each iteration of the systems engineering processes, are performed to support any of the Technical Management processes (5.3) and the Technical processes (5.4) that require the analytical data to support decisions. Also, note that performance of the processes focused on concept and system definition

require input from processes that focus on system realization, deployment, and use. All this needs to be accomplished across the life cycle. Figure 1 illustrates the interrelationships among these clauses.

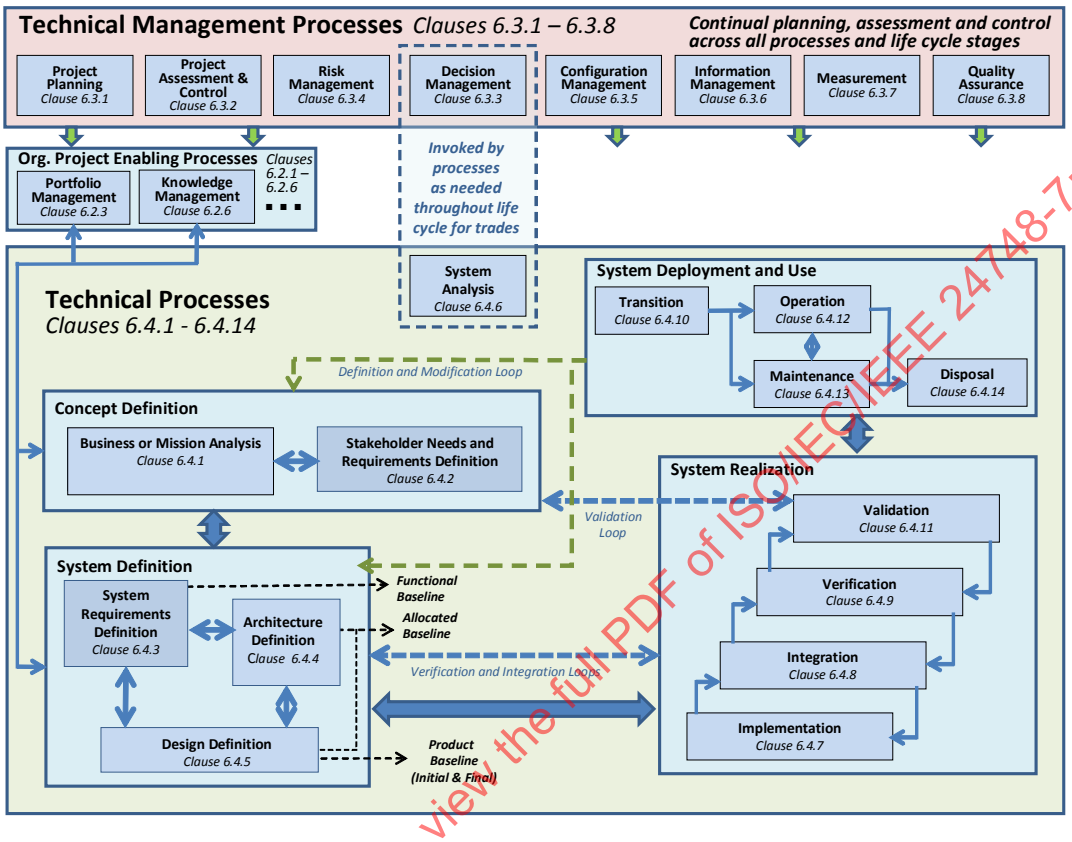

Figure 1—Systems engineering planning, assessment, and control interfaces with the systems engineering technical activities

5.8 Process reference model

ISO/IEC/IEEE 15288:2015 5.8 “Process reference model” applies as stated.

6. System life cycle processes

6.1 Agreement processes

The Agreement processes description from ISO/IEC/IEEE 15288:2015 applies as stated with the following additions:

NOTE—The acquirer-supplier agreement developed by the Agreement processes can take on a much broader scope and significance in a DoD government/contractor environment. This agreement, often a negotiated and signed contract for the full system or product of interest, provides much of the context for implementation and governance of the other processes defined throughout this standard.

Figure 2 illustrates the application of Agreement processes at the Product, System, and System Element levels.

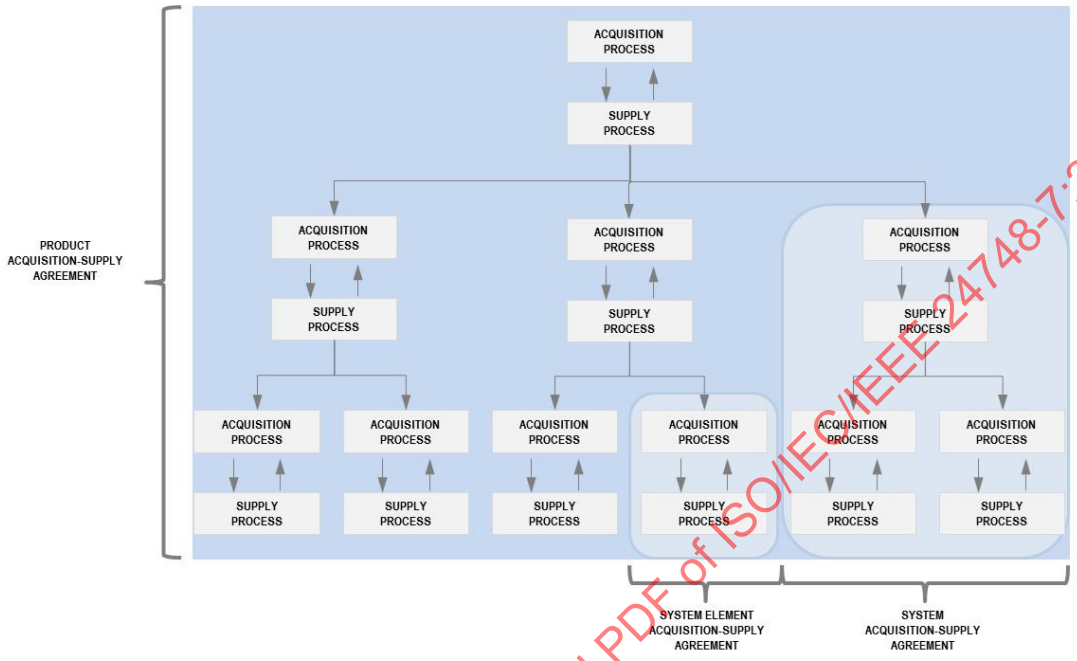

Figure 2—Application of the Agreement processes at Product, System, and System Element levels

6.1.1 Acquisition process

6.1.1.1 Purpose

ISO/IEC/IEEE 15288:2015 6.1.1.1 “Purpose” applies as stated.

6.1.1.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.1.1.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.1.1.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.1.1.3 “Activities and Tasks” shall apply.

6.1.1.4 Acquisition process outputs

One or more of the following Acquisition process outputs shall be provided in accordance with the acquirer-supplier agreement:

- Request for Proposal
- Contract, including any special contract requirements

  NOTE—Includes statement of objectives (SOO), statement of work (SOW), and contract data requirements list (CDRL) for US DoD acquisition, or similar information for other defense agencies based on their organizational-specific acquisition life cycle model, processes, regulations, and requirements.
- Contract modifications, approved engineering change proposals (ECPs), approved engineering change requests (ECRs) to modify the acquirer-supplier agreement

6.1.2 Supply process

6.1.2.1 Purpose

ISO/IEC/IEEE 15288:2015 6.1.2.1 “Purpose” applies as stated.

6.1.2.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.1.2.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.1.2.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.1.2.3 “Activities and Tasks” shall apply.

6.1.2.4 Supply process outputs

One or more of the following Supply process outputs shall be provided in accordance with the acquirer-supplier agreement:

- Contract
- Contract modifications, ECPs/ECRs to modify the acquirer-supplier agreement
- Other deliverables per CDRL or equivalent contract requirements list

6.2 Organizational Project-Enabling processes

The Organizational Project-Enabling processes description from ISO/IEC/IEEE 15288:2015 applies as stated.

6.2.1 Life Cycle Model Management process

6.2.1.1 Purpose

ISO/IEC/IEEE 15288:2015 6.2.1.1 “Purpose” applies as stated.

6.2.1.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.2.1.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.2.1.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.2.1.3 “Activities and Tasks” shall apply.

6.2.1.4 Life Cycle Model Management process outputs

The following Life Cycle Model Management process outputs shall be provided in accordance with the acquirer-supplier agreement:

— None (outside scope of single contract)

NOTE—Project-specific outputs are provided in the Systems Engineering Management Plan (SEMP)—see 6.3.1.4.

6.2.2 Infrastructure Management process

6.2.2.1 Purpose

ISO/IEC/IEEE 15288:2015 6.2.2.1 “Purpose” applies as stated.

6.2.2.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.2.2.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.2.2.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.2.2.3 “Activities and Tasks” shall apply.

6.2.2.4 Infrastructure Management process outputs

The following Infrastructure Management process outputs shall be provided in accordance with the acquirer-supplier agreement:

— None (outside scope of single contract)

NOTE—Project-specific outputs would be provided in the SEMP—see 6.3.1.4.

6.2.3 Portfolio Management process

6.2.3.1 Purpose

ISO/IEC/IEEE 15288:2015 6.2.3.1 “Purpose” applies as stated.

6.2.3.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.2.3.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement with the following addition:

NOTE—Business ventures, opportunities, or investments in the DoD context refer to acquisition programs, hence to be referred to as “projects.”

6.2.3.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.2.3.3 “Activities and Tasks” shall apply.

6.2.3.4 Portfolio Management process outputs

The following Portfolio Management process outputs shall be provided in accordance with the acquirer-supplier agreement:

— None (outside scope of single contract)

NOTE—Project-specific outputs would be provided in the SEMP—see 6.3.1.4.

6.2.4 Human Resource Management process

6.2.4.1 Purpose

ISO/IEC/IEEE 15288:2015 6.2.4.1 “Purpose” applies as stated.

6.2.4.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.2.4.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.2.4.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.2.4.3 “Activities and Tasks” shall apply.

6.2.4.4 Human Resource Management process outputs

The following Human Resource Management process outputs shall be provided in accordance with the acquirer-supplier agreement:

— None (outside scope of single contract)

NOTE—Project-specific outputs would be provided in the SEMP or the project staffing plan—see 6.3.1.4.

6.2.5 Quality Management process

6.2.5.1 Purpose

ISO/IEC/IEEE 15288:2015 6.2.5.1 "Purpose" applies as stated with the following addition:

NOTE—The Quality Management process focuses on the organization and the collective set of project objectives.

6.2.5.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.2.5.2 "Outcomes" shall apply in accordance with the acquirer-supplier agreement.

6.2.5.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.2.5.3 "Activities and Tasks" shall apply.

6.2.5.4 Quality Management process outputs

The following Quality Management process outputs shall be provided in accordance with the acquirer-supplier agreement:

— None. See outputs from quality assurance—6.3.8.4.

6.2.6 Knowledge Management process

6.2.6.1 Purpose

ISO/IEC/IEEE 15288:2015 6.2.6.1 "Purpose" applies as stated.

6.2.6.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.2.6.2 "Outcomes" shall apply in accordance with the acquirer-supplier agreement.

6.2.6.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.2.6.3 "Activities and Tasks" shall apply.

6.2.6.4 Knowledge Management process outputs

The following Knowledge Management process outputs shall be provided in accordance with the acquirer-supplier agreement:

— None (outside scope of single contract)

NOTE—Project-specific outputs would be provided in the SEMP—see 5.3.1.4.

6.3 Technical Management processes

The Technical Management processes description from ISO/IEC/IEEE 15288:2015 applies as stated.

6.3.1 Project planning process

6.3.1.1 Purpose

ISO/IEC/IEEE 15288:2015 6.3.1.1 “Purpose” applies as stated.

6.3.1.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.3.1.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.3.1.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.3.1.3 “Activities and Tasks” shall apply with the following addition:

— Add to Activity b) **Plan project and technical management**, Task 7):

NOTE—Planning and execution of the engineering efforts are conducted by the supplier as directed by the statement of work or other contractual agreements following the guidance in the acquirer’s systems engineering plan (SEP).

6.3.1.4 Project Planning process outputs

The following Project Planning process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) SEMP aligned with the acquirer’s SEP with the following attributes:

1) Identifies the technical assessment and control of the project, including required technical reviews and audits and their completion criteria, technical measurement, quality assurance, baseline management, and change control.

2) Provides a description, or reference to, the life cycle model and systems engineering processes or process model description for the technical effort, including an overview of the methods, tools, and techniques which are applicable across the project.

3) Identifies any specific infrastructure needs to support the technical effort.

4) Describes or points to the WBS, project schedule, project budget, and personnel resources.

5) Identifies any project constraints that may limit or restrict the project or system solution.

6) Identifies supporting plans.

NOTE 1—The SEP is an output of the Planning process from the acquirer. It would be referred to in the Acquisition process documentation.

NOTE 2—The SEMP is the supplier's overarching plan for managing technical work.

b) Contract work breakdown structure (CWBS) with the following attributes:

1) Is consistent with the physical architecture as it is developed.

2) Is maintained and applied to plan and monitor work carried out under the project.

c) The integrated master plan (IMP), integrated master schedule (IMS), earned value management (EVM) planning, and other specific planning as needed with the following attributes:

1) Provide the cost and schedule baseline for management control and technical execution.

2) Include reviews and checkpoints for decision-making.

3) Establish a consistent management framework with provision for the transfer of unresolved or incomplete requirements to the Risk Management process (see 5.3.4).

6.3.2 Project Assessment and Control process

6.3.2.1 Purpose

ISO/IEC/IEEE 15288:2015 6.3.2.1 "Purpose" applies as stated.

6.3.2.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.3.2.2 "Outcomes" shall apply in accordance with the acquirer-supplier agreement.

6.3.2.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.3.2.3 "Activities and Tasks" shall apply with the following additions:

— Add to Activity b) **Assess the project,** Task 6):

NOTE—Includes the conduct of progress assessment at all major milestones and design process iterations that examine system effectiveness, life cycle costs, schedule, risk, and evolutionary growth potential.

— Add to Activity b) **Assess the project**, Task 7):

NOTE—For conduct of technical reviews and audits, see IEEE Std 15288.2-2015.

6.3.2.4 Project Assessment and Control process outputs

The following Project Assessment and Control process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) Documented process for assessing system effectiveness, life cycle cost, schedule, and risk with the following attributes:

1) Integrates the system effectiveness/cost effectiveness/hazard/risk analysis and assessment tasks into the systems engineering processes to support development of life cycle balanced products

NOTE—Achieving a balanced solution is accomplished by collectively assessing key parameters, such as cost, schedule, performance, and risk, to select the best alternative.

2) Identifies the following for each assessment to be performed:

i) The tools, source data, assumptions, methodology, and development tools/environments used; and standards to be followed.

ii) Quantified objectives and goals.

iii) Measurements, measurement objectives, and analyses activities and how they correlate with required capabilities, system technical requirements, and constraints.

iv) The elements of performance, cost, schedule, and risk, including hazard and compliance risks, that could be affected by the factors considered in each tradeoff required by the physical solution selection.

NOTE—Process may be included in a measurement plan.

b) Variance reports and corrective actions.

6.3.3 Decision Management process

6.3.3.1 Purpose

ISO/IEC/IEEE 15288:2015 6.3.3.1 “Purpose” applies as stated with the following addition:

NOTE—The Decision Management process is applicable across the acquisition program life cycle to support reasoned decision-making in a variety of contexts. Examples include the following:

— Analysis of Alternatives (AoA)
— Material development or “Make vs. Buy” decisions
— Competitive prototyping and experimentation
— Milestone decisions
— Modeling and simulation of relevant product and project attributes, characteristics, or parameters

— Performance trades
— Life cycle sustainment strategies

6.3.3.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.3.3.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.3.3.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.3.3.3 “Activities and Tasks” shall apply.

6.3.3.4 Decision Management process outputs

The following Decision Management process outputs shall be provided in accordance with the acquirer-supplier agreement:

NOTE—Outputs of this process could occur outside of the acquirer-supplier agreement with respect to internal decision-making in the program.

a) A Decision Management strategy with the following attributes:

   1) Provides a description of the decision analysis approach to be employed for given decision situations. Includes measurable selection criteria, weighting factors, desired outcome, and threshold values for selection.

   2) Includes the decision schedule, decision authorities, budget, and resource needs (people, process, tools, and data).

b) A Recommended Course of Action with the following attributes:

   1) Is supported by effective trade space analysis with objective and traceable rationale.

   2) Identifies alternatives analyzed.

   3) Identifies advantages and disadvantages, and any opportunities or risks associated with the recommendation.

c) Documented and implemented decisions with the following attributes:

   1) Are recorded for each iteration and each design selection toward achieving the baseline attributes.

   2) Are explicitly related to the tradeoffs and assessments conducted or other objective analyses or monitoring data.

   3) Are captured in terms of proposed baselines or functional architecture or updates or changes thereto, corrective action plans, or updates to the plans and monitoring devices.

6.3.4 Risk Management process

6.3.4.1 Purpose

ISO/IEC/IEEE 15288:2015 6.3.4.1 “Purpose” applies as stated with the following addition:

Risk is a measure of future uncertainties that have negative consequences when achieving program performance goals and objectives within defined cost, schedule, and performance constraints. Risk management should address risk identification, analysis, mitigation planning and implementation, and tracking. Risks should be quantified and implications reflected in the program’s IMS and IMP.

Opportunity is a measure of future uncertainties that have positive consequences. The purpose of opportunity management is to improve cost, schedule, and performance outcomes for the program (e.g., reducing actual program costs below baseline target).

NOTE 1— For additional guidance in DoD application, see *Risk Management Guide for DoD Acquisition* [B8].

NOTE 2—Program risks, and opportunities as applicable, are assessed at technical reviews and include specific cost and schedule implications.

6.3.4.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.3.4.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.3.4.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.3.4.3 “Activities and Tasks” shall apply.

6.3.4.4 Risk Management process outputs

The following Risk Management process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) The Risk Management Plan with the following attributes:

   1) Specifies a process for risk and opportunity identification (including all associated assumptions), analysis, assessment, mitigation, monitoring, and documentation associated with system requirements throughout the system life cycle.
   2) Includes identifying all types of risks that could impact the program or technical solution such as products, processes (e.g., process variability), changes to or challenges in meeting critical technical parameters, technology maturity, affordability, hazard exposures, and other sources of program, schedule, and technical risk.
   3) Includes program risk assessment, which analyzes and ranks risks using a defined risk rating scheme in terms of the likelihood of occurrence and the severity of impact on life cycle costs, schedule, performance, or hazard.

NOTE—An opportunity management plan may be part of the Risk Management Plan. However, a supplier may have a separate process for Opportunity Management. In either case, the process needs to be defined in the acquirer-supplier agreement and include many of the attributes identified previously.

6.3.5 Configuration Management process

6.3.5.1 Purpose

ISO/IEC/IEEE 15288:2015 6.3.5.1 “Purpose” applies as stated with the following addition:

Configuration Management (CM) is the process for establishing and maintaining consistency of a system’s functional, performance, and physical attributes with its requirements, design, and operational information throughout the system’s life cycle.

NOTE—Additional guidance and information can be found in ANSI/EIA-649-B-2011 [B1] and SAE/EIA-649-1.

6.3.5.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.3.5.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.3.5.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.3.5.3 “Activities and Tasks” shall be accomplished for DoD applications as modified by SAE/EIA-649-1 and specified in the acquirer-supplier agreement.

6.3.5.4 Configuration Management process outputs

The following Configuration Management process outputs shall be provided in accordance with the acquirer-supplier agreement.

6.3.5.4.1 General outputs

The general outputs are as follows:

a) A Configuration Management Plan with the following attributes:

1) Is based on a current and active government or industry standard such as SAE/EIA-649-1 or other as specified by contract.

2) Provides configuration management planning for the program and manages the implementation of that planning.

3) Addresses configuration identification, which includes establishment of a structure for products and product configuration (e.g., hierarchy of system elements).

4) Addresses configuration change control, which helps ensure that changes to a configuration baseline are properly identified, recorded, evaluated, approved or disapproved, and incorporated and verified, as appropriate.

5) Addresses configuration status accounting, which manages the capture and maintenance of product configuration information necessary to account for the configuration of a product throughout the product life cycle.

6) Addresses planned configuration audits across the life cycle.

b) Assessments of change control implementation with the following attributes:

1) Includes the decisions and change control actions to develop the baselines.

2) Includes configuration control, including the systematic proposal, justification, evaluation, coordination, approval, or disapproval of all proposed changes to the baselines.

c) Assessments of proposed changes to a baseline to determine the following:

1) The corresponding impacts to the other baselines.

2) The impacts to the system effectiveness and potential for growth in relation to the functional baseline or the needed capability and in relation to both total program and instant contract cost, schedule, and risk.

d) Configuration Change Management records with the following attributes:

1) Includes requests for change or variance associated with a given CM product.

2) Evaluates the supporting rationale for either approving or rejecting a change.

3) Documents all approvals and agreements associated with the disposition of the request.

4) Archives all requests within the established CM management system.

e) Configuration Item Status Accounting records with the following attribute:

1) Includes configuration audit and evaluation results.

6.3.5.4.2 Baselines

Baselines are as follows:

NOTE—Data that comprises the baselines is provided from the Technical processes.

a) Functional baseline with the following attributes:

1) Describes the functional, performance, interoperability and interface requirements.

2) Describes the verifications required to demonstrate achievement of those requirements.

3) Identifies any specialized software and documents the operating environment used to author the above requirements.

b) Allocated baseline with the following attributes:

1) Describes the functional, performance, and interoperability requirements that are allocated from those of a system or higher level configuration item; and interface requirements with interfacing configuration items.

2) Describes the verifications required to demonstrate achievement of those requirements.

3) Identifies any specialized software and documents the operating environment used to author the above requirements.

c) Product baseline with the following attributes:

1) Describes its detailed design, including necessary physical (form, fit and function) characteristics and selected functional characteristics designated for production, acceptance testing, and production test requirements.

2) Identifies the verifications necessary for accepting product deliveries (first article and acceptance instructions).

3) Identifies and documents the design of any special tooling, software, equipment and facilities required to manufacture, operate, maintain, calibrate, or inspect items contained in the design.

4) Identifies and documents the design of any special packaging parts required to package the CI.

5) Includes any quality assurance provisions required to accept deliveries of the CI (first article or acceptance inspection).

6) Includes any unique process specifications required to manufacture, operate, maintain, or calibrate items contained in the design.

7) Identifies any specialized software and documents the operating environment used to author the detailed design.

8) Includes technical data that provides instructions for the installation, operation, maintenance, training, and support of a system or equipment.

6.3.6 Information Management process

6.3.6.1 Purpose

ISO/IEC/IEEE 15288:2015 6.3.6.1 “Purpose” applies as stated.

6.3.6.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.3.6.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.3.6.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.3.6.3 “Activities and Tasks” shall apply with the following addition:

— Add to Activity b) **Perform information management**, Task 2):

NOTE—The use of digital environments to store and distribute information is encouraged; consider during planning and execution.

6.3.6.4 Information Management process outputs

The following Information Management process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) Information Management products with the following attributes:

1) Captures and organizes data inputs as well as current, past revisions, and final product outputs.

NOTE—The acquirer normally outlines the technical data management approach in the Intellectual Property Strategy.

2) Are under configuration control per the configuration management process.

3) Provides reference and support information as a basis for the systems engineering effort.

4) Includes a required distribution statement, restrictive markings, and restrictions on use, release, or disclosure as applicable.

6.3.7 Measurement process

6.3.7.1 Purpose

ISO/IEC/IEEE 15288:2015 6.3.7.1 “Purpose” applies as stated with the following addition:

Within DoD, the measurement process also functions as a quantitative management tool for monitoring the planned and actual achievement of cost, schedule, risk, and technical performance. It facilitates the continuing verification of anticipated and actual achievement of technical parameters.

6.3.7.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.3.7.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.3.7.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.3.7.3 “Activities and Tasks” shall apply.

6.3.7.4 Measurement process outputs

The following Measurement process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) Measurement information items including measures, analysis results, and initial recommendations.

NOTE—These measures may include status of system effectiveness, schedule, life cycle cost, quality, or risk (to include the status of the risks on the watch list), including progress against the plans.

b) Measures and select technical parameters for tracking that are critical indicators of technical progress and achievement and include system parameters, CI parameters, or both.

c) Measurement data with the following attributes:

1) Provides data on established technical performance measures (TPM) for use in project assessment and control to support the assessment of the system technical performance, and for an assessment of risk in achieving the measures of effectiveness or measures of performance and associated operational requirements.

NOTE—TPMs are a subset of measures that evaluate technical progress (i.e., product maturity) and support evidence-based decisions at key decision points such as technical reviews or milestone decisions.

2) Provides technical project measurement data for use in project assessment and control to support the assessment of technical progress toward fulfilling system requirements.

6.3.8 Quality Assurance process

6.3.8.1 Purpose

ISO/IEC/IEEE 15288:2015 6.3.8.1 “Purpose” applies as stated with the following addition:

NOTE—Quality Assurance is one aspect of Mission Assurance. All aspects of Mission Assurance should be considered throughout all of the Systems Engineering processes.

6.3.8.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.3.8.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.3.8.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.3.8.3 “Activities and Tasks” shall apply with the following additions:

— Add the following task to Activity a) **Prepare for quality assurance:**

1) Confirm that supplier quality assurance requirements are defined and adequate.

— Add the following task to Activity b) **Perform product or service evaluations:**

1) Confirm verification of supplier quality assurance program.

6.3.8.4 Quality Assurance process outputs

The following Quality Assurance process outputs shall be provided in accordance with the acquirer-supplier agreement:

— Quality assurance plans and schedules
— Quality evaluation reports
— Quality assurance records and reports
— Incident records and reports

6.4 Technical processes

The Technical processes description from ISO/IEC/IEEE 15288:2015 applies as stated with the following additions:

NOTE—The results of systems engineering Technical process activities are captured and stored by the supplier, including product support analysis results, assessments, trade studies, and verifications, in accordance with the acquirer-supplier agreement. This includes decisions and the rationale for those decisions so that they can be reviewed throughout the life of the program. These artifacts will be maintained in the supplier's format and made available to support the system throughout its lifecycle. The Technical process activities to be captured are documented in the SEMP.

6.4.1 Business or Mission Analysis process

6.4.1.1 Purpose

ISO/IEC/IEEE 15288:2015 6.4.1.1 "Purpose" applies as stated with the following addition:

NOTE—The Business or Mission Analysis process includes the identification and characterization of a materiel need, or the identification of a problem, need or gap described in the Business Capability Phase. It also includes the analysis of alternatives, and the selection of a preferred materiel solution. Although primarily a government function, contracted support may be used for analysis or development of the output products described in 5.4.1.4. For US DoD programs, this is described in the Joint Capabilities Integration and Development System (JCIDS) CJCSI 3170.01 [B2]. For other defense programs, refer to applicable local guidance and authorities.

6.4.1.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.4.1.2 "Outcomes" shall apply in accordance with the acquirer-supplier agreement.

6.4.1.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.4.1.3 "Activities and Tasks" shall apply with the following addition:

— Add to Activity b) **Define the problem or opportunity space**, Task 2):

NOTE—Unique military operational requirements dictate the use of specialty engineering services. These needs are revealed by analysis of the enemy capabilities using scenarios and threat assessments. These will be dependent on the branch of service and technologies involved. See Annex E for an example application.

6.4.1.4 Business or Mission Analysis process outputs

The following Business or Mission Analysis process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) Identification of quantifiable need statements.

b) The appropriate "as is" and "to be" architecture descriptions describing the business or mission point of view, including both dynamic and static views.

c) Capability gap analysis.

d) Threat definition.
NOTE—For US DoD programs, this is based on and referenced to Defense Intelligence Agency (DIA) or Service Technical Intelligence Center approved documents.

e) Identification of alternative materiel approaches and trade analyses and, for the selected materiel approach(es), alternative operational and system concepts that could fill capability gaps and that offer potential for further refinement and subsequent development.

f) Operational scenarios for the operational and system concepts under consideration to fill the capability gaps.

g) Assessment of the relationship between capabilities and evolutionary growth in capabilities versus the life cycle cost, schedule, and risk for the materiel approaches or system concepts that could provide the capabilities to identify any capabilities that drive cost, schedule, or risk.

h) Definition of technology maturation and other risk mitigation steps for potential future action toward the development of promising system concepts.

i) Sustainment strategies for the selected alternative solutions.

6.4.2 Stakeholder Needs and Requirements Definition process

6.4.2.1 Purpose

ISO/IEC/IEEE 15288:2015 6.4.2.1 “Purpose” applies as stated with the following addition:

NOTE—The Stakeholder Needs and Requirements Definition bridges the gap between the identification of a materiel need. Although primarily a government function, contracted support may be used for analysis or development of the output products described in 5.4.2.4. For US DoD programs, this is described in the JCIDS CJCSI 3170.01 [B2] and the acquisition of a materiel solution is governed by the Defense Acquisition System, i.e., DoDD 5000.01 [B3] and DoDI 5000.02 [B4]. For other defense programs, refer to applicable local guidance and authorities.

6.4.2.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.4.2.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement with the following addition:

NOTE—Constraints (Outcome ‘c’) include affordability constraints or design constraints such as use of non-developmental or reusable items and constraints pertaining to development, production, test, deployment/installation, training, support/maintenance, and disposal.

6.4.2.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.4.2.3 “Activities and Tasks” shall apply.

6.4.2.4 Stakeholder Needs and Requirements Definition process outputs

The following Stakeholder Needs and Requirements Definition process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) List of stakeholders.

b) Defined set of user and other stakeholder requirements, appropriate to system maturity.

c) The operational scenarios and operational concept (OpsCon) for the operational and system concepts under consideration to fill the capability gaps.

6.4.3 System Requirements Definition process

6.4.3.1 Purpose

ISO/IEC/IEEE 15288:2015 6.4.3.1 “Purpose” applies as stated.

6.4.3.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.4.3.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement with the following additions:

NOTE 1—The outcomes of the System Requirements Definition process form the basis for the functional baseline and support the development of the allocated baseline as defined in the Configuration Management process (5.3.5).

NOTE 2—The System Requirements Definition process should include incorporation of DoD design considerations including statutory and regulatory constraints. See the *Defense Acquisition Guidebook*, Chapter 4 [B5], for a list of the minimum design considerations that should be examined for relevancy.

NOTE 3—The System Requirements Definition process often requires analyses and trades to deliver a balanced solution. The System Analysis Process and Decision Management process facilitate these analyses and trades.

6.4.3.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.4.3.3 “Activities and Tasks” shall apply with the following additions:

NOTE—The System Requirements Definition process is an iterative activity whereby system requirements are defined, refined, analyzed, traded, and managed to remove deficiencies and minimize impacts of potential cost drivers to establish an agreed-to set of requirements coordinated with the appropriate stakeholders. For a more detailed discussion, see 5.7 in ISO/IEC/IEEE 15288.

— Add to Activity d) **Manage system requirements**:

NOTE—This activity supports the configuration identification activities in Configuration Management process (5.3.5) including definition of the functional baseline and continuing throughout the development process to also support the definition of the allocated baseline.

— Add to Activity d) **Manage system requirements**, Task 2):

NOTE—Consideration should be given to adopting a requirements management system supported by tools that will assist in accomplishing the activities and tasks and facilitate the sharing of requirements data.

6.4.3.4 System Requirements Definition process outputs

The following System Requirements Definition process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) A set of system requirements with the following attributes:

1) Includes supporting rationale for requirement statements determined from the requirements analysis, functional analysis, and design trades results.

2) Includes verification method (e.g., analysis, inspection/examination, demonstration, or test) associated with each requirement.

3) Provides traceability to the operator/user capabilities for which the system is being designed and to the missions for which it is intended.

4) Includes analyses of each lower-level requirement to help ensure that it meets defined characteristics of good requirements.

5) Includes analyses of lower-level requirements to help ensure they satisfy the higher-level capabilities, requirements, or constraints from which they resulted.

6) Documents system interoperability needs, including any internal or external interface constraints identified in the approved concept documents and the operational and system architecture views.

7) Includes all functional, non-functional, interface, and performance requirements and constraints and those imposed by each specialty function.

NOTE—Constraints include external and internal interfaces; operating, launch, transportation, and storage environments; and design considerations. Constraints can come from any interoperating system, enabling system, operating environment, or other limitations from the acquirer.

8) Documents decision trade studies (tradeoffs) that balance system effectiveness, affordability concerns, supportability, life cycle cost, schedule, risk, and evolutionary growth potential issues inclusive of obsolescence risk.

9) Assesses through review and documented agreement/approval to help ensure the following:

i) Compliance with the above attributes.

ii) A balanced solution including system effectiveness, life cycle cost, schedule, risk, and the potential for evolutionary growth and risk of obsolescence.

b) Requirements Traceability Mapping with the following attributes:

1) Includes full bi-directional traceability between the requirements source and the system requirements down to their lowest level.

2) Maintains traceability such that changes to any requirement, capability, system, software, or physical element are identified and updated for each applicable item.

6.4.4 Architecture Definition process

6.4.4.1 Purpose

ISO/IEC/IEEE 15288:2015 6.4.4.1 “Purpose” applies as stated with the following modification:

Iteration of the Architecture Definition process with the Business or Mission Analysis process, System Requirements Definition process, and the Stakeholder Needs and Requirements Definition is often

employed to converge on a balanced solution. A balanced solution is determined by considering cost, schedule, performance, and risk within affordability constraints.

NOTE—The Architecture Definition process often requires analyses and trades to converge on a balanced solution. The System Analysis Process and Decision Management process facilitate these analyses and trades.

6.4.4.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.4.4.2 "Outcomes" shall apply in accordance with the acquirer-supplier agreement with the following additions:

a) Functional (logical) architecture is defined.

b) Physical architecture is defined.

6.4.4.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.4.4.3 "Activities and Tasks" shall apply with the following additions:

Add the following tasks for DoD:

— Add the following tasks to Activity c) **Develop models and views of candidate architectures**:

1) Develop the Functional (Logical) Architecture view/model. Perform functional (logical) analyses, allocations/assignments, and verification iteratively based on tradeoffs to develop a functional architecture or logical representation of the system.

NOTE—Non-developmental item (NDI) elements that impose functional constraints on the architecture need to be defined as part of the functional (logical) architecture view.

2) Develop the physical hierarchy/architecture view/model.

— Add the following task to Activity e) **Assess architecture candidates**:

1) Assess each candidate architecture against critical quality characteristics and performance parameters (including system resilience) to help avoid mission critical failures.

— Add the following note to Activity f) **Manage the selected architecture:**

NOTE— Consideration is often given to adopting a UPDM modeling environment supported by tools that can assist in accomplishing the activities and tasks and facilitate the sharing of architectural data.

6.4.4.4 Architecture Definition Process outputs

The following Architecture Definition Process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) Architectural models or views with the following attributes:

1) Represent the system and its integration to achieve the operational capability requirements and to support engineering trades and analyses.

2) Trace to the capabilities for which the system is being designed and to the missions for which it is intended.

NOTE—Traceability among mission, capability, and architecture characteristics is to be maintained.

3) Include necessary architecture products such as those defined in the DoD Architecture Framework (DoDAF).

NOTE—The DoDAF is an approach to architecture development and architecture products within the DoD.[8]

4) Include appropriate approved standards.

NOTE—For US DoD programs, this is contained in the current approved version provided by the DoD Information Technology Standards Registry (DISR).

5) Provide an integrated architecture for interoperability that extends and is consistent with any architectural views/models provided by the acquirer (or otherwise identified by the supplier and sanctioned in writing by the acquirer).

b) Functional (logical) architecture view/model, with the following attributes:

1) Includes the minimum or threshold required operational capabilities consistent with concepts of operation, system behavior, and required functionality.

2) Accurately reflects the functional and performance requirements in the requirements set.

3) Models the system behavior to include, but not limited to, all sequencing, concurrency, and high level timing requirements.

4) Provides sufficient definition to form the basis for detailed and precise functions or logical elements and their allocated or derived performance/functional requirements at the next lower level.

5) Is decomposed to lower levels to the point that each architectural element can be related to elements of the physical hierarchy to form the allocated baseline, and the allocation of the system performance requirements and design constraints to the lower levels is complete.

6) Defines both the internal and external interfaces, and addresses the physical implementation, as well as the logical issues (e.g., data formats, data semantics) as they apply.

7) Includes documentation (i.e., trade studies) to support decisions for each decomposition, grouping, sequencing, timing, iteration, and concurrency that is chosen.

c) Physical hierarchy or architecture view/model with the following attributes:

1) Identifies physical interfaces and system elements.

2) Identifies critical attributes of physical design elements, including design budgets (e.g., weight, reliability).

3) Includes traceability to functional and performance requirements and design constraints for each element.

[8] See http://dodcio.defense.gov/TodayinCIO/DoDArchitectureFramework.aspx.

4) Includes all derived design to requirements and design constraints for each element.

d) Architecture Traceability Mapping with the following attributes:

1) Traces between each element of the system requirements and each element of the functional architecture, to include the mission functions and system requirements.

2) Traces to the allocated functional and physical elements from which the architectural elements are derived.

e) The design reference timeline with the following attribute:

1) Includes a timeline model or sequence model of functional requirements for each mission capability or phase.

6.4.5 Design Definition process

6.4.5.1 Purpose

ISO/IEC/IEEE 15288:2015 6.4.5.1 "Purpose" applies as stated with the following addition:

NOTE—The essence of this activity is to achieve a balanced and feasible design with acceptable risk, and that falls within the program design constraints including cost, schedule, and performance.

6.4.5.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.4.5.2 "Outcomes" shall apply in accordance with the acquirer-supplier agreement.

6.4.5.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.4.5.3 "Activities and Tasks" shall apply.

6.4.5.4 Design Definition process outputs

The following Design Definition process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) System design description.

b) Interface definition with the following attributes:

1) Includes physical interactions.

2) Identifies system boundaries.

3) Includes functional interactions.

4) Identifies interactions with systems or environments outside of system boundaries.

c) Allocated baseline as described in 5.3.5.4.2, baselines b).

d) Product baseline (initial) as described in 5.3.5.4.2, baselines c).

6.4.6 System Analysis process

6.4.6.1 Purpose

ISO/IEC/IEEE 15288:2015 6.4.6.1 "Purpose" applies as stated with the following addition:

NOTE—System Analysis includes the broad range of assessments, trades, and analyses performed over the entire life cycle of a system. System analyses are conducted as necessary to determine balanced technical solutions pertaining to system concepts, technologies, requirements, and designs of a system and its components.

6.4.6.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.4.6.2 "Outcomes" shall apply in accordance with the acquirer-supplier agreement.

6.4.6.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.4.6.3 "Activities and Tasks" shall apply.

6.4.6.4 System Analysis process outputs

The following System Analysis process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) Environment, safety, and occupational health (ESOH) analysis and impact assessment with the following attribute:

   1) Performs an analysis to determine the impact on and by each system product and process alternative.

b) ESOH-related tradeoffs and analyses with the following attributes:

   1) Adhere to all applicable statutes, regulatory requirements promulgated by federal, state, and local entities, hazard risk management standards, and to contractually designated hazardous material lists.

   2) Analyze factors such as mishap risk; hazard exposures; noise, air, and water pollution; quantities and types of hazardous materials used; hazardous waste disposal; and other defined ESOH requirements as applicable.

   3) Define and assesses methods to mitigate problems, hazards, risks, and impacts identified from this analysis.

   4) Include the results of these assessments into effectiveness analyses as well as system definition, design, and verifications.

5) Document analyses output appropriate to the acquisition phase and use in conjunction with cost and performance analyses outputs to support acquisition phase exit criteria.

6) Include ESOH-critical characteristics of people, product, and process solutions, and their risks included in risk management process.

NOTE—Tradeoffs and analyses should be linked to iterations of the systems engineering processes of which they are a part and to any decisions that they support or justify.

c) Failure mode, effects, and criticality analysis (FMECA) with the following attributes:

1) Lists mission critical failures that can cause loss of mission or inability to execute mission.

2) Includes fault analysis with potential flaw contributors for each mission critical failure.

d) Effectiveness analysis with the following attributes:

1) Supports identification of mission and performance objectives and requirements.

2) Supports the allocation of performance to functions.

3) Provides criteria for the selection of solution alternatives.

4) Provides analytic confirmation that designs satisfy user requirements.

5) Supports verification of people, product, and process solutions.

e) Requirements analysis with the following attributes:

1) Verifies requirement statements and requirement sets meet characteristics of good requirements.

NOTE—ISO/IEC/IEEE 29148:2011 [B7] provides a set of characteristics for good requirements.

2) Verifies two-way traceability between stakeholder and system requirements; system requirements and each element of the functional architecture; and each element of the functional architecture and the functional and physical elements of the system-level architectures.

f) Product support analysis (PSA) with the following attributes:

1) Defines supportability management, surveillance, and control plans.

2) Identifies supportability objectives.

3) Prepares and evaluates alternatives.

4) Determines product support resource requirements.

5) Assesses the suitability of the support system.

6) Collects and analyzes operational and maintenance data to improve the system design.

NOTE—See SAE TA STD 0017 [B9] for additional guidance on product support analysis.

g) Performance trade studies.

6.4.7 Implementation process

6.4.7.1 Purpose

ISO/IEC/IEEE 15288:2015 6.4.7.1 “Purpose” applies as stated.

6.4.7.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.4.7.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.4.7.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.4.7.3 “Activities and Tasks” shall apply with the following additions:

— Add to Activity a) **Prepare for implementation**, Task 2)

NOTE—Includes design considerations as specified in the *Defense Acquisition Guidebook*, Chapter 4 [B5], some of which are statutory.

— Add to Activity b) **Perform implementation**:

NOTE—As part of the performance activity, the supplier is to build, reuse, code, or acquire the products that make up the system to include the implementation (fabrication and code) and sustainment assets as specified in the statement of work. This does not include tools (e.g., test tools) that the supplier uses prior to release of the asset (hardware or software) to Configuration Management.

6.4.7.4 Implementation process outputs

The following Implementation process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) Realization of the physical system elements as identified in the product baseline, including fabrication and production methods.

6.4.8 Integration process

6.4.8.1 Purpose

ISO/IEC/IEEE 15288:2015 6.4.8.1 “Purpose” applies as stated.

6.4.8.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.4.8.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.4.8.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.4.8.3 “Activities and Tasks” shall apply with the following additions:

— Add to Activity a) **Prepare for integration**:

NOTE—Includes description of the required systems integration laboratories or other facilities, personnel, test stands, harnesses, testing software, and integration schedule.

— Add to Activity b) **Perform integration**:

NOTE—Includes verifying the utility and integrity of the integration environment (e.g., functional capabilities, safety, security, calibration).

— Add to Activity b) **Perform integration,** Task 2):

NOTE—Integration activities are performed with approved assembly/integration and verification procedures at each level of the buildup.

6.4.8.4 Integration process outputs

The following Integration process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) The system integration plan (SIP) with the following attributes:

1) Describes the system integration strategy including the sequence in which the system components will be integrated.

2) Describes the overall program integration process.

3) Identifies the specific integration objectives/steps to be accomplished.

4) Identifies, or provides references to, the system simulation, stimulation, test equipment, environment, data collection and analysis tools to be used during integration activities.

b) Assembly/integration procedures that are aligned with verification procedures with the following attributes:

1) Define integration roles and responsibilities of all supplier and acquirer participants.

2) Include assembly/integration, verification and end-to-end test verification of component/software unit interfaces and mission functionality/interoperability.

3) Include assembly/integration, verification and end-to-end test verification of hardware/ software item interfaces and mission functionality/interoperability.

4) Include integration/verification of the total operations chain system and support interfaces and mission functionality/interoperability.

c) Discrepancy reports, causal analysis, and corrective action procedures with the following attribute:

1) Is integrated with the assembly and verification procedures and end-to-end test verification procedures.

d) End-to-end test architecture and design plans, test procedures, test exceptions and associated fault risk assessment test results and discrepancies with the following attribute:

1) Includes correlated end-to-end test information to provide context and significance that:

i) Each test objective is mapped to mission phase objectives, first-time events, mission-critical events, or failure/fault paths.

ii) Test-specific exceptions are mapped to mission characteristics and fault paths.

iii) Each test discrepancy is mapped to identified associated test exceptions or fault paths, where possible.

6.4.9 Verification process

6.4.9.1 Purpose

ISO/IEC/IEEE 15288:2015 6.4.9.1 “Purpose” applies as stated with the following addition:

NOTE—The individual system elements provided by the Implementation process are verified through developmental test and evaluation (DT&E), acceptance testing, or qualification testing.

6.4.9.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.4.9.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.

6.4.9.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.4.9.3 “Activities and Tasks” shall apply with the following additions:

— Add to Activity a) **Prepare for Verification**:

NOTE—As verification is planned, consideration should be given to the reuse of data and economical use of test resources as part of an integrated testing activity.

— Add to Activity b) **Perform Verification,** Task 2):

NOTE—Verification activities may be witnessed by the acquirer (or organization specified by the acquirer).

6.4.9.4 Verification process outputs

The following Verification process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) Planned system verification with the following attributes:

1) Quantitatively verifies that each system product (whether new, modified, NDI, or commercial off the shelf) meets all of its requirements and design constraints in accordance with the verification method for each requirement or constraint in the allocated baseline.

2) Includes system effectiveness evaluation per 5.4.5 and manufacturing process proofing.

3) Addresses verification requirements and criteria for solution alternatives; definition of verification to demonstrate proof of concept; and development, qualification, acceptance, pertinent operational, and other testing.

4) Addresses life cycle requirements for verification consistency in and across the solution set.

5) Identifies the processes and procedures to be executed to verify requirements, including specific verification methods allocated to each requirement, assumptions, and data used in verifications by analysis.

6) Includes progressive verification that product and process designs satisfy their requirements (including internal and external interfaces) from the lowest level of the physical hierarchy up to the total system.

7) Correlates identified discrepancies with respect to the product baseline, technical performance metrics, and constraints.

8) Maintains a record of all discrepancies.

9) Verifies that hazard risks have been mitigated to the forecast levels.

b) Verification results with the following attributes:

1) Verify required performance of all critical characteristics by demonstration or test. Where total verification by demonstration or test is not cost effective, feasible, or part of the acquirer-supplier agreement, employ modeling and simulation to address key characteristics and assumptions.

2) Verify risks identified in the Risk Management process are mitigated to levels acceptable for continued development of the system as planned.

c) Design qualification data with the following attributes:

1) Provides the verification method for each requirement in the allocated baseline and each verification requirement in the product baseline.

2) Confirms that the design of the system (hardware or software) complies with each requirement and constraint in the functional baseline, and that the design of each system product and integrated assembly of products that is separately documented in the allocated or product baselines complies with each of its requirements and constraints.

3) Is based on all applicable verification data obtained by test, demonstration, inspection, or analysis; accepted values for physical constants; and, where applicable, validated threat data. Where analysis is the qualification method, the models and tools used to perform the analysis should be validated.

d) Acceptance verification data with the following attributes:

1) Verifies that each delivered hardware product, each constituent product of a delivered hardware product, and each system product that is used to manufacture, verify, integrate, or deploy end products that are to be delivered meets each of its requirements (other than those for which the verification method is analysis) in the maintained, allocated, or product baselines in accordance with the applicable verification method or verification requirements.

2) Confirms that hardware components and integrated assemblies have been found free of unacceptable deficiencies in workmanship and materials based on the inspections and tests required by the product baseline.

3) Verifies that each software element and operational procedure performs the intended actions free from unexpected effects or system-related hazards and reasonable approaches have been adopted to detect errors.

4) Verifies system interoperability, including hardware and software elements and operational procedures of the system-of-interest, and with designated systems in the operational environment.

e) Fault analysis conducted in support of system end-to-end testing.

6.4.10 Transition process

6.4.10.1 Purpose

ISO/IEC/IEEE 15288:2015 6.4.10.1 "Purpose" applies as stated.

6.4.10.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.4.10.2 "Outcomes" shall apply in accordance with the acquirer-supplier agreement.

6.4.10.3 Activities and Tasks

ISO/IEC/IEEE 15288:2015 6.4.10.3 "Activities and Tasks" shall apply with the following addition:

— Add to Activity a) **Prepare for the transition,** Task 1):

NOTE—Includes the conduct of deployment analyses and assessments to support the development of people, product, and process solutions necessary to deploy system end-items by the supplier to the extent required in the acquirer-supplier agreement.

— Add to Activity a) **Prepare for the transition**, Task 2):

NOTE—Includes site or facility surveys.

6.4.10.4 Transition process outputs

The following Transition process outputs shall be provided in accordance with the acquirer-supplier agreement:

a) Deployment analyses and assessments with the following attributes:

1) Include factors for site/host selection, activation/installation, field assembly, and checkout requirements, including identification of site-unique hazard classification and explosive ordinance disposal requirements.

2) Identify operational and maintenance facilities, equipment and process requirements.

3) Verify the capacity requirements of the developed system will be within the resource requirements of the existing infrastructure or approved infrastructure modifications.

4) Include determination of ESOH impacts and constraints (environmental impacts on the system and system impacts on the human, system, related systems, and environment) at deployment sites as defined by the hazard analysis, environmental analysis, and impact assessment task [5.4.4.4 a)].

5) Include training items and personnel.

6) Include packaging, handling, storage, and transportation.

7) Identify site transition requirements.

8) Document deployment-critical characteristics of people, product, and process solutions to be included in risk management efforts.

6.4.11 Validation process

6.4.11.1 Purpose

ISO/IEC/IEEE 15288:2015 6.4.11.1 “Purpose” applies as stated with the following addition:

Validation provides objective evidence that the capability provided by the system in the intended environment complies with stakeholder performance requirements. Early validation activities provide confidence in the system’s ability to achieve its intended mission or use under specific operational conditions. Final validation involves operational testing on a production-representative system in an operationally realistic environment.

6.4.11.2 Outcomes

ISO/IEC/IEEE 15288:2015 6.4.11.2 “Outcomes” shall apply in accordance with the acquirer-supplier agreement.