GUIDANCE FOR UTILIZING SYSTEMS ENGINEERING STANDARDS (IEEE 15288.1 and IEEE 15288.2) ON CONTRACTS FOR DEFENSE PROJECTS

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1 Introduction

1.1 BACKGROUND

The application of systems engineering (SE) processes and practices throughout the system life cycle has been shown to improve project performance, as measured by satisfaction of technical requirements within cost and schedule constraints. Simply put, projects that use effective SE processes perform better than those that do not[1]. Given this knowledge, it is within the best interests of both acquirers and suppliers to ensure that effective and sufficient SE processes are used as the core of an effective systems engineering effort[2].

ISO/IEC/IEEE 15288 is a systems engineering standard developed by the consensus of SE experts from government, industry, and academia. It is recognized by both industry and the Department of Defense (DoD) as being a common process framework for the performance of effective systems engineering throughout the system life cycle. It is supported by companion standards IEEE 15288.1 and IEEE 15288.2 that define requirements for systems engineering and technical reviews on DoD projects[3] to help establish acquirer-supplier agreements.

IEEE 15288.1 expands on the SE life cycle processes in ISO/IEC/IEEE 15288 with the outcomes, activities, and outputs applicable to DoD projects. These processes are listed in Table 1.

IEEE 15288.2 defines a set of technical reviews and audits that may be conducted for a DoD project and specifies the timing, inputs, review criteria, and outputs for those reviews. These technical reviews and audits are listed in Table 2.

Throughout the remainder of this document, the ensemble of these three standards will be referred to as the 15288 standards. Collectively these documents are implemented by DoD projects to ensure effective technical performance on DoD contracts that will result in project and mission success.

NOTE: As industry consensus standards are published by a non-governmental standards development organization (SDO), users of the 15288 standards must remain aware of copyright and licensing limitations associated with these documents. Please review the copyright and licensing statements contained in each of the 15288 standards to avoid inadvertent copyright violations when tailoring and applying them on contract. Licensing of the standard may limit distribution of industry published standards. Clarification of copyright law or licensing issues associated with using these standards on contract should be addressed with government and/or SDO legal staff.

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[1] Elm, Goldenson. *The Business Case for Systems Engineering Study: Results of the Systems Engineering Effectiveness Survey*. Carnegie Mellon University, Pittsburgh, PA 2012. Available at http://resources.sei.cmu.edu/library/asset-view.cfm?assetID=34061

[2] National Defense Industrial Association Systems Engineering Division Task Group Report, "*Top Systems Engineering Issues In US Defense Industry*". September 2010

[3] The term "project" is used throughout this document. However, all references to a project are equally applicable to a "program" (i.e., a collection of related projects).

Table 1: Systems Engineering Life Cycle Processes

Agreement processes	**Technical management processes**	**Technical processes**
• Acquisition process • Supply process **Organizational project-enabling processes** • Life Cycle Model Management process • Infrastructure Management process • Portfolio Management process • Human Resource Management process • Quality Management process • Knowledge Management process	• Project Planning process • Project Assessment and Control process • Decision Management process • Risk Management process • Configuration Management process • Information Management process • Measurement process • Quality Assurance process	• Business or Mission Analysis process • Stakeholder Needs and Requirements Definition process • System Requirements Definition process • Architecture Definition process • Design Definition process • System Analysis process • Implementation process • Integration process • Verification process • Transition process • Validation process • Operation process • Maintenance process • Disposal process

Table 2: Technical Reviews and Audits

General Technical Reviews and Audits	**Domain-Specific Technical Reviews and Audits**
• Alternative Systems Review • System Requirements Review • System Functional Review • Preliminary Design Review • Critical Design Review • Test Readiness Review • Functional Configuration Audit • System Verification Review • Production Readiness Review • Physical Configuration Audit	• Software Requirements and Architecture Review • Software Specification Review • Integration Readiness Review • Flight Readiness Review

1.2 PURPOSE

The government's intent for developing IEEE 15288.1 and 15288.2 with industry was to enable direct citation on contract in order to reflect the government's requirements for systems engineering in acquirer-supplier agreements. Use of standards in key technical disciplines enhances system and project performance. Standards provide a common framework for communicating how best practices should be applied with sufficient resources to implement effective systems engineering on defense acquisition projects. When suitably tailored, these standards provide explicit requirements needed to properly scope and resource for a full range of government contracts. At the same time, there is a desire to leverage the use of good engineering practices which have already been established by industry and facilitate future innovation in these technical areas.

IEEE 15288.1 is an addendum to ISO/IEC/IEEE 15288 which expands on the systems engineering life cycle processes with additional detail specific to defense acquisition projects. The addendum adds requirements for systems engineering outputs and the attributes (criteria) for each. The addition of engineering outputs reflects the government's information-based management approach while acknowledging that systems engineering processes are the basis for executing the required work activities. The government's SE acquisition approach is based on a contractual acquirer-supplier agreement for the technical activities that need to be performed, the engineering outputs to be produced, and the assessment methods of the acquirer as those activities are executed by the supplier to perform the contracted service or generate the contracted product/system. IEEE 15288.1 is the primary document that will be tailored by DoD to define the government's requirements for systems engineering. It will form the basis of the acquirer-supplier agreement defining the systems engineering activities and tasks to be performed, the outcomes to be achieved, and the outputs (engineering products or documents) to be developed.

ISO/IEC/IEEE 15288 requires the project personnel to identify, plan, and conduct technical reviews, but does not provide detailed information regarding specific technical reviews and audits to be conducted. IEEE 15288.2 is an elaboration standard that provides detailed definition, requirements, and criteria for the technical reviews and audits associated with defense acquisition projects. IEEE 15288.2 is the primary document that will be tailored by DoD to specify the reviews, evaluation criteria, and expected outcomes that are appropriate to the specific acquisition. Through appropriate tailoring and proposal process (which may include additional negotiation after contract award), an acquirer-supplier agreement is created with specific criteria to be met in each applicable review. IEEE 15288.2 was written with the expectation that the criteria would be tailored for the specific project or contractual characteristics and requirements.

The government intends to use the 15288 standards in the acquirer-supplier mode[4]. As with any standards, the 15288 standards should be tailored appropriately for the specific contractual application and applied in a manner that satisfies the business and mission needs and constraints of the project. While claims or declaration of full or partial conformance[5] may be provided by an offeror, the standards (as tailored) and other associated contractual artifacts are used as the basis of determining compliance with the acquirer-supplier agreement.

The government intends to implement the 15288 standards as compliance documents, in support of project requirements and other acquisition planning documents such as the government's Systems Engineering Plan (SEP), as part of a clearly-stated and properly scoped acquirer-supplier agreement. This is meant to ensure that government requirements are bid effectively, resourced appropriately, reflected accurately in the proposed Systems Engineering Management Plan (SEMP), project plan and/or schedule and, ultimately, executed in a manner commensurate with effective technical practices.

The purpose of this document is to provide guidance:

- For acquirers on how to tailor the 15288 standards to meet and communicate project needs.
- For acquirers on how to incorporate appropriate language into a request for proposal (RFP) to invoke the standards and express relative importance of the standards in proposal evaluations.

[4] ISO/IEC/IEEE 15288. Introduction
[5] IEEE 15288.1 and IEEE 15288.2. Section 2. Conformance.

- For offerors on how to develop their proposals to leverage existing organizational processes, or propose alternative value-added tailoring, to support the RFP requirements and comply with the standards as tailored.
- For acquirers on how to evaluate an offeror's ability and commitment to effectively implement systems engineering processes compliant with government requirements based on the proposed SEMP, project plan, master schedule and their past performance.
- For acquirers on how to monitor and enforce a supplier's compliance with the acquirer-supplier agreement and delivery of the contracted product/service/system.

1.3 DEFINITIONS

Acquirer	An organization or individual soliciting products or services from a *supplier*. The *acquirer* typically defines the scope and terms of the procurement via an *RFP* released to potential *suppliers*. Potential *suppliers* (*offerors*) respond to the *RFP* via proposals and/or bids. The *acquirer* evaluates proposals submitted by *offerors*, selects a *supplier*, and negotiates a formal contract for the desired products, systems, and/or services. For purposes of this guide, the *acquirer* is typically a defense project management office or other government procurement organization, but may be a prime contractor in relationships with subcontractors or lower-tier *suppliers*.
CDRL	Contract Data Requirements List
Compliance	A formal demonstration of adherence to the terms, conditions, and requirements of an agreement
Conformance	A formal demonstration of meeting the requirements defined by a standard
DAL	Data Accession List
DID	Data Item Description
IMP	Integrated Master Plan – an event-driven plan consisting of a hierarchy of project events, with each event being supported by specific accomplishments, and each accomplishment associated with specific criteria to be satisfied for it completion
IMS	Integrated Master Schedule – an integrated, networked schedule containing all the detailed discrete work packages and planning packages necessary to support the events, accomplishments, and criteria of the IMP
Informative	Documents or other information that are useful and supplemental, but are not mandatory. Also known as "Reference"
Normative	Documents or requirements that are indispensable and mandatory (i.e., they must be understood and used). Also known as "Compliance"

Offeror	Potential *suppliers* responding to an acquirer's *RFP or RFI*. At the time of contract award, the selected *offeror* is referred to as the *supplier*.
Outcomes	A set of objectives for a life cycle process. Outcomes define a state that is expected to be achieved by the successful completion of the process.
Outputs	Information, artifacts, or services resulting from the performance of a life cycle process
RFP	Request for proposal – a formal solicitation by an acquirer interested in procurement of a commodity, service or valuable asset, to potential suppliers to submit business proposals
RFI	Request for information - a formal request issued by an acquirer with the purpose of collecting written information about the capabilities of various suppliers
SDO	Standards Development Organization
SEMP	Systems Engineering Management Plan - a plan developed by the supplier defining the supplier's systems engineering approach to be applied to a project
SEP	Systems Engineering Plan - a plan developed by the acquirer defining the acquirer's systems engineering approach to be applied to a project. The SEP may be included as part of the RFP / RFI to communicate the acquirer's expectations for the systems engineering efforts of the supplier.
SOW	Statement of Work - The portion of a contract which establishes and defines all non-specification requirements for contractor's efforts either directly or with the use of specific cited documents
Supplier	The selected *offeror* engaged via an acquirer-supplier agreement, generally a contract with the *acquirer,* to provide the desired products, systems, and/or services

2 Tailoring Overview

In the competitive environment of most DoD acquisitions, effective systems engineering starts with the system acquirer:

1. stressing the importance of systems engineering within the scope of the overall acquisition;
2. defining the acquirer's expectations, generally expressed in requirements, for supplier's systems engineering outcomes, activities, and/or outputs;
3. levying requirements on the supplier via the contract to perform effective systems engineering;
4. ensuring that the supplier's systems engineering efforts are appropriately funded and resourced; and
5. ensuring a means for the acquirer to monitor and evaluate the supplier's compliance with those requirements.

An overview of how the 15288 standards are successfully implemented in DoD acquisition contracts is shown in Figure 1.

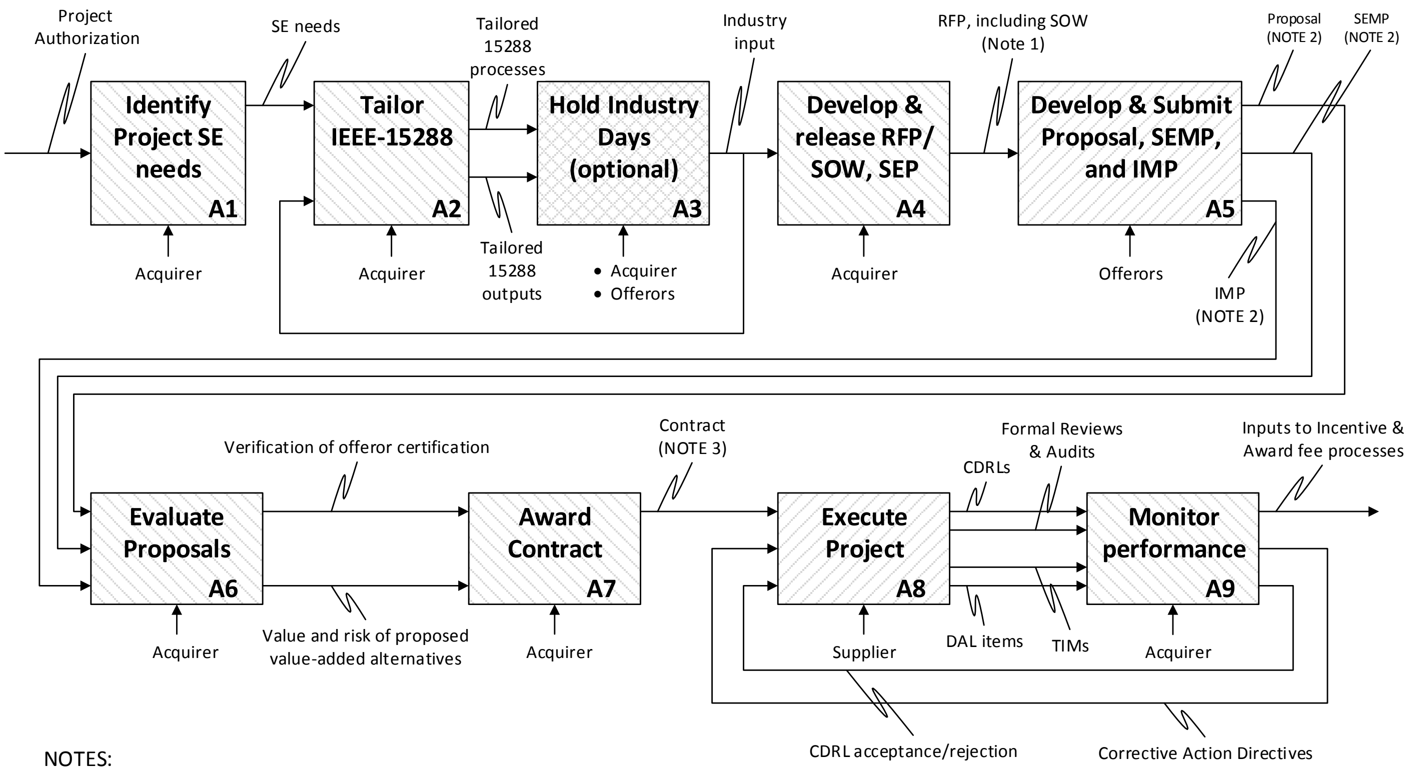
The process starts with the acquirer identifying the SE needs of the project. Not all projects are likely to use all processes within the 15288 standards to the same extent. For example, a project for follow-on production of a previously designed system may not use the *Architecture Definition*, the *Design Definition*, and other design-related processes to a large degree. A project to develop a proof-of-concept prototype for testing and evaluation may not use all elements of the *Maintenance* process.

Upon considering the project's unique requirements and constraints, the acquirer should tailor the 15288 standards to add, modify, or remove process, output, and/or technical review requirements to define the scope of work to be included in the effort (see ISO/IEC/IEEE 15288:2015 Annex A for guidance on the tailoring process). The resulting tailored version of the 15288 standards defines the acquirer's requirements for systems engineering to be performed by the supplier. The use of direct-cite standards in a DoD RFP supports the Statement of Work (SOW) portion of the RFP. These expectations may be discussed with potential offerors during Industry Days and/or draft RFP reviews (when offered), and offeror inputs are considered in the development of the final RFP.

The acquirer then develops the RFP and SOW that invoke the 15288 standards and define the requirements for performance of systems engineering and technical reviews for the project. The RFP should:

- Define the acquirer-tailored requirements of the 15288 standards
- Mandate that the offeror respond to the requirements and show conformance to the tailored requirements of the 15288 standards
- Form the foundation of acquirer expectations upon which an offeror can propose alternative organizational processes that respond to those requirements and identify opportunities for the value-added benefits of those internal processes or any proposed alternatives

NDIA
National Defense Industrial Association



NOTES:

1) Includes requirement for offerors to define and perform SE conformant with IEEE-15288 processes.
Includes requirement for offerors to provide outputs conformant with IEEE-15288 outputs.

2) Includes mapping of offeror's tailored processes to acquirer-tailored IEEE-15288 processes.
Includes mapping of offeror's outputs to acquirer-tailored IEEE-15288 outputs.
Includes certification that offeror's proposed processes and outputs satisfy acquirer's requirements for same
Includes value-added alternatives to IEEE-15288 processes and outputs

3) Includes requirement to execute SE processes as proposed.
Includes requirement to provide SE outputs via CDRLS or DAL, as proposed.
Includes offeror's certification that proposed processes and outputs conform to acquirer-tailored 15288 standards

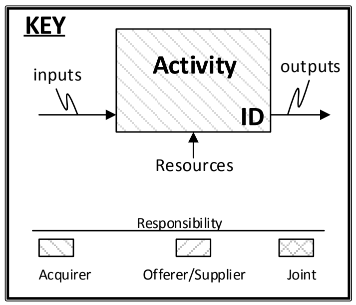


Figure 1:15288 standards utilization

The offeror should include information in the proposal, SEMP, project plan and/or schedule to show understanding and satisfaction of the acquirer's intent of the tailored requirements. Responsiveness to the acquirer's intent does *not* specifically mean following the acquirer-tailored 15288 standards to the letter. The acquirer's intent in using standards as an acquisition tool is not to mandate specific processes/tasks/methods ("how" requirements) for execution of these technical practices, but insofar as possible to support existing organizational practices already in place to implement these industry best practices. Responding to these standards means to reflect the intent of the acquirer-tailored 15288 standards in a manner that provides maximum value, both technical and programmatic, to the acquirer and the offeror. The offeror is encouraged to consider further tailoring of the 15288 standards in a manner that can be demonstrated to provide greater value to the acquirer, while adhering to the intent of the standard and the acquirer's acquisition goals.

Ultimately offerors should describe how they plan to execute and resource the engineering effort to meet the needs of the project. Offerors should provide as part of their proposals credible assurance of their capability to implement SE processes consistent with the acquirer's requirements reflected in the tailored standards. Candidate approaches might include:

- Providing assertions of full or partial conformance to the15288 standards (as defined by the standards);
- Providing a mapping between the standards and the organizational or project processes to be followed and outputs to be produced;
- Providing certifications or ratings for other relevant standards or models;
- Providing evidence of past performance for prior projects following processes consistent with the 15288 standards; or
- Proposing alternatives to the 15288 standards that clearly demonstrate the benefits to the acquirer as well as the risks associated with the alternative.

The end result is a collection of activities the offeror is committing to perform, a collection of outcomes that the offeror is committing to achieve, and a collection of outputs that the offeror is committing to develop and provide. These activities, outcomes and outputs should be consistent with those of the tailored 15288 standards.

The acquirer reviews the offeror's proposal, including any offeror-proposed tailored requirements of the 15288 standards, to determine whether the proposed use of the processes shows an understanding of the problem being addressed and shows conformance to the acquirer's tailored requirements of the 15288 standards. The acquirer reviews the offeror's proposal to ensure that all requested activities, outcomes, and outputs have been addressed and are reflected in the proposed planning artifacts and that management/technical resources (funding, personnel, and facilities/equipment) will be in place to ensure both acquisition and mission success. The acquirer may ask for the offeror's detailed process descriptions/information to support a more detailed assessment of conformance to the standards.

When a contract is awarded, the acquirer should ensure that the agreement contractually baselines the tailored standards (and/or contractor internal practices that conform to 15288 standards) and the associated planning documents, including SEMP and IMP/IMS. This formalizes the acquirer-supplier agreement for systems engineering – the commitment by the supplier to perform the agreed upon activities, achieve the agreed upon outcomes, and provide the agreed upon outputs.

Evaluation of the supplier's compliance with the acquirer-supplier agreement and required SE processes, outputs and outcomes during contract execution will be accomplished by ongoing process monitoring at specified checkpoints or during technical reviews, participation with the supplier throughout the development of the systems engineering outputs/processes, and output review when provided by the supplier to the acquirer. The evaluation also intends to determine whether the use of the processes shows an understanding of the problem being addressed and is producing the maturation of the technical specification/products required for both acquisition and mission success.

As the supplier executes the project, the acquirer will continuously assess compliance using appropriate measures, preferably with "leading indicators" rather than "lagging indicators". Monitoring the processes, tasks, activities, outcomes, and outputs of the 15288 standards enables the acquirer to assess the systems engineering activities of the supplier. Research[1] has shown that effective systems engineering correlates strongly with project performance (i.e., satisfaction of budget, schedule, and technical requirements). Thus, monitoring a supplier's systems engineering activities serves as a leading indicator of project performance, enabling the acquirer to identify project or product shortfalls early, and address them in a timely and economical manner. The NDIA SE Division report on *System Development Performance Measurement* [6] includes effective leading indicators. Examples of these indicators are:

- Requirements trends (requirements stability, stakeholder needs met)
- Interface trends
- Risk burn-down
- Technical performance measures (TPM) trends/summary
- Technical maturity

Deficiencies and non-compliance issues relative to the acquirer-supplier agreement should be addressed via contracting directions and contracting actions by the Contracting Officer.

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http://www.ndia.org/Divisions/Divisions/SystemsEngineering/Documents/Studies/NDIA%20System%20Development%20Performance%20Measurement%20Report.pdf

3 Tailoring ISO/IEC/IEEE 15288, IEEE 15288.1 and IEEE 15288.2 to meet project needs

This section describes an approach and considerations for tailoring of the 15288 standards to address specific project needs.

3.1 TAILORING OVERVIEW

The 15288 standards describe a generic perspective of SE processes and technical reviews. The applicability of that perspective may vary for specific projects, acquisition phases, or suppliers. Therefore, the standards should be tailored to meet the needs of the specific project, balancing the cost of using the standards with the risk reduction achieved from their use. One should also note that the value of standards, such as the 15288 standards, is not in the rote performance of the processes and technical reviews that they define. Rather, it is in the thought processes and the resulting outcomes of the activities that enable better decision making from both technical and programmatic perspectives. As such, the objective should not be to mandate strict task-level conformance to the standards or to require task-level verification of compliance, but to ensure that the *intent* of the standard is met in a way that is most efficient and effective to achieve the outcomes and outputs expected by performance of the processes.

In general, detailed tailoring of ISO/IEC/IEEE 15288 is not done because that can lead to prescriptive specification of "how" the process is performed to accomplish the desired activities, tasks and development of outputs. If necessary, ISO/IEC/IEEE 15288 may be tailored to further refine the systems engineering process requirements. Prescriptive specification is often associated with cost-driving impacts on existing supplier processes and can potentially constrain supplier innovation that could be of mutual benefit.

All tailoring decisions should take into consideration the cost-benefit trades of including or excluding specific elements of the standards. In doing so, the potential negative impacts and unintended consequences should be considered. Tailoring of these standards is generally addressed in two phases:

1. **Acquirer tailoring prior to the issuance of the RFP**. The acquirer may initially tailor the requirements of the standards based on the specific business or mission needs and constraints of the project. For example, some projects do not cover the full acquisition life cycle, and thus do not require equal effort across all processes. In this example, it is more likely to affect the scale or rigor of application for a specific process rather than whether it is included. This initial tailoring establishes the systems engineering expectations of the acquirer in the RFP and provides a baseline against which offerors should bid.
2. **Offeror tailoring during the proposal effort**. During the proposal effort, offerors respond to the RFP requirements and may demonstrate alignment of their established organizational processes with those of the acquirer-tailored standard. This can be accomplished by adapting existing organizational processes to conform to the standards, or by proposing alternative tailoring of the 15288 standards in a manner that preserves the acquirer's intent but aligns with the established organizational processes. So

the offeror may tailor the outputs associated with the affected processes, such as the *Systems Analysis* process.

3.2 FACTORS DRIVING TAILORING

All 15288 processes have been shown to add value to projects. However, the degree to which each process may be used on a project and the benefits that each provides, can vary greatly based on characteristics of the project. For example:

- Larger or more complex projects may benefit from more comprehensive and formal application of these processes, whereas, smaller or lower-risk projects may not need to support the same level of application, and may not gain the same level of benefits.
- Projects developing systems that are safety-critical, mission-critical, or within regulated domains (e.g., medical, nuclear) may demand more comprehensive and formal application of some processes, as well as additional or more detailed outputs reflecting the risks inherent to the domain.

The application of the 15288 processes to a project may be influenced by various project characteristics. This section provides guidance for tailoring the requirements of the 15288 standards based on self-identified characteristics of the project.

A team of systems engineers from government, industry, and academia identified key driving characteristics that can impact the tailoring of the 15288 processes. Key drivers are shown in Table 2.

Table 2: Driving Characteristics

Driving Characteristic	**Sub-characteristics**
Life cycle considerations	• Acquisition life cycle phases covered • Government / industry division of effort • Duration of development effort • Total cost of ownership • Development life cycle (e.g., rapid) • Known or assumed funding profile
Mission application	• Domain • Mission criticality ('-ilities' required; domain regulations) • Number of usage scenarios • Number of deployment sites / environments • Design for reusability
Organizational complexity	• Number of development organizations • Diversity of organizational viewpoints, for example based on corporate legacy • Commonality and integration of standard processes or toolsets • Reuse of existing components or intellectual property • Staff experience, capability, and skills needed
Technical complexity	• Number of requirements • Number of system external interfaces • Number of user classes • Number of system elements / internal interfaces /architectural levels • Number of KPPs • Total development cost
Risk	• System precedence / technology availability • Technology obsolescence • Integration of the technology • Programmatic / external risk • Sustainment / disposal risk • Manufacturing / supply chain risk • Prior acquisition / system failures or past performance history
Technical understanding	• Requirements understanding • Architecture understanding • Emergence likelihood

Appendix A provides a discussion of how each driving characteristic and its associated sub-characteristics may influence tailoring of the 15288 processes.

4 Acquirer tailoring prior to the issuance of the RFP

Tailoring of standards by the acquirer as part of SOW development is important because it communicates the acquirer's expectations for supplier SE performance to prospective offerors, specifically regarding non-specification requirements. Tailoring may include removal, modification, or addition of requirements. In many cases, the tailoring primarily reflects the scale or rigor of the application of the processes in 15288.1 or the level of detail for the reviews of 15288.2. In these cases, the tailoring will focus more on the outputs required from the execution of the process or the scope and criteria of the reviews or audits. Use of a direct cite standard supports the SOW in documenting the work to which offerors must bid, and against which offerors may opt to propose additional or alternative tailoring. Tailoring of the 15288 standards should be included in the RFP as an attachment to the SOW.

Due to copyright and licensing limitations, tailoring of industry-published standards precludes "marking up" and distributing the standard itself, unless specific permission is obtained from the SDO. Tailoring may need to be documented as change language indicating the requirements modification, deletion, or addition. For example: "Clause X.X.X, Change to read, ..."; "Clause X.X.X, Delete in its entirety"; or "Clause X.X.X, Add the following additional requirements: ...".

Consideration should be given to the intended delivery mechanism for outputs. If the acquirer desires to receive formal delivery of an output for approval, then a Contract Data Requirements List (CDRL) item may be required. If the acquirer desires to have access to data and/or outputs, but not formal delivery, then those outputs can be specified in a data accession list (DAL). When appropriate, use of existing data item descriptions (DID) should be considered for content specification only.

4.1 GENERAL CONSIDERATIONS FOR USE OF STANDARDS ON DOD CONTRACTS.

Early project planning is essential to successful projects. When selecting and tailoring standards, the acquirer should consider the characteristics of the project and the scope of the contracted effort to determine the appropriate use of SE processes and technical reviews. The project characteristics described in Section 3.2 and Appendix A provide common examples that are useful to consider as part of the acquirer tailoring decisions. These considerations support tailoring the outputs required for a specific project and the associated criteria for those outputs. The tailoring of the systems engineering and technical review approach should provide a balanced approach to cost, schedule, and performance at acceptable risk.

Other acquirer-specific considerations that may impact selection and pre-RFP tailoring of standards include:

- Acquisition model and applicable life cycle phase(s) (see DoDI 5000.02)
- Acquisition type (open and competitive vs. sole source, see FAR)
- Funding profile, organization of project office, and size of support staff size
- Past performance of known or expected bidders

Mission criticality and risk acceptance levels can drive both the acquirer's general approach to implementation of standards on contract as well as tailoring of specific technical content in those standards.

The acquirer should carefully consider and be transparent about the type of response that they expect from offerors. Many factors can influence the desired level of fidelity in an offeror's response, including the relative importance of SE and other aspects of the acquisition, source selection resources, or prior experience with the offerors. Both preparation and evaluation of proposals is cost-intensive, so clear communication of expectations is important for both acquirer and supplier organizations. This insight is important for offerors to ensure that they provide the necessary information to clearly convey their offer, and for the acquirer to ensure that they receive the necessary information to properly evaluate the proposals.

When SE is of critical importance, more detailed offeror response may be warranted. The most minimal response may be an offeror's self-certification of conformance to the standards, while the maximum response may be a complete assessment and documentation of the relationship between the offeror's SE processes and the requirements specified in the RFP, or provision of offeror internal process documents for source selection review. Intermediate responses may include citation of the offeror's internal process documentation and description of how they meet the intent of the standards and requirements specified in the RFP. While the response types at the extreme may be desirable for a variety of reasons, they tend to involve different but significant source selection risks.

The type of offeror response desired may also be dictated by the acquisition type, and perhaps the contract type. A "full and open" competition allows for limited and controlled communication between the source selection team and the offerors for clarification. In a sole source situation, that communication can be much more interactive. In the former case, it is important that the proposal provides sufficient information to allow the source selection team to assess and gain assurance that the offer is responsive to the requirements, has adequate resourcing for effective task performance, and meets the intent of the standards. In the latter case, it is possible for detailed discussions in a more dynamic environment, which may be more amenable to detailed explanation of offeror practices and how they meet the requirements or intent of the standards. Likewise, contract type may play a similar role with greater levels of specificity being appropriate in fixed price contracts, and more flexibility (less detail specified at initiation of contract) allowable in a cost reimbursable contracts.

In general, the offeror's SE approach will be documented in the proposal's technical volume – execution details in the SEMP, scheduling details in the project plan and/or schedule, and resourcing details in the cost volume. The acquirer's SEP, and the supplier's Systems Engineering Management Plan (SEMP) where applicable, should define the planned acquirer/supplier implementation, and common understanding of expected outputs. The tailored systems engineering standards, ISO/IEC/IEEE 15288 IEEE 15288.1, and IEEE 15288.2, should be specified in an attachment to the supplier's statement of work. When baselined by contract, this forms a common language and the acquirer-supplier agreement for the scope of work to be performed along with the baseline against which compliance is evaluated.

There are opportunities to improve the implementation of standards on contract after the pre-RFP tailoring. During the *Acquisition* process, the offerors will describe their implementation of IEEE 15288.1-2014 and

IEEE 15288.2-2014 in their system engineering planning along with a schedule and resources estimates to meet the requirements of the Statement of Work (SOW), System Performance Specification and other contractual requirements. The contract negotiation process assesses the reasonableness and realism of the approach, and provides an opportunity for further tailoring of the standards to improve systems engineering effectiveness, achievement of a common understanding of conformance verification, and affordability improvements. The acquirer should encourage suppliers to propose additional tailoring to the IEEE 15288.1 and IEEE 15288.2 standards, with appropriate justification. If tailoring description is requested from the supplier, the response is recommended to be an appendix to the Technical Volume and not be considered as part of any page limit.

4.2 AN APPROACH FOR USE OF SYSTEMS ENGINEERING STANDARDS ON CONTRACT

The tailored 15288 standards should be provided as part of the solicitation to define the acquirer's requirements for the systems engineering outcomes, activities, and outputs. Outcomes, activities and outputs should be tailored to meet the project's need for information to provide visibility into the success of product/system development, and support decision making to ensure both programmatic and mission success.

IEEE 15288.1, Clause 6 in particular, should be the focus of tailoring to remove outcomes, activities, and outputs that are clearly outside the scope of the acquisition. Those within the scope can be further refined to reflect the specific acquisition contract and project needs by further tailoring the breadth/depth of the activities/tasks to be performed and the criteria associated with the outputs.

Specific attention must be given to the tailoring of 15288 Outcomes and Outputs clauses that include the phrase "... in accordance with the acquirer-supplier agreement." Since the SOW, standard, and tailoring will constitute the contractual agreement, the expected outcomes/outputs must be clearly expressed to ensure clarity of requirements. It is likely that the expected outcomes/outputs will need a SOW statement to invoke them as requirements, and the scope of those outcomes and outputs defined by the 15288 standard will need to be clarified in tailoring to meet the specific expectations of the project. Silence in the acquirer-supplier agreement, specifically failure to clarify these clauses, could result in an erroneous assumption of either full inclusion or full exclusion.

Appendix B provides a work aid for guiding discussions and documenting rationale for tailoring decisions related to the outputs.

The acquirer should be cautious when eliminating or significantly minimizing any systems engineering activity in the standard. The acquirer should consider all potential negative impacts and unintended consequences resulting from tailoring, as they may add risk to the project. Tailoring of systems engineering activities and outputs should be balanced with business/mission needs and constraints of the project.

4.3 AN APPROACH FOR USE OF A TECHNICAL REVIEWS AND AUDITS STANDARD ON CONTRACT

The acquirer-tailored standard IEEE 15288.2 should be provided as part of the solicitation to define the acquirer's requirements for the technical reviews and audits to be conducted in support of the project.

Consideration may be given to different philosophies of technical review execution, for example, bottom-up (subsystem reviews culminating in a system-level review) versus top-down (system review before subsystem reviews). The tailoring should carefully consider the information needed to make informed decisions. The request for information should be balanced by business/mission needs and constraints of the project.

- Technical reviews that do not normally exist within the acquisition phase associated with the contract's period of performance are candidates for deletion.
- For each applicable technical review and audit, the acquirer should review the criteria and tailor accordingly. The criteria in the standard were intended to be tailored for the specific project and situation. Criteria that do not apply are candidates for deletion. Each evaluation criterion levied for technical reviews carries an associated element of cost that may not yield sufficient benefit for the situation needed. The selected criteria should reflect the level and type of risk for the project.

The requirements for the technical reviews and audits are provided in clauses 5 and 6 of IEEE 15288.2. Tailoring of which reviews are appropriate to the project is done in clause 5. This clause includes the core reviews across the system life cycle and the requirements in conducting the reviews. As written, they are normative requirements. Deletion of reviews because they are inappropriate to the acquisition phase should be deliberate and documented in the tailoring. Any required adaptation of the timing for reviews to respond to acquisition life cycle model variances can be done in the 5.2.3 through 5.11.3 review timing sections of IEEE 15288.2.

The specialized reviews in IEEE 15288.2 Annexes A, B, C, and D must be specifically invoked to be applicable. As written they are informative (non-mandatory) and must be specifically tailored to be normative, if desired as a contractual requirement.

Entry, exit, and success criteria for the reviews are provided in clause 6 of IEEE 15288.2 and should be tailored for specific project characteristics. The intent of this section is that it becomes normative when tailored. This emphasizes the importance of mutually agreed-upon acquirer-supplier expectation for each of the applicable reviews or audits.

When tailoring either the reviews or the criteria it is important to remember that this standard is not tasking the engineering work efforts required to produce the review content. Engineering efforts should be tasked in the SOW and may have standards for standard practices, design criteria, or test associated with those efforts. The focus of technical reviews and IEEE 15288.2 is limited to the review and approval of intermediate outputs by the acquirer to support effective project management.

5 Requiring conformance to the 15288 standards in the RFP

Application of the IEEE 15288 standards on acquisition contracts includes two related but distinct concepts:

- *Conformance*: the extent to which the system engineering activities, tasks, and outputs proposed and produced by an offeror are consistent with the requirements of the IEEE 15288 standards, as tailored. Conformance of systems engineering processes to the IEEE 15288 standards is primarily evaluated prior to contract award (i.e., via proposals and documentation submitted in response to a RFP and SOW).
- *Compliance:* the extent to which a supplier adheres to the contractual acquirer-supplier agreement by performing the required systems engineering activities and generates the required outputs and work products. Compliance is primarily monitored and evaluated during project execution.

Once the required scope of conformance to the 15288 standards (see section 4) has been established, the acquirer establishes a requirement for the offerors to propose that conformance. This is accomplished by incorporating conformance requirements into Section C (Statement of Work), Section L, and Section M of the RFP.

The following sections provide recommended clauses to be incorporated into the SOW and RFP. The following conventions are used in these clauses:

- text contained in {} braces is optional and may be deleted
- text contained in [] brackets is intended to be modified by the acquirer

5.1 SECTION C - STATEMENT OF WORK

The recommended clauses of Table 3 should be tailored and added to the SOW systems engineering section:

Table 3: Section C Recommended Clauses

(SOWxx1) The Contractor shall define and implement systems engineering processes in conformance with IEEE 15288.1-2014{as tailored by [Ref *tailoring document*]}. Conformance shall be measured via the outcomes and outputs specified by 15288.1-2014{as tailored by [Ref *tailoring document*]}. **(SOWxx2)** The Contractor shall define and conduct technical reviews and audits in conformance with IEEE 15288.2-2014 {as tailored by [Ref *tailoring document*]}. Conformance shall be measured via outputs and criteria specified by 15288.2-2014. **(SOWxx3)** The Contractor shall develop a Systems Engineering Management Plan (SEMP) consistent with the government-provided Systems Engineering Plan (SEP) {*RFP Document reference*}. **(SOWxx4)** The Contractor shall document a system/product development approach applying systems engineering standards, including processes, outputs, technical reviews, and audits in the SEMP {[CDRL xxxx]}, along with rationale for tailoring. **(SOWxx5)** The Contractor shall propose an Integrated Master Plan (IMP) and Integrated Master Schedule (IMS) that includes the applicable Technical Reviews and Audits as documented in the SEMP or IMP.

5.2 SECTION L: INSTRUCTIONS, CONDITIONS, AND NOTICES TO OFFER

The recommended clauses of Table 4 should be tailored and considered individually for addition to section L:

Table 4: Section L Recommended Clauses

(L1:M1, M2, M3) The offeror{, as part of its *technical proposal*, } shall describe the implementation of IEEE 15288.1-2014 and IEEE 15288.2-2014{as tailored by [Ref *tailoring document*]} in its system engineering processes and schedule to meet the requirements of the Statement of Work (SOW), System Performance Specification, and other contractual requirements.

The acquirer should encourage offerors to propose additional tailoring to the 15288 standards, with appropriate justification. If a tailoring description is requested from the offeror, the response is recommended to be an appendix to the Technical Volume and not be page limited. The rationale for the tailoring shall include risk and cost benefit analysis for the tailoring (e.g., risk of tailoring compared with the risk of not tailoring).

5.3 SECTION M: PROPOSAL EVALUATION CRITERIA

The recommended clauses of Table 5 should be tailored and considered individually for addition to Section M:

Table 5: Section M Recommended Clauses

The offeror's proposal will be evaluated based upon: 1. **(M1:L1)** The extent to which the offeror's proposed systems engineering approach (including processes, outputs, technical reviews, and audits) is conformant with IEEE 15288.1-2014 and IEEE 15288.2-2014 {as tailored by [Ref *tailoring document*]}. 2. **(M2:L1)** The extent to which the offeror's proposed schedule and proposal support the systems engineering approach. 3. **(M3:L1)** The extent to which the offeror's systems engineering approach provides a balanced approach to cost, schedule, and performance at acceptable risk {including any alternative value-added tailoring options that meet the intent of IEEE 15288.1 and IEEE 15288.2}.

The rationale for the tailoring should include risk and cost benefit analysis for the tailoring (e.g., risk of tailoring compared with the risk of not tailoring). Eliminating or significantly restricting SE areas ostensibly to improve cost, schedule or performance may not actually add value when the associated risks are considered.

6 Offeror tailoring during the proposal effort

Given the acquirer's requirements for 15288 conformance, as stated in the RFP, the offeror's objective is to provide the most efficient and effective means of achieving that conformance. Often this is best achieved through the use of existing organizational processes. In this case, the offeror's challenge is to assure that these existing processes satisfy the acquirer's conformance requirements.

The offeror may also include proposals for alternatives to the 15288 standards. Such proposals should address the value added by the alternative, as well as the risks and opportunities associated with the alternative. The end result is a collection of processes the offeror is committing to perform, a collection of outputs that the offeror is committing to provide, either as CDRLS or DAL items, and a commitment to conformance with the processes and outputs of the 15288 standards.

Analysis of the driving factors of section 3.2 will also inform the offeror's approach to tailoring.

Additionally, tailoring will be further influenced by the technical solution being proposed by the offeror. For example, consider a proposed solution that is a modification of a previously developed system. Since the system design already exists, the *Architecture Definition* and *Design Definition* processes employed will differ from those used on a green field design. These *Architecture Definition* processes will focus not on the creation of a new architecture, but on the adaptation of an existing architecture to the new application. Likewise the *Design Definition* process will focus on adapting existing designs to the new application. Prior experience will also influence the risks facing the offeror, concentrating them in areas of less experience.

A useful place to start in assuring conformance is to map the organizational processes and the outputs that they produce to the 15288 processes and the 15288.1 outputs. Given such a mapping, the offeror may then identify those process and output gaps that need to be filled to provide the required level of conformance. Since many defense contractors have made prior investments in the CMMI Model, NDIA has performed a mapping between the CMMI processes and work products and the 15288 process and 15288.1 outputs. This can serve as a starting point for process mapping activities for many offerors.

As a result of the mapping process, offerors should be able to specify a collection of standard or modified organizational processes that they will execute on the project, and a collection of standard or modified outputs that those processes produce. The offerors' proposals should:

- Identify the organizational processes that will be performed to achieve conformance to the acquirer's process requirements derived from IEEE/ISO/IEC 15288, and certify that those process meet the stated requirements
- Identify the work products produced from these organizational processes that will satisfy the acquirer's output requirements derived from IEEE 15288.1, and certify that those work products meet the stated requirements
- Identify the review activities to be performed that will satisfy the acquirer's technical review needs derived from IEEE 15288.2, and certify that those review activities meet the stated requirements.

7 Evaluating and contracting for conformance to IEEE 15288.1 and 15288.2

During the source selection process, the acquirer will perform an assessment of offerors' proposals to determine whether or not they are responsive to the RFP and, with regard to systems engineering and technical reviews, in conformance with the 15288 standards. The source selection will also assess bid realism and select the offer that provides the best overall technical and programmatic benefit.

The proposal submitted by the offeror should:

a. clearly address the activities, outputs, reviews and audits that are incorporated into the project;

b. ensure that these conform to the 15288 standards; and

c. demonstrate the ability and commitment to:

    i. successfully execute the required SE activities,

    ii. produce the required outcomes and outputs, and

    iii. conduct the required technical reviews and audits.

During source selection the acquirer should ensure that the offers are:

- Responsive to the mission/project technical requirements stated in the RFP.
- Responsive to the systems engineering requirements stated in the RFP.
- In conformance with the 15288 standards, as tailored.
- Properly implementing the required technical reviews and audits to support technical, mission, and programmatic decision-making.
- Inclusive of mechanisms, such as Technical Interchange Meetings (TIM), and management/review boards, for early and persistent insight into the evolving engineering activities, development of the acquisition products, and associated risks
- Properly planned and resourced, such that execution of the proposed effort is assured.
- Supported by past performance success in similar/related acquisition efforts.
- Credible and well balanced for the overall needs of the effort.
- The best value proposition to the acquirer considering technical merit, cost, schedule, and risk.

Needless to say, this evaluation can be complex and involve many variables, including weighting of evaluation factors. It is generally not a purely technical evaluation but should not be a purely cost evaluation. Balancing of the acquisition priorities and weighting, including the requirements for systems engineering process and technical reviews, is critical to source selection success.

Often during the contracting process, the acquirer and supplier will enter into negotiations to achieve specific contracting objectives (e.g., reduction in price, accelerated schedule). The negotiated contract provides the definition of the activities and outputs of the supplier, and forms the baseline against which the acquirer will assess the supplier's compliance. However, it is possible that these negotiations will modify or eliminate some of the processes, work products, or technical assessments initially proposed by the offeror and evaluated by the acquirer. Such modifications will likely impact the degree of conformance to the 15288 standards that the contractor will provide. It is imperative during the negotiation process that the acquirer and the supplier identify the impact of negotiated changes on the conformance to the 15288 standards and reach agreement on the resulting level of conformance to be provided.

8 Monitoring for compliance

The awarded contract creates a commitment for the supplier to:

1. Perform the negotiated processes in accordance with the contract requirements, including all associated compliance standards or contractually baselined contractor command media
2. Create and make available the negotiated outputs
3. Perform the negotiated technical reviews and/or audits
4. Ensure that these processes and outputs conform to the 15288 standards if further tailored by the acquirer or supplier in post-contract negotiations
5. Deliver a product that meets the specification requirements placed on contract

The ultimate objective of the acquirer is to obtain a product or system that meets his/her needs and satisfies the terms of the negotiated agreement. In order to achieve this objective, the acquirer and supplier should monitor the execution of the project to ensure conformance to the best practices described in the 15288 standards, and compliance with the specification and non-specification requirements contained in the acquirer-supplier agreement.

8.1 PROCESS COMPLIANCE

Through various engagements (e.g., TIMs, design reviews, etc.) with the supplier during contract execution, the acquirer will have the opportunity to observe the processes being performed on the project, or observe evidence of the processes having been performed. Through these observations, the acquirer can identify elements of non-compliance in the form of:

- Failure of the supplier to perform the processes as negotiated
- Failure of the processes to conform to the acquirer-defined elements of the 15288 standards

If such failures are observed, the acquirer can issue corrective action directives. For some contracts and suppliers, the Defense Contract Management Agency (DCMA) can be helpful in assessing the supplier's process performance.

8.2 PROCESS OUTPUT COMPLIANCE

Throughout the execution of the contract, the acquirer can monitor compliance with the negotiated provision of outputs. These outputs may be obtained as CDRL items or via the DAL. The acquirer should also assess outputs as an indicator of the technical maturity, feasibility, technical risk, and expected performance of the end product. As outputs become available, the acquirer should obtain and evaluate the output to verify:

- The output complies with the negotiated agreements
- The output conforms to the acquirer-defined elements of the 15288 standards

- The output provides reasonable confidence that the product will meet specification requirements

Early insight into output compliance can also be assessed through acquirer participation in TIMs and by reviewing analyses or test results as they are evolving or being conducted. If the outputs provided as CDRL items fail to satisfy these requirements, they may be rejected with instructions to correct deficiencies and re-submit. If outputs provided via the DAL fail to satisfy these requirements, the Contracting Officer may issue a corrective action directive specifying actions to comply with the negotiated contractual commitments.

8.3 TECHNICAL REVIEW COMPLIANCE

Throughout the execution of the project, the acquirer should be involved in the conduct of technical reviews and audits specified in the contract. Monitoring for compliance should address both the technical review process, as well as the entry/exit/success criteria established as part of the acquirer-supplier agreement. The acquirer should use technical reviews and audits to evaluate product maturity, assess technical feasibility and risk, and monitor technical performance measures and test results. At each technical review or audit, the acquirer should verify:

- The technical review or audit complies with the negotiated agreements
- The technical review or audit conforms to the acquirer-defined elements of the 15288 standards
    - Appropriate preparation is made
    - Entry criteria are defined and met
    - Appropriate personnel are involved
    - The defined review process is followed
    - Exit/success criteria are defined and met
    - Results are documented
    - Action items are driven to closure

If the technical review or audit fails to satisfy these requirements, they may be rejected with instructions to correct deficiencies and reassess.

Appendix A Project Characteristics Driving Tailoring of the 15288 Standards

This appendix provides a discussion of how certain driving characteristics and associated sub-characteristics may influence tailoring of the 15288 standards. The tailoring should identify which outcomes, activities, tasks, and outputs in part or in full, are applicable to the acquisition and those which are not. Before any considerations can be made with regard to adjusting the intensity and rigor applied to the outcomes, activities, tasks, and outputs, the type of system and mission application or domain should be adequately understood. The characteristics discussed in this appendix include

- Life cycle considerations
- Mission application
- Organizational complexity
- Technical complexity
- Risk
- Technical Understanding

A.1 LIFE CYCLE CONSIDERATIONS

System and acquisition life cycle considerations can have an enormous impact on the focus and rigor of systems engineering processes used on a specific project. The life cycle considerations listed below are examples of those that can drive the tailoring of the 15288 standards. However, unlike the driving factors for risk or technical understanding which tend to drive tailoring in a consistent direction (e.g. higher risk requires more rigor in many processes), life cycle considerations may not be aligned in the ways they influence tailoring. Therefore, it is critical to carefully examine each of the life cycle considerations below, as well as any additional considerations that may be applicable, to determine how specific processes and technical reviews should be tailored.

- **Acquisition life cycle phases covered** – Few contracts cover the full acquisition life cycle from concept development to operation, maintenance, and disposal. The phase(s) of acquisition or development covered by the RFP can have a large impact on which technical processes are emphasized for that project or contract. For example:
  - Contracts addressing early acquisition phases will likely mean more emphasis and rigor in the *Stakeholder Needs and Requirements Definition*, *System Requirements Definition*, and *Architecture Definition* processes, among others.
  - Contracts addressing later phases may require increased rigor or more scrutiny on the *Transition*, *Validation*, *Operation*, and *Maintenance* processes.
  - Contracts for a system that has already been partially developed may allow tailoring of the *Architecture Definition* process by deleting the need for developing models and views of candidate architectures since the architecture choice has already been made.

In contrast, the acquisition phase(s) covered in the RFP may have less impact on the tailoring of technical management processes, which generally apply throughout the acquisition life cycle.

While a contract may not address the full life cycle of the system, it is important for both the acquirer and the supplier to ensure adequate attention to all life cycle processes. While a contract may address only the design, production, and delivery of a system, someone will have to operate and sustain that system after delivery. Failure to consider *Transition*, *Operation*, and *Maintenance* processes during the design and production of the system can have an adverse impact on both the performance of the system and the life cycle cost. The acquirer should clearly indicate the level of attention to be paid to aspects of the system life cycle outside of the acquisition phase(s) within the scope of the contract by defining the process activities, outcomes, and outputs expected from the supplier.

- **Acquirer/Supplier division of labor** – The division of labor and/or responsibility between the acquirer and the supplier can impact the tailoring of processes in the acquirer-supplier agreement. There may be outcomes, activities, and/or outputs that the acquirer elects to perform. In those cases, the applicable process elements would be tailored out of the acquirer-supplier agreement. For example, the acquirer may conduct an Analysis of Alternatives to select the system concept to address a particular need. In this case, the activities and outcomes of the *Business/Mission Analysis* process are the responsibility of the acquirer and should be tailored out. The acquirer should clearly indicate the process activities, outcomes, and outputs to be provided by the acquirer, and those expected from the supplier.
- **Duration of development effort –** The duration of the development effort can impact tailoring of SE processes is several ways. Schedule constraints due to urgent operational needs may not allow for all activities, tasks, and outputs of certain processes to be performed, requiring both the acquirer and supplier to exercise careful selection, prioritization, and application rigor/intensity of the processes based on risk. Since the elimination/reduction of process elements increases the risk of the project, such tailoring should be accompanied by an increase in the rigor and focus of the *Risk Management*, *Measurement*, and *Project Assessment and Control* processes in order to have the timely insights needed to manage under the schedule constraints. On the other hand, lengthy development efforts may require the supplier to establish more robust *Project Planning*, *Project Assessment and Control*, *Configuration Management*, and *Information Management* processes to keep the project on track and ensure knowledge and data is not lost. Lengthy development efforts may also require more robust *Business or Mission Analysis* and *Stakeholder Needs and Requirements Definition* processes to account for new or changing requirements to meet emerging threats.
- **Development life cycle model (e.g., rapid development) –** The opportunities and constraints associated with the development life cycle model chosen for a given project can impact tailoring of SE processes. As discussed above, rapid acquisitions to meet urgent operational needs introduce schedule constraints that may limit the use of some SE processes. Other life cycle models include incremental delivery of capabilities, which may affect a project's *Architecture Definition*, *Design Definition*, and *Implementation* processes (e.g., an evolutionary life cycle benefits from having a robust architecture and design that accommodates the addition of functionality in the future). The choice of the life cycle model may impact the timing of the process activities and tasks, as well as the timing and content of the outputs (e.g., for an incremental delivery, the outputs would be provided incrementally as the system evolves rather than as a single, complete product).

A.2 MISSION APPLICATION

The Mission and the scope and type of project can influence the acquisition strategy and overall technical approach of the project and may have a significant impact on tailoring of the 15288 standards. The mission will dictate the degree to which specific SE processes may be required. Table A- 1 identifies the Mission Application Sub-Factors. Table A- 2 provides examples of the Sub-Factors with a mapping to their associated ISO/IEC/IEEE 15288 processes. Table A- 3 provides a space-specific example of tailoring considerations. The following is a list of considerations to be evaluated during the assessment of Mission Applications:

- Mission application tailoring must be consistent with overall project strategy and the technical/risk objectives of the project (related to Risk, Technical Utility, Technical Complexity, etc.).
- Acquisition planning requires defining a set of contractual activities that represent the best balance between performance, risk, schedule, and cost for the mission (related to Life Cycle considerations, Risk, Technical Understanding).
- Mission requirements will be unique to each project as defined by the validated mission needs, success criteria, programmatic constraints and project risks (related to Technical Complexity).
- When mission failure is not an option, use of the best practices codified in the 15288 standards can improve the likelihood of success.
- Mission assurance requirements should be considered and tailored over the life cycle of a project (related to Life Cycle considerations).
- During project initiation, technical efforts are likely to be directed toward developing and formalizing sufficient knowledge concerning new technology concepts to permit evaluation of such concepts in the design of system or other military support material (related to Life Cycle considerations, Risk).

Table A- 1: Mission Application Sub-factors

Mission Application	• Domain • Mission criticality ('-ilities' required; domain regulations) • Number of usage scenarios • Number of deployment sites / environments • Design for reusability

Domain – “System Domain” is a term with many meanings. To some, it means a classification of the system type (e.g., weapon, transportation, command and control, information technology). For others it refers to the system operating environment (e.g., air, land, sea, space, undersea, cyberspace). For some, it addresses a classification of the end-users (e.g., Army, Air Force, Navy, Marines). Regardless of your definition of the term, the domain of a system can have a significant impact on the tailoring of the 15288 processes.

The system domain can introduce unique requirements and constraints regarding the 15288 processes and outputs. When tailoring the 15288 standards to suit the project, consider all aspects of the system domain as it may affect the acquisition being planned, including:

- **In what physical environment will the system operate?** Environmental considerations will impact a number of the 15288 processes. Developing a system for operation in space differs in many ways from developing a system for use on land. All of the technical processes of the 15288 standards are likely to be impacted by the system environment. For example, *Architecture Definition* will be strongly influenced by the operating environment. The architectures of spacecraft, aircraft, and land vehicles are driven by different needs and limited by different constraints. Hence, the *Architecture Definition* process applied to systems in these domains may differ considerably. Similarly, *Design Definition* will also be strongly influenced by the operating environment, due to differing needs and constraints. Space-based systems may use design techniques focusing on thermal management. Aircraft may use design techniques that emphasize strength to weight ratios. Land-based systems may stress ruggedness and portability. These differences in architecture and design will propagate to differences in the *System Analysis* and *Implementation* processes. Furthermore, the environment will also impact the *Maintenance* and *Disposal* processes.

- **What type of system is being developed?** Development of platforms, weapons, command & control, or IT systems platform each poses unique requirements and constraints on the development activities. The 15288 technical processes and resulting outputs are likely to differ for these categories of systems. For example, development of an IT system using iterative development techniques may require a very robust *Configuration Management* process. Development of a platform such as a ship may require extensive attention to the *Architecture Definition* process, since the ship is essentially a system-of-systems. Development of a satellite may require extra attention to the *Quality Management* process to address the environmental qualification of components and overall system reliability. Only a clear understanding of the system type will support appropriate tailoring of the 15288 standards
- **Who are the acquirers and end-users of the system?** Organizations (e.g., DoD Components and other agencies) may have unique requirements and constraints for acquired systems. The organizations may have subtle differences in their system development methods, affecting the *Acquisition* process of the acquirer and the *Supply* process of the supplier. They may define their missions differently, affecting the *Business or Mission Analysis* process and the *Stakeholder Needs and Requirements Definition* process. They may do in-house engineering and contract for "build to print" production, or they may contract for engineering and production. They may have differing requirements for testing, affecting the *Verification* and *Validation* processes and requirements for Objective Quality Evidence (OQE) affecting the *Quality Management* and *Quality Assurance* processes. Some organizations and industries (e.g., nuclear, medical, aviation, nautical) may have specific requirements for certification. Thus, a clear understanding of the system stakeholders is necessary to properly tailor the 15288 processes and outputs.

Table A- 2: Mission Application Sub-factors Examples

Mission Application Sub-Factors	**Examples**	**15288 processes**
Mission criticality	○ Reliability, Maintainability & Availability (RMA) ○ Safety, Privacy, Cybersecurity, Dependability (degraded performance) ○ Interoperability, Extendibility	6.4.2 Stakeholder needs and requirements definition 6.4.3 System requirements definition 6.4.4 Architecture definition 6.4.9 Verification
Number of Usage Scenarios	○ Concept of Operations ○ Operation Concepts ○ Mission scenarios ○ Interoperability	6.4.2 Stakeholder needs and requirements definition 6.4.6 System Analysis 6.4.11 Validation
Number of deployment sites/ environments	○ Configuration Management ▪ Single Operational baseline ▪ Multi-Configuration baselines ○ Data Management ○ Logistics	6.4.4 Architecture definition 6.4.5 Design definition 6.4.8 Integration 6.4.10 Transition 6.4.11 Validation
Design for reusability	○ Logical Architecture ▪ Non-Developmental Items(COTS, GOTS, Reuse) ○ System element fidelity ○ System Integration ○ Interface Management ○ Requirements traceability	6.4.3 System requirements definition 6.4.4 Architecture definition 6.4.8 Integration

Table A- 3: Example - Summary of Space Vehicle Risk Class Attributes

System Development Activity	Lowest Risk Tolerance (e.g. operational systems)	Medium Risk Tolerance (e.g. demonstration systems)	Highest Risk Tolerance (e.g. experimental systems)	References to SE Standards which may be Tailored to Achieve specific Requirements
Technical Oversight	Formal inspections, peer reviews, independent assessments and analysis of design, requirements and verification documentation conducted	• Some independent assessments and analysis conducted on design, requirements and verification documentation • Inspections conducted on high risk areas	• Informal inspections as required by the developer • Peer review encouraged	**15288.2**
Cost Reporting	Earned value management (EVM) system required	EVM may be used	Not required	**15288.1** 6.2.3 Portfolio Management (6.2.3.3 items 5 & 7) 6.3.1.4 Project Planning Process Outputs
Risk Management	• Formal risk management (RM) plan as deliverable and common risk management tool • validated/approved process and process documentation, formal risk management boards, integration of risk management process/databases throughout the subcontractor/supplier chain with full acquirer participation	• Contractor RM best practices applied at inception of the project to the end • Risks reported on a monthly basis (as required) until risks are mitigated	Risk is accepted by the developer or reported on a periodic basis	**15288.1** 6.3.4 Risk Management
Configuration Management	Formal configuration management (CM) plans, processes and boards integrated throughout the sub/supplier chain with government approval for baseline/change control and configuration audits	• CM plan not a deliverable • Rely on contractor system with periodic visibility into process controls such as internal CSA reports. Include delivery of baselines.	Periodic visibility into acquirer CM process controls	**15288.1** 6.3.5 Configuration Management Process **EIA 649-1** Configuration Management **Defense Acquisition Guidebook(DAG)** 4.3.7 Configuration Management Process
Subcontractor/ Supplier Management	• Formal subcontractor/supplier management practices required • Includes validated/approved process and process documentation, integration of prime and sub/supplier activities	Monitored for critical items (such as command and data handling or momentum wheels)	Usually no or little monitoring of subcontracts	**15288.1** 6.1.2 Supply Process
Manufacturing & Production Management	Formal manufacturing and production management projects with plans required	• Limited government oversight • focus on anomalies, waivers, parts alerts	Informal manufacturing and production management approach	**15288.1** 6.3.5.4 Configuration Management Process Outputs 6.3.7 Implementation Process

Table A- 3: Example - Summary of Space Vehicle Risk Class Attributes

System Development Activity	**Lowest Risk Tolerance (e.g. operational systems)**	**Medium Risk Tolerance (e.g. demonstration systems)**	**Highest Risk Tolerance (e.g. experimental systems)**	**References to SE Standards which may be Tailored to Achieve specific Requirements**
Reviews & Audits	Formal comprehensive design reviews required to component level at all major milestones (SFR, PDR, and CDR)	Four or five major reviews are performed (SRR, PDR, CDR, TRR, pre-ship review)	Developer's discretion	**15288.2, with section 6 criteria tailored**
Systems Engineering Process	System engineering (SE) processes/applicable deliverables required throughout the system life cycle	• SE principles applied to project but formality and deliverables are minimized • government evaluates contractor processes	Highly tailored to a small set of critical SE processes	**15288.1**
Design Assurance	Design reviews/deliverables include assessment of design process execution, change process, design changes, technology readiness level, and adequacy of technology demonstrations	Dependent on supplier process with government insight	Dependent on supplier process	**15288.2**
System Safety	Formal systems safety program with plan required as deliverable	System safety program required	Developer needs to prove space vehicle is safe to integrating/launch vehicle contractor(s)	**15288.1** 6.4.2 Stakeholder need and Requirements Definition Process 6.4.3.4 System Requirements Definition Process Outputs
Reliability	Reliability plan and analysis required	Reliability analysis required	Reliability analysis requirements based on applicable safety requirements	**15288.1** 6.4.2 Stakeholder need and requirements Definition Process 6.4.3.4 System Requirements Definition Process Outputs

A.3 ORGANIZATIONAL COMPLEXITY

Organizational complexity can be associated with both the number of development organizations involved and how they relate to one another in performing their tasks and fulfilling their missions. Viewpoints of the involved organizations may be diverse and have likely been formed based on their respective corporate legacy. Standards can be very effective in focusing these viewpoints on a common goal. As the number and hierarchy of involved participants grow, the degree of formality and process rigor will need to grow as well. Tailoring of the standards must be particularly scrutinized in the *Project Planning* process, where the Project Management Plan along with the acquirer's Systems Engineering Plan (SEP) and supplier's Systems Engineering Management Plan (SEMP) must closely align.

Another key 15288 process area related to Organizational Complexity is *Project Assessment and Control*. As the project is executed, the performance of a complex organization should be monitored to maintain on-going awareness of task performance and evolving risks. Well-orchestrated interaction between the acquirer and supplier can be crucial to both acquisition and mission success for procurements with greater levels of complexity. This allows for “leading indicators” of progress and potential problems before formal reviews or output delivery. Technical and project reviews should be planned to enhance information sharing at key decision points where changes can be made to the acquisition with minimal risk or impact. Although formal reviews are conducted at the progress points identified in the IMS, the discussion and information sharing between supplier and acquirer should be honest and frequent to ensure that any deviations from planned performance are investigated and analyzed before they become significant concerns. Affected stakeholders throughout the complex organization should be kept aware of project status, along with any need for corrective actions and re-planning. Additional process tailoring may be required at that time and should be updated in the SEMP/IMP/IMS and other detailed plans to facilitate recovery.

The *Decision Management* process is vital to support management and tracking of the many diverse choices inherent in a complex acquisition, especially when performed by a complex organization. As the diversity and hierarchy of stakeholders increases, the process outputs and their fidelity may need to be more detailed. Tailoring of the *Decision Management* process should ensure that the alternatives are properly analyzed and recommendations made, in as timely a manner possible, that are consistent with the needs, expectations, and phase of the project. Capturing and promptly communicating these decisions across the project, regardless of project phase, are vital as the solution matures to prevent unnecessary rework, cost, and schedule delays. Expectations as to what types of decisions are to be made and their evaluation process/criteria, along with results of prior key decisions, should be factored into the technical plans, including the SEP, SEMP, and lower level technical plans used by the project.

In order to retain and communicate the project effort throughout a complex organization, a robust *Information Management* process is needed. Expectations of the *Information Management* services should be factored into the SEP and SOW, with the acquirer specifying the needs and expectations of the supplier’s processes and capabilities. Similarly, the supplier processes should be articulated in the SEMP to explain how information is managed within the supplier’s organization and what information will be supplied to sub-tier suppliers and the acquirer. It is important to identify the types of information which should be retained as well as duration of retention and what information should be retired/archived.

A.4 TECHNICAL COMPLEXITY

Technical complexity may be driven by a number of factors, including:

- Number of requirements
- Requirement complexity
- Number of system external interfaces
- Number of user classes
- Number of system elements / internal interfaces /architectural levels

- Number of KPPs
- Reliance on immature technology

As technical complexity increases due to any or all of these factors, the supplier must enhance a number of processes to address this complexity. Increased complexity may be manifested in more system elements, more and more complicated interactions or interfaces between system elements, and more system functions

Chances are high that ALL 15288 processes will contribute to project success to some degree, regardless of the level of technical complexity. However, the challenges of higher complexity may require even more rigor and more emphasis in processes including, but not limited to:

- ***System Requirements Definition*** – increased complexity is typically embodied in more requirements, and more complex requirements. A robust *System Requirements Definition* process is essential to manage this requirements environment. For more complex systems, formal and documented requirements development methods that ensure clarity, completeness, and traceability of requirements are required. Automated requirements management tools can be helpful.
- ***System Analysis*** – increased complexity often implies more intricate, more comprehensive, and/or more types of analysis to define the functionality to be implemented. In more complex systems, such analysis is best served by formal analytical methods, (e.g., performance analysis, feasibility analysis, specialty engineering analysis), increased IPT utilization and interaction, increased stakeholder interaction.
- ***Architecture Definition*** – increased complexity can drive more complex physical architectures containing more elements, more complicated elements, and more interfaces and dependencies between elements. Complexity can also drive more complex functional architectures, with larger numbers of and more sophisticated functions, and more interdependencies. This is further complicated when interacting systems are being developed concurrently by multiple organizations. Development of more complex systems requires greater attention to system architecture modeling and documentation. Tools and techniques such as SysML and DoDAF can be helpful. Increased attention should also be paid to architecture analysis to ensure satisfaction of both functional, non-functional, and performance requirements.
- ***Design Definition*** – increased complexity often results in larger and more complicated designs needed to satisfy system requirements and conform to system architectures, both of which are impacted by technical complexity. Design of more complex systems often manifests itself in larger and more diverse design teams, performing more complicated design tasks. In such cases, design staff may require more sophisticated skill sets, and design activities may require more technical analyses and documentation demanded by a more robust *Design Definition* process.
- ***Verification*** – increased requirements, more complex architectures, and more complicated designs derive from increased technical complexity. All of these factors drive an increase in the scope of the *Verification* activities. A robust *Verification* process is needed to ensure adequate and comprehensive technical reviews throughout the development process. The process must also ensure necessary and sufficient developmental testing at all levels (e.g., component, integration, system, certification), which may increase with increased complexity.
- ***Project Planning*** – Increased complexity results in more complicated requirements, architectures, and designs, and often creates demands for larger development teams. All of these factors place increased demands on the *Project Planning* process. Larger design teams require greater task definition and coordination. More complicated design tasks require more attention to design planning, design

management and design monitoring. In such cases, a more robust *Project Planning* process is needed to define, distribute, track, and manage the tasks of the project.

- ***Configuration management*** – Increased complexity is often manifested in more requirements, more complicated architectures, and larger designs. All of these produce more artifacts that must be maintained under configuration management. Furthermore, the larger design teams associated with more complex systems produce more artifacts, and update these artifacts more frequently. All of these factors demand a robust *Configuration Management* process. Tools that automate the *Configuration Management* process and integrate with customer *Configuration Management* processes can be helpful.
- ***Risk Management* -** Increased complexity is often manifested in more requirements, more complicated architectures, and larger designs. All of these produce more risks that must be managed. All of these factors demand a robust *Risk Management* process. Tools that automate the *Risk Management* process and integrate with customer *Risk Management* processes can be helpful.

A.5 RISK

Technical risk is a key factor influencing the tailoring of the processes of the 15288 standards. Risk may arise from numerous sources, including:

- System precedence / technology availability –
- Technology obsolescence –
- Integration of the technology –
- Programmatic / external risk –
- Sustainment / disposal risk –
- Manufacturing / supply chain risk –
- Prior acquisition / system failures or past performance history

For projects posing higher risks, the supplier must enhance a number of processes to address this risk.

All 15288 processes likely apply to projects of any risk level, but the challenges of higher risk projects may require more rigor and more emphasis in processes including, but not limited to:

- ***Risk Management*** – Clearly, projects with higher levels of technical risk require more attention to the *Risk Management* process. To manage risks, the project should employ robust methods of continuously identifying, characterizing, and prioritizing risks. The supplier should develop and document plans for addressing the identified risks, and track the execution of these plans. It is important to ensure that risk mitigation plans be integrated with the project IMP and IMS, and be appropriately budgeted and staffed. Tools that automate the *Risk Management* process and integrate with customer *Risk Management* processes can be helpful.
- ***Business or Mission Analysis*** – Projects with higher technical risks will be challenged to satisfy their business or mission objectives. Consequently, the *Business and Mission Analysis* process must be performed rigorously to clearly identify, document, and prioritize the business or mission objectives. This analysis aids the project planners in evaluating the impact of identified risks on those objectives, and helps formulate mitigations that optimize project results.

- ***Life Cycle Model Management*** – the choice of a development life cycle is influenced by the level of project risk. Risk often necessitates variation from the initial plan and the initial system design. Some development life cycles, such as agile and spiral, are more adept at addressing such changes.
- ***Project Planning*** – Project risks must be addressed during the *Project Planning* process. Adequate budget and schedule reserves must be established to address the mitigation activities taken to manage the risks, and/or the consequences that will arise from realization of the risks. Additionally, the project plans must provide sufficient resources and staff for the execution of the *Risk Management* process.
- ***Measurement*** – Establishing a *Measurement* process that includes robust use of leading indicators is an important step in managing risk. Leading indicators can aid in early identification of deviations from plan resulting from identified or unidentified risks. Early identification supports early corrective actions, which are often less costly that later corrective actions.
- ***Project Assessment and Control*** – Projects facing higher risks are more likely to deviate from initial project plans. Careful attention to the *Project Assessment and Monitoring* process can detect these deviations as leading indicators of future project issues, and can provide valuable inputs to the *Risk Management* process.
- ***Architecture Definition*** – Fragile architectures can be unable to accommodate variations needed to address risks as they arise. Thus, a robust and flexible architecture is often a good defense against technical risks. System architectures often have strong influences on a project's quality attributes (e.g., reliability, scalability, adaptability). These quality attributes can be essential in addressing issues as the system evolves during its development to address risks as they arise. Knowing the risks facing a project enables the development of an architecture best suited to address those risks.
- ***Configuration management*** – Projects facing higher risks are more likely to deviate from initial project plans. Thus, more attention is needed to the *Configuration Management* process to ensure that these deviations are authorized and effectively documented and communicated.
- **All of the rest of the processes** – depending upon the characteristics of the risks facing the project. Risks arising from requirements issues demand more attention to the *Stakeholder Needs and Requirements Definition* process and the *System Requirements Definition* process. Risks arising from test issues may demand more attention to the *Verification* and *Validation* processes.

A.6 TECHNICAL UNDERSTANDING

The technical understanding of the problem and solution spaces is a primary factor driving the tailoring of systems engineering processes across the life cycle. This includes, but is not limited to, the:

- Mission understanding
- Requirements understanding
- System architecture understanding
- Technology understanding
- Likelihood of emergent properties (i.e., unplanned and unanticipated performance) of the system

The lower the level of understanding of these sub-factors may make it necessary to increase the rigor of implementation of the following processes:

- ***Business or Mission Analysis*** **process** – Lower levels of mission understanding may be mitigated by increased efforts in the *Business or Mission Analysis* process. Such analysis can refine and clarify mission understanding, ensure proper identification of the problem space, and provide opportunities to validate that understanding across the stakeholder community.
- ***Stakeholder Needs and Requirements Definition*** **process**– Lower levels of mission understanding and/or requirements understanding demand increased efforts in the *Stakeholder Needs and Requirements Definition* process. These efforts should focus on identifying all relevant stakeholders, accurately collecting and representing their needs, integrating those needs into a complete consistent set of stakeholder requirements, and validating that set of requirements across the stakeholder community. This effort enhances the understanding of the mission by viewing it from the perspective of the stakeholders.
- ***System Requirements Definition*** **process** – Development of a high-quality set of system requirements is based on a clear understanding of the mission, the stakeholder needs, and the available technology. Lower levels of understanding in these areas demands increased effort in the *System Requirements Definition* process. These efforts should focus on the translation of mission requirements and stakeholder needs into a high-quality set of system requirements that are implementable within the constraints of available technology and within the constraints of the project (i.e., cost and schedule).
- ***Architecture Definition*** **process** – Development of an appropriate system architecture demands a clear understanding of the mission, the system requirements, and the available technology. Lower levels of understanding in these areas demand increased effort in the *Architecture Definition* process. These efforts should focus on:
    - the development of candidate architectures intended to satisfy both the functional and non-functional requirements of the system, and
    - the evaluation of the candidate architectures to choose the one that best satisfies both the programmatic constraints and the requirements.
- ***System Analysis*** **process** – The *System Analysis* process supports nearly all technical processes, and is typically performed throughout the development life cycle to support architecture development, design implementation, system integration, etc. The *System Analysis* process is based on a clear understanding of the mission, system requirements, system architecture, and available technology. Lower levels of understanding in these add risk and effort to the *System Analysis* process. A lack of understanding of these inputs is best rectified by regressing to the earlier processes to improve that understanding. However, remaining deficiencies in that understanding may be partially mitigated within the *System Analysis* process by investigating sensitivities and resiliency issues within the system. Development of less sensitive and more resilient solutions can reduce the impact of evolving understanding of mission, requirements, and system architecture.
- ***Design Definition*** **process** – The development of a system design is based on a clear understanding of the mission, the system requirements, and the system architecture. Lower levels of understanding in these areas demand additional efforts in the *Design Definition* process. The *Design Definition* process builds on the system requirements allocated to the system elements, and the system element descriptions and system interface descriptions of the system architecture. A lack of understanding of these inputs is best rectified by regressing to the earlier processes to improve that understanding. However, remaining deficiencies in that understanding will add both risk and effort to the *Design Definition* process. Partial mitigation of these deficiencies may be achieved by ensuring the traceability of efforts and results of the *Design Definition* process to elements of mission, requirements, and architecture inputs and assumptions.

As the understanding of these inputs evolves, this traceability supports the ability to propagate this evolution into design changes.

- ***Decision Management* process** – The primary objective of the *Decision Management* process is to choose between alternative courses of action encountered throughout the process. The *Decision Management* and *Systems Analysis* processes are closely allied in these activities. Lower levels of mission, requirements, architecture, and technology understanding compromise the ability to make such choices, resulting in demands for increased efforts in the *Decision Management* process to collect and evaluate the information needed to support decision making. Project personnel should identify and record assumptions supporting specific decisions. Then, when technical understanding of the project evolves, the impact of that evolution may be traced to prior decisions that may need to be revisited.
- ***Project Assessment and Control*** process – limited technical understanding compromises the project manager's ability to perform the *Project Assessment and Control* process. Without adequate technical understanding, accurate assessments of project status and project risks may not be possible. This may necessitate increased effort within the *Project Assessment and Control* process resulting from an inability to discriminate between critical and non-critical elements of the assessment.
- ***Risk Management*** process **–** A lack of technical understanding can significantly increase project risk. This demands increased effort and attention to the *Risk Management* process to identify and manage these risks. Projects with limited technical understanding should employ a more robust *Risk Management* process that broadens the categories of risks to be considered, increases the frequency of risk reporting and monitoring activities, and engages a broader population of project staff in risk identification and analysis activities.

To manage the risks of the lack of technical understanding, it is often necessary to define and implement the processes associated with the concept and system definition in a more iterative and/or incremental manner. It is typical to need to iterate between these processes with more comprehensive use and rigor in the system analysis and decision management (which establishes the trade studies). Developing a better technical understanding requires closer communication and coordination between the acquirer and supplier, thus driving a more comprehensive approach to *Project Assessment and Control*, and may require additional changes in the agreements via the *Acquisition* and *Supply* processes. Finally, additional focus will be needed on the management of risks. As the technical understanding (i.e., concept and system definition) evolves, the initial cost and schedule estimates will likely change, as well as potential technical impacts. Thus, there will be a need for strong integration between the *Project Assessment and Control* process and the *Risk Management* process.

Appendix B Work aid for definition of outputs to be supplied

The table below is meant to be used as a work aid for the acquirer to select which outputs are required to be produced by the supplier during execution of the project. Keeping in mind that all outputs selected and included in the negotiated contract add to the total cost, the acquirer should consider which outputs are truly value-added. Not all outputs from IEEE 15288.1 are likely to be required for every project. Considering the project, technical, and contract characteristics described in Appendix A, the acquirer should indicate which outputs are required and include the priority and rationale for including or excluding those outputs. Depending on the priority, the supplier may choose to propose additional tailoring of the outputs to provide maximum value to the acquirer. Attributes for many of these outputs are included in 15288.1.

ISO/IEC/IEEE 15288:2015 Process	15288.1 Outputs	Relative Emphasis for the Project Acquisition (Priority and Rationale)	Tailored Outputs
Agreement Processes			
Acquisition process	• Request for Proposal • Supplier Selection Report • Agreement • Agreement Change Management Procedure • Agreement Change Report • Supply Assessment Report • Delivery Acceptance Report		
Supply process	• Supply Response (e.g., proposal, tender) • Agreement Change Management Procedure • Agreement Change Requests • Supply Delivery Records		
Organizational project-enabling processes			
Life cycle model management process	• Life Cycle Policies, Processes • Life Cycle Procedures • Life Cycle Models • Process Assessment Results • Process Improvement Report		

ISO/IEC/IEEE 15288:2015 Process	15288.1 Outputs	Relative Emphasis for the Project Acquisition (Priority and Rationale)	Tailored Outputs
Infrastructure management process	• Infrastructure Requirements • Infrastructure Elements • Infrastructure Change Requests		
Portfolio management process	• Portfolio Analysis Report • Project Initiation Report • Project Evaluation Report • Project Closure Report		
Human resource management process	• Required Skills Report • Skills Inventory • Skill Development Assets • Skill Development Records • Qualified Personnel • Staff Assignment Records		
Quality management process	• Quality Management Policies, Objectives & Procedures • Quality Assurance Assessment Report • Corrective & Preventive Action Report		
Knowledge management process	• Knowledge, Skill, & Knowledge Asset Records • Knowledge, Skill, & Knowledge Asset Report • Knowledge, Skill, & Knowledge Management Elements		
Technical management processes			
Project Planning Process	• Project Technical Management Plan • Project Life Cycle Model • Work Breakdown Structure • Project Schedules • Project Budgets • Project Infrastructure & Services Requirements • Project Authorization Record		

ISO/IEC/IEEE 15288:2015 Process	15288.1 Outputs	Relative Emphasis for the Project Acquisition (Priority and Rationale)	Tailored Outputs
Project assessment and control process	• Project Assessment Records • Measurement Analysis Results & Recommendations • Project Assessment Reports • Project Control Requests • Authorization to Proceed to Next Milestone		
Decision management process	• Decision Register • Decision Report		
Risk management process	• Risk Profile • Risk Action Requests • Risk Profile Reports		
Configuration management process	• Configuration Management Records • Configuration Baselines • CM Change / Variance Requests • Configuration Status Reports • Configuration Evaluation Reports • System Release Reports		
Information management process	• Information Item Register • Information Management Reports		
Measurement process	• Measurement Records • Measurement Information Needs Report		
Quality assurance process	• QA Evaluation Reports • QA Records • Incident Records • Problem Records		
Technical Processes			
Business or mission analysis process	• Preliminary Life cycle Concepts • Problem or Opportunity Statement • Solution Alternatives & Recommendation		

ISO/IEC/IEEE 15288:2015 Process	15288.1 Outputs	Relative Emphasis for the Project Acquisition (Priority and Rationale)	Tailored Outputs
Stakeholder needs and requirements definition process	• Operational Concept • Other Life cycle Concepts • Stakeholder Needs • Stakeholder Requirements • Stakeholder Requirements Report • Critical Performance Measures • Traceability Mapping		
System requirements definition process	• System Description • System Requirements • System Requirements Report • Critical Performance Measures • Traceability Mapping		
Architecture definition process	• Architecture Viewpoints • Architecture Views & Models • Architecture Report with rationale • Interface Definitions (initial) • Architecture Assessment Report • Traceability Mapping		
Design definition process	• Design Characteristics Report • Design Artifacts • Design Artifacts Report with rationales • Interface Definitions • Traceability Mapping		
System analysis process	• System Analysis Report		
Implementation process	• Implementation Records • Implementation Report • Traceability Mapping		
Integration process	• Integration Records • Integration Report • Traceability Mapping		

ISO/IEC/IEEE 15288:2015 Process	15288.1 Outputs	Relative Emphasis for the Project Acquisition (Priority and Rationale)	Tailored Outputs
Verification process	• Verification Records • Verification Report • Traceability Mapping		
Transition process	• Transition Records • Transition Report • Traceability Mapping		
Validation process	• Validation Records • Validation Report • Traceability Mapping		
Operation process	• Operation Records • Operational Problem Reports • Customer Support Records • Operation Report		
Maintenance Process	• Maintenance Records • Maintenance Requests • Maintenance Problem Reports • Logistics Actions & Report • Maintenance Report		
Disposal process	• Disposal Records • Archive Report		

Appendix C Acknowledgments

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