Requirements Capture (AFIS WG on RE) , CMM, and summary of EIA 632 Standard (A.E.K Sahraoui)

1. Capture		
1.1. Identifier les parties prenantes	GP 2.7 (DI 2) Identify and Involve Relevant Stakeholders EIA 632 C.4.a	3
1.2. Identifier les documents applicables	EIA 632 C.4.b	
1.3. Analyser les besoins (opérationnel, …) et contraintes (environnement, réutilisation …)	SP 1.1 Obtain an Understanding of Requirements EIA 632 C.16.d EIA 632 C.27 ? EIA 632 C.28 ?	2
1.4. Identifier et formaliser les exigences de besoin et contraintes	SP 1.1 Elicit Needs SP 1.2 Transform Stakeholder Needs, Expectations, Constraints, and Interfaces into Customer Requirements EIA 632 C.5.a EIA 632 C.14.a EIA 632 C.15.a, b, c EIA 632 C.16.b, c	3
1.5. Définir une stratégie de vérification / validation du système	EIA 632 C.7.c, d, e EIA 632 C.11	
1.6. Consolider les exigences de besoin	SP 1.2 Obtain Commitment to Requirements	2
1.7. Définir la méthode de vérification du produit associé aux exigences, les critères d'acceptation	EIA 632 C.33.a	
1.8. Catégoriser les exigences (en particulier Identifier les exigences critiques)		
1.9. Évaluer la sensibilité des exigences critiques (incidence d'une modification d'une exigence critique sur les aspects coûts, délais, définition: analyses de marges)	ECSS 10A	
1.10. Assurer la traçabilité des exigences	SP 1.4 Maintain Bi-directional Traceability of Requirements	2
1.11. Formaliser les justifications, décision, compromis …	EIA 632 C.10.c EIA 632 C.12.a EIA 632 C.16.e	
2. Analyse		
2.1. Procéder à l'analyse logique / physique du système (identification des traitements, performances assurés par le système en tenant compte des scénarios opérationnels, identification des interfaces avec les systèmes externes, impact des exigences se sûreté de fonctionnement), à l'analyse des risques, de coûts ..	SP 1.1 Elicit Needs EIA 632 C.16.a EIA 632 C.17 EIA 632 C.18	
	SP 3.1 Establish Operational Concepts and Scenarios	3
	SP 3.2 Establish a Definition of Required Functionality	3
	SP 3.4 Evaluate Product Cost, Schedule and Risk	3
2.2. Identifier les exigences techniques (notamment exigences des composants) à partir des résultats de l'analyse logique du système	SP 2.1 Establish Product and Product Component Requirements EIA 632 C.17.c, d	3

		SP 2.3 Identify Interface Requirements	3
	2.3. Identifier les exigences de conception relatives au produit (notamment les exigences réglementaires applicables)	ECSS 10A	
	2.4. Identifier les contraintes liées à chaque exigence spécifique (notamment les limites d'applicabilité)	ECSS 10A	
	2.5. Élaborer les plan de vérification et de validation du produit en regard des exigences (stratégie de vérification / validation)		
	2.6. Formaliser les justifications, décision, compromis …	EIA 632 C.10.c EIA 632 C.12.a	
	2.7. Assurer la traçabilité des exigences	SP 1.4 Maintain Bi-directional Traceability of Requirements EIA 632 C.29.b, c	2
3. Allocation			
	3.1. Allouer les exigences à l'architecture choisie (démarche top-down)	SP 2.2 Allocate Product Component Requirements	3
	3.2. Consolider les exigences avec les éléments d'architecture réutilisés (démarche bottom-up)		
	3.3. Spécifier les exigences d'interfaces des composants	SP 2.3 Identify Interface Requirements	3
	3.4. Assurer la traçabilité des exigences	SP 1.4 Maintain Bi-directional Traceability of Requirements	2
4. Validation des exigences			
	4.1. Caractériser les exigences (identification des propriétés d'une exigence)		
	4.2. Évaluer les différentes situations du profil de vie du système, en association avec les conditions d'environnement ainsi qu'avec le nombre d'occurrences applicables et leur durée.	ECSS 10A	
	4.3. Vérifier la cohérence de l'ensemble des exigences obtenues en capture. En particulier une compréhension satisfaisante des attentes du client et un accord avec lui sur les exigences affinées.	SP 1.1 Obtain an Understanding of Requirements ECSS 10A EIA 632 C.14.b EIA 632 C.15.d EIA 632 C.25.b	2
	4.4. Vérifier les exigences individuellement suivant leurs caractéristiques préalablement définies.	SP 3.3 Analyze Requirements EIA 632 C.25.a	3
	4.5. Vérifier l'exhaustivité et la cohérence de l'ensemble des exigences suite aux activités d'analyse	SP 1.1 Obtain an Understanding of Requirements EIA 632 C.16.h EIA 632 C.17.d, e EIA 632 C.25.b	2
		SP 3.5 Validate Requirements with Comprehensive Methods	3
	4.6. Résoudre les conflits d'exigences	EIA 632 C.16.f	2
5. Modification			
	5.1. Gérer les modifications d'exigences	SP 1.3 Manage Requirements Changes EIA 632 C.12.h	2
	5.2. Identifier l'état véritable des exigences (maturité)	ECSS 10A	
	5.3. Formaliser les justifications, décision, compromis …		
6. Management			

6.1. Identifier les processus associés (Enabling products)	EIA 632 C.4.c	
6.2. Identifier les phases et jalons du cycle de vie du système	EIA 632 C.4.d	
6.3. Définir la stratégie de management des risques	EIA 632 C.5.c EIA 632 C.7.b EIA 632 C.12.e EIA 632 C.24	
6.4. Définir le processus d'Ingénierie des exigences et son intégration avec les autres processus	EIA 632 C.4.e EIA 632 C.7.a	
6.4.1. Définir les outils utilisables	EIA 632 C.5.h	
6.4.2. Définir l'approche de management des exigences (modèle de données, modèle d'exigence, documents types, gestion de la configuration…)	EIA 632 C.12.b, c, d, g	
6.4.3. Définir des règles de gestion des exigences (traçabilité, niveau, attributs…)		
6.4.4. Définir des indicateurs de suivi, processus … en fonction des objectifs du projet	EIA 632 C.4.f EIA 632 C.9.b, c EIA 632 C.10.a, b	
6.5. Définir les besoins en ressources (moyens, humains …)	EIA 632 C.6.c, d	
6.6. Diffuser évolutions d'exigences	EIA 632 C.13.c	
?	SP 1.5 Identify Inconsistencies between Project Work and Requirements	2

Processus CMMi

Level 2

SG 1 Manage Requirements

    SP 1.1 Obtain an Understanding of Requirements

    SP 1.2 Obtain Commitment to Requirements

    SP 1.3 Manage Requirements Changes

    SP 1.4 Maintain Bi-directional Traceability of Requirements

GG 2 Institutionalize a Managed Process

    GP 2.1 (CO 1) Establish an Organizational Policy

    GP 2.2 (AB 1) Plan the Process

    GP 2.3 (AB 2) Provide Resources

    GP 2.4 (AB 3) Assign Responsibility

    GP 2.5 (AB 4) Train People

    GP 2.6 (DI 1) Manage Configurations

    GP 2.7 (DI 2) Identify and Involve Relevant Stakeholders

    GP 2.8 (DI 3) Monitor and Control the Process

    GP 2.9 (VE 1) Objectively Evaluate Adherence

    GP 2.10 (VE 2) Review Status with Higher-Level Management

Level 3

SG 1 Develop Customer Requirements

    SP 1.1 Elicit Needs

    SP 1.2 Transform Stakeholder Needs, Expectations, Constraints, and Inter-faces into Customer Requirements

SG 2 Develop Product Requirements

    SP 2.1 Establish Product and Product Component Requirements

    SP 2.2 Allocate Product Component Requirements

    SP 2.3 Identify Interface Requirements

SG 3 Analyze and Validate Requirements

    SP 3.1 Establish Operational Concepts and Scenarios

    SP 3.2 Establish a Definition of Required Functionality

    SP 3.3 Analyze Requirements

    SP 3.4 Evaluate Product Cost, Schedule and Risk

    SP 3.5 Validate Requirements with Comprehensive Methods

GG 3 Institutionalize a Defined Process

    GP 2.1 (CO 1) Establish an Organizational Policy

    GP 3.1 (AB 1) Establish a Defined Process

    GP 2.2 (AB 2) Plan the Process

    GP 2.3 (AB 3) Provide Resources

    GP 2.4 (AB 4) Assign Responsibility

    GP 2.5 (AB 5) Train People

    GP 2.6 (DI 1) Manage Configurations

    GP 2.7 (DI 2) Identify and Involve Relevant Stakeholders

    GP 2.8 (DI 3) Monitor and Control the Process

    GP 3.2 (DI 4) Collect Improvement Information

    GP 2.9 (VE 1) Objectively Evaluate Adherence

    GP 2.10 (VE 2) Review Status with Higher-Level Management

Table C.1—Requirement 1 (Supply Process - Product Supply)

Representative tasks	Expected outcomes
a) Assess acquisition request, offer, or directive	The capability of the enterprise, organization, project, or team to provide a system, or portion thereof, that meets acquisition document requirements within the stated constraints and the enterprise strategic plan and business strategy, or within the project plan and constraints, or within the team charter, as applicable, is determined. Includes, as appropriate: 1) engineering and other applicable technical and project plans that allow determination of engineering and management tasks, costs and schedules, resource requirements, and technical capabilities and capacities (invoke applicable Planning Process tasks); 2) decision whether to work with the acquirer to provide the desired system, or a portion thereof, based on established enterprise criteria or on project or team capability; 3) resolution of added or changed requirements and areas of concern. 4) preparation and submission of an appropriate technical and cost response in accordance with acquisition request, enterprise business strategy, and enterprise policies and procedures, or with project plans, policies, and directives.
b) Negotiate agreement	A satisfactory agreement is established based on the bounds determined by, as applicable: 1) applicable legal, regulatory, policies, procedures, and practices that will affect negotiation strategy or conduct; 2) the type of agreement to be negotiated; 3) negotiation strategy; 4) conditions identified from the plans for the procurement work effort that could affect negotiations and agreement performance; 5) constraints identified from the plans for the procurement work effort that could affect negotiations and agreement performance.
c) Record agreement	Established agreement is captured in a form and medium appropriate to the effort.
d) Implement agreement	A project established and processes (including replanning, as necessary) activated to complete the requirements of the agreement.
e) Deliver products and other deliverables per agreement	Agreement requirements satisfied by delivery of required products and other deliverables in accordance with agreement instructions.

Table C.2—Requirement 2 (Acquisition Process - Product Acquisition)

Representative tasks	Expected outcomes
a) Prepare acquisition requests, offers, or directives	Acquisition documents, as applicable to the technical effort, prepared to include: 1) plans to be provided to suppliers, as applicable; 2) purpose of the acquisition, the essential requirements to be met, the products to be delivered by a supplier, and the operational concept and expected operational environment for each product, as applicable; 3) what the products to be delivered must be able to do; how well the products must perform; desired characteristics of the products, constraints, and other essential product attributes; management concerns including line of authority, financial management, and reporting; and requirements that can affect the cost, schedule, and risk in accomplishing the work effort or delivery of the product; 4) concerns such as cost and schedule that can constrain the work effort or product, and states whether or not the concern can be traded off; 5) expected tasks or work to be done by the supplier; 6) the data and other work products to be delivered, including form, format, and schedule.
b) Evaluate supplier response	Supplier or suppliers selected that will do the agreed-to work and provide the desired products, as appropriate.

c)	Make offer or provide directive	Offer made or directive provided to the selected supplier or suppliers.
d)	Negotiate agreement	A satisfactory agreement established based on the bounds determined by, as appropriate: 1) applicable legal, regulatory, policies, procedures and practices that will affect negotiation strategy or conduct; 2) the type of agreement to be negotiated; 3) negotiation strategy; 4) conditions identified from the plans for the procurement work effort that could affect negotiations and agreement performance; 5) constraints identified from the plans for the procurement work effort that could affect negotiations and agreement performance.
e)	Record agreement	Established agreement is captured in a form and medium appropriate to the effort.
f)	Accept delivered products	Installed or delivered system products validated as satisfying user, customer, or assigned requirements, and other applicable certification or acceptance criteria.

Table C.3—Requirement 3 (Acquisition Process - Supplier Performance)

	Representative tasks	Expected outcomes
a)	Define supplier relationships	The type of supplier support required, level of participation, procedures and criteria for selection and control, procedures for participation, as appropriate, on developer's multidisciplinary teams, and an appropriate acquirer-supplier agreement are established.
b)	Participate on product teams	Agreed-to procedures for participation of supplier personnel on developer multidisciplinary product teams and for participation of developer personnel on supplier multidisciplinary product teams are implemented.
c)	Monitor product metric data	Supplier performance against product metrics established in the agreement is determined. Invoked the applicable tasks in the Assessment Process.
d)	Flow-down changes in requirements of operational concept	Assurance made that all requirement and operational concept changes affecting the supplier's project have been properly communicated to the supplier.
e)	Control requirement changes	All changes approved to functional and performance requirements and to constraints, made by the supplier, that would affect the developer's project or other related projects or products. Approved changes have been appropriately distributed and implemented.
f)	Assess progress against requirements	Progress against assigned requirements included in the agreement and as changed by established change procedures is determined. Required technical reviews completed. Invoked applicable tasks of the Assessment Process.
g)	Validate products received	Assurance made that delivered products satisfy assigned requirements and approved changes. Resolution of identified variations resulting from validation of the delivered product is completed. Invoked the applicable tasks of the End Products Validation Process.

C.2   Technical Management task outcomes

Table C.4—Requirement 4 (Planning Process - Process Implementation Strategy)

Representative tasks	Expected outcomes
a) Identify stakeholders	Intended users or customers and other stakeholders who will have an interest or stake in the outcome of the project are established.
b) Identify applicable documents	Applicable source and technical documents and the requirements therein that could affect the project effort are identified and acquired, including: 1) the scope and purpose of both the project and products to be developed or reengineered 2) stated purpose of the products, expectations of the stakeholders, expected benefits to stakeholders, as well as the goals and objectives of the system, or portion thereof, to be developed or reengineered 3) enterprise policies, priorities, and constraints on funding, personnel, facilities, manufacturing capability and capacity, and critical resources that will affect accomplishing the requirements and goals of the source and technical documents 4) (a) applicable processes, standards, and specifications; (b) core enterprise technologies; (c) risks to business growth by new project; (d) must-win criteria; (e) net cost targets; (f) methods of resource allocation; (g) how work and changes will be authorized; (h) how information will be captured; (i) how work packages will be formed and controlled; (j) scope and procedures for tradeoff analyses, effectiveness analyses, and risk management, based on enterprise goals and planning baselines.
c) Identify associated process approaches	How development of enabling products associated with production, test, deployment/installation, and logistics processes will be implemented is determined.
d) Identify applicable life cycle phases	Applicable enterprise-based life cycle phases (see Annex B.2), the expected work product outputs and management reviews, and the relevant exit criteria for each applicable enterprise-based life cycle phase, including level of product maturity expected, level of acceptable risk, management review concerns, and documentation requirements, are determined.
e) Identify and define technical process and project integration	How the applicable processes of this Standard will be integrated with each other and with other processes specified in enterprise and agreement documents, and which internal and external projects that will be involved and how they will be integrated are determined.
f) Identify and define progress assessment	Required reporting requirements, specific product and process metrics to be used, how and when metrics will be collected and by whom, and how progress will be assessed are determined.
g) Prepare the process implementation strategy	A process implementation strategy document based on the integrated results of the outcomes of the above tasks is prepared.

Table C.5—Requirement 5 (Planning Process - Technical Effort Definition)

Representative tasks	Expected outcomes
a) Identify project requirements	The following are determined: 1) specific requirements include (a) work that the supplier is required to accomplish, (b) functions of the system, or portion thereof, to be furnished, engineered, or improved; how well the functions are to be performed; any required physical characteristics; and the operations concept, (c) data to be delivered and when, (d) budget and schedule requirements, and (e) other technical requirements provided in acquirer-supplied planning documents; 2) other stakeholders who have or who will have requirements or expectations with respect to the work to be accomplished or the system to be provided (for example, local, national, or international government agencies; persons living or working in the areas near where system products will be used or where products will be developed and produced; commercial or military competitors; and employees involved with the project); 3) potential conflicts between the acquirer-supplier agreement (proposed or final), the process implementation strategy, and enterprise policies and procedures, core technologies, and capacities; 4) specific constraints and any conflict between the process implementation strategy and the agreement (proposed or final) with respect to development, production, test, deployment, support, or disposal of the system products to be delivered, or the training of personnel required to operate and maintain the products.
b) Establish information database	The types and quantity of data and schema and other information that will have to be recorded and maintained are determined; a database that can securely retain and make available project information, as required, is established.
c) Define risk management strategy	The following are determined: (1) how the technical risk areas of the technical effort will be identified and tracked and (2) the appropriate risk aversion approaches based on the acceptable levels of risk specified in the agreement or in enterprise policies and procedures.
d) Define product and process metrics	The following are defined: (1) product metrics by which the quality of the products is to be evaluated; (2) process metrics by which the efficiency and effectiveness of the tasks of the technical effort are to be evaluated; and (3) frequency and methods by which product and process metrics are to be collected.
e) Establish cost objectives	Rigorous cost goals (ownership, acquisition, operating, support, and disposal) to be used in tradeoff analyses are established.
f) Identify technical performance measures	The following are determined (1) technical objectives related to success of the system, or portion thereof, [e.g., measures of effectiveness (MOEs) by which the user, customer, or acquirer will measure satisfaction or acceptance]; and (2) critical performance parameters that will receive management focus and are to be tracked using Technical performance Measurement (TPM) procedures.

g) Identify applicable tasks	The following are identified: (1) key events of the project (e.g., technical reviews, physical integration, major test, product and process verifications, and end product validations) established by input planning documents; (2) entry and exit completion criteria for each event; and (3) tasks required for meeting the entry and exit criteria of each event and for accomplishing each applicable process.
	    NOTE—The following structure of tasks can be helpful for accomplishing scheduling, staffing determination, and resources required:
	
	    1 Key events required to meet technical requirements (e.g., test and technical review)
	    2 Primary tasks related to accomplishing entry and exit criteria of each key event (e.g., define stakeholder requirements and prepare engineering drawings)
	    3 Support tasks that enable the staff accomplishing primary tasks to meet their objectives (e.g., provide resources, equipment, facilities; acquire appropriately skilled personnel for accomplishing the primary tasks; and arrange travel).
	    4 Management tasks required to direct, monitor, review, and approve the primary and support tasks (e.g., serve as chair of a technical review, and review and approve documents for transmittal to the customer).

	Representative tasks	Expected outcomes
h)	Identify methods and tools	The following are determined: (1) appropriate methods for accomplishing identified tasks, or groups of tasks of each applicable process; (2) required automated tools; (3) required specialized facilities and equipment; and (4) training requirements.
i)	Establish technology insertion approaches	The applicable or potential technology constraints are identified and the approach for conducting parallel technology developments, and planned technology insertions are established.

Table C.6—Requirement 6 (Planning Process - Schedule and Organization)

	Representative tasks	Expected outcomes
a)	Develop event-based schedule	The key events for the technical effort associated with applicable enterprise-based life cycle phases, related applicable tasks to each event, and the completion criteria for each task and an event are developed and documented.
b)	Develop calendar-based schedule	The calendar date that each key event will be completed or expected to be completed; the planned start and completion time for accomplishment of each task (primary, support, and management); and the dependency relationships between tasks and between tasks and events, and between events with other events are developed and documented.
c)	Identify resource requirements	The material resources, facilities, and equipment required to complete each scheduled primary, support, and management task are determined, and the date such resources are required is specified.
d)	Define staffing and discipline needs	The following are determined: (1) personnel needs by discipline and performance level to complete scheduled primary, support, and management tasks, and the date each staffing need is required; (2) internal and external supplier training needs and schedules to achieve required proficiencies; and (3) risk to the project, if adequate staffing is not available.
e)	Define team and organization structure	(1) The multidisciplinary teams needed to carry out the planned technical efforts and produce required work products are formed within enterprise and project resource constraints; (2) The composition of teams by functional and disciplinary membership that are organized to support specific system product development is established; (3) The names of staff members assigned to each team are established; (4) Responsibilities and authority of teams and team members are defined; and (5) Roles, responsibilities, authority and boundaries for each team are established.

Table C.7—Requirement 7 (Planning Process - Technical Plans)

Representative tasks	Expected outcomes
a) Develop Engineering Plan	An efficient and economical means of implementing the processes for engineering a system is defined and documented. It answers the following questions: 1) What is the general problem to be solved? 2) What is the benefit to the acquirer (enterprise perspective)? 3) What is the application context of the general problem to be solved? 4) What is the boundary of the general problem to be solved, denoting what can be controlled by the developer (inside) and what influences the development and is influenced by the development but not controlled by the developer (outside)? 5) What are the required inputs and outputs? 6) What are the influencing factors and constraints? 7) How are the system concerns, as appropriate, of reliability, availability, maintainability, security, safety, health factors, survivability, electro-magnetic compatibility, radio frequency management, and human factors being considered and included? 8) What processes and tasks must be accomplished? 9) How will each process be accomplished? 10) What resources, methods, and tools are necessary to accomplish the tasks of each process? 11) How will the required resources and tools be acquired? 12) What is the organizing structure? 13) How will the organization be staffed and managed? 14) What are key intermediate events leading to project completion, and how will their occurrence be determined? 15) When, where, and by whom will tasks and events be completed? 16) What are the risks involved? How will risks be managed? 17) What are the completion criteria for the process tasks? 18) What are the entry and exit criteria for reaccomplishing each process? 19) How will project completion be determined? NOTES 1 The engineering plan usually covers one or more phases of the enterprise-based life cycle and the applicable phases of the engineering life cycle. 2 The engineering plan is to cover process applications within the engineering life cycle to meet the exit criteria of the applicable enterprise-based life cycle phases, as consistent with the acquirer-supplier agreement and the extent of the project conducted within an enterprise.
b) Develop Risk Management Plan	Documentation of the tasks to be accomplished by project teams and analysts for identification of potential risks, characterization and prioritization of identified risks, aversion of risks, tracking and control of risks, and communication of risk status are defined and documented.
c) Develop Technical Review Plan	The tasks to be accomplished to implement required technical reviews and a detailed description for each review are developed and documented to include: (1) a check list for tasks to be accomplished, (2) entrance and exit criteria, (3) review schedule, (4) documentation requirements, (5) distribution list for technical data package, (6) participants, and (7) responsibilities of participants.
d) Develop Validation Plans	The tasks to be accomplished and the resources to be allocated and scheduled for validating that: (1) the system technical requirements, logical representations, and derived technical requirements are well formulated (see Requirement 25) and conform to their respective sources, and (2) the products received from suppliers, or delivered to an acquirer, conform to the user, customer, or assigned requirements associated with the end product are defined and documented.
e) Develop Verification Plans	The tasks to be accomplished and the resources to be allocated and scheduled for verifying that (1) the selected and characterized physical solution description satisfies the assigned system technical requirements, logical representations, and derived technical requirements, (2) end products satisfy their specified requirements, and (3) enabling products will be ready when required to provide life cycle support to their respective end products are defined and documented.

Representative tasks	Expected outcomes
f) Develop Other Applicable Plans	The tasks to be accomplished to complete required control activities or other design activities such as design-to-cost, Technical Performance Measurement, technology insertion, safety, security, human factors engineering, and maintenance reliability (see Annex D for others), as required in an agreement or by enterprise policies and procedures, are defined and documented.

Table C.8—Requirement 8 (Planning Process - Work Directives)

	Representative tasks	Expected outcomes
a)	Develop work packages	The work required, input sources, schedules, budget, and reporting requirements to implement, execute, and control the work are defined and documented.
b)	Generate work authorizations	Approval/disapproval of work packages is assigned, and work authorizations are documented.

Table C.9—Requirement 9 (Assessment Process - Progress Against Plans and Schedules)

	Representative tasks	Expected outcomes
a)	Identify events, tasks, and process metrics for monitoring	The events and tasks that must be monitored, as well as the metrics that will be used to assess progress against plans and schedules, are identified. The applicable expected values for each progress metric are established.
b)	Collect and analyze process metrics data	Results from completion of required tasks and events, and process metrics data are determined and tracked.
c)	Compare process metrics data against plans and schedules	The following are determined: (1) completion of required tasks and events, (2) variances of metrics from expected values, (3) progress variances from plans and schedules, (4) technical areas requiring management or team attention, and (5) cost and schedule risks.
d)	Implement required changes	The cost effective changes to correct variances and needed changes to plans and schedules, and required changes, revised work directives, and updated plans to reflect approved changes and management decisions are identified, approved, and implemented.

Table C.10—Requirement 10 (Assessment Process - Progress Against Requirements)

	Representative tasks	Expected outcomes
a)	Identify product metrics to be monitored	Product-related metrics, and their expected values, that will affect the quality of the product and provide information of the progress toward satisfying user/assigned requirements, other stakeholder requirements, and derived requirements are identified and documented.
b)	Collect and analyze product metrics data	The following are determined, as appropriate: (1) analyzed, estimated, or measured values of critical performance parameters at predetermined events (e.g., simulation and prototype tests), (2) compliance to applicable requirements, (3) levels of technical risks, (4) marginal cost benefit of performance beyond requirements, (5) degree of customer satisfaction and public acceptance, and (6) effect of a critical performance parameter status on related end-user products.
c)	Record rationale for decisions and assumptions made	The following are recorded, as applicable: (1) rationale for selection of alternatives based on recommendations and effects of tradeoff and effectiveness analyses and (2) assumptions associated with decisions made during requirements definition, solution definition, tradeoff analyses, effectiveness analyses, verifications, and validations.
d)	Compare results against requirements	The following are determined, as applicable: (1) satisfaction of technical requirements, (2) progressive maturity of the system, or portion thereof, being engineered/reengineered, (3) variances from expected values from Technical Performance Measurements, and (4) variations from requirements resulting from end product verifications and end product validations.
e)	Identification and Implementation of Required Changes	The following are identified, evaluated, and implemented, as applicable: (1) alternative corrective actions to mitigate out-of-tolerance Technical Performance Measurements, (2) other changes to be implemented so that products will meet requirements, (3) recommended user/assigned, other stakeholder, or technical requirement changes, and (4) implementation of revised specifications and configuration baselines that reflect approved changes and management decisions.

Table C.11—Requirement 11 (Assessment Process - Technical Reviews)

	Representative tasks	Expected outcomes
a)	Identify technical review objectives and requirements	The following are identified and documented: (1) purpose and objectives of the review, (2) agenda requirements, (3) tasks to be completed at each required review, (4) entrance and exit requirements, (5) documentation requirements, (6) distribution requirements, and (7) responsibilities of review participants.
b)	Determine progress against event-based plan	The satisfaction of entrance requirements to the review are determined and documented.
c)	Establish technical review board, agenda and speakers	For each review, the following are established: (1) persons who will participate in the review, (2) chairperson, (3) secretary, (4) reviewers of the presentation, (5) agenda that meets review requirements and ensures that all required tasks are completed, and (6) members of the design team that will prepare the data package, prepare the presentation, prepare material for distribution at the review, make the presentation, answer questions, and accomplish tasks to close out action items.
d)	Prepare technical review package and presentation material	Comprehensive read-ahead material is prepared that includes sufficient information so that technical board members can understand the design and participate effectively in the review. Review team responsibilities, agendas, plans, and expectations from the review; are defined and documented. A comprehensive set of presentation materials that describe the assigned design topics and that satisfy review objectives is prepared.
e)	Facilitate resolution of emerging issues	Emerging issues identified and resolved prior to the review.

f)	Conduct technical review	The following are assessed by the review: (1) maturity of system, or portion thereof, being engineered, (2) progress according to plans and requirements, (3) risks and variances in cost, schedule, and performance, and (4) readiness to proceed with the next phase of development. Action items required to meet review objectives are generated, recorded, and assigned.
g)	Close-out review	The following are completed for review close-out: (1) preparation and distribution of minutes that include purpose, time, place, attendees, decisions, action items, due date, and persons responsible for resolving actions items, (2) resolution of action items, and (3) sign off by chairperson.

Table C.12—Requirement 12 (Control Process - Outcomes Management)

Representative tasks		Expected outcomes
a)	Capture process outcomes	The following are recorded in the information database: (1) the outputs of the technical processes implemented in the engineering of a system, (2) the methods, tools, models, and metrics used, (3) recommendations, decisions, assumptions, and effects, (4) lessons learned, and (5) other data that allows traceability of requirements.
b)	Perform configuration management	The configuration of the products is documented and made available. The following is realized: (1) product configuration is known and reflected in product information; (2) beneficial product changes are effected without adverse consequences; (3) change is managed from the first implemented phase during system design, (4) information that will be needed to make later decisions on products is captured; (5) consistency between a product and information about the product; and (6) capability to distinguish between product versions or builds. NOTE—ANSI/EIA-649 can be used in conjunction with this Standard, for configuration management.
c)	Perform change management	Traceability of changes is maintained and controlled, including source of the change, processing methods, approvals, and implementations in accordance with the Change Management Plan.
d)	Perform interface management	System internal and external interfaces are maintained and controlled, including completion of interface definition, assessments of compatibility, changes, and coordinations and approvals in accordance with the Interface Management Plan. Interfaces are managed, ensuring that: (1) all internal and external functional and physical (including human) interfaces for a building block are identified, defined, assigned, documented, and managed; (2) building block design definitions are compatible in terms of form, fit, and function; and (3) interface changes affecting the building block and affected by the building block (see Clause 6) are controlled to prevent adverse consequences.
e)	Perform risk management	Potential risks are identified, characterized and prioritized, and properly averted, tracked and controlled. Risk status is communicated in progress reports, in proposals, and at technical reviews, in accordance with the Risk Management Plan. A clear view of future risks is provided, better decision making is enabled, and problems are prevented from occurring—but if they do occur, a plan exists to mitigate the effect of the problem. NOTES 1 Risk is always present in an engineering or reengineering project. Sources of risk include the tendency of acquirers to: (1) desire products of a system that are intended for technical accomplishment near the limits of the state of the art (performance); (2) push for delivery of system products as soon as possible to meet an imminent market opportunity or threat; and (3) limit funding available. Additionally, risks come from both internally and externally imposed constraints (e.g., resource, capacities, environmental conditions, and reuse). 2 The major sources of risk are programmatic, schedule, political, financial, and technical. Risks are greater when planning, control, resources, and time are inadequate. Risks are also greater when information is not available for decision making, or when the information is too much, too little, too late, irrelevant, or inaccurate.

f)	Perform data and document management	Data and documents are maintained and controlled, including development support, handling and storage, and required technical data and document delivery in accordance with the Data Management Plan. Data and document management includes capturing data and documents generated during implementation of the processes of this Standard, and generating and maintaining an evolving technical data package. A typical technical data package includes: (1) a buy-to description (e.g., detail specifications and/or final drawings); (2) a build-to description; (3) design documentation; (4) engineering changes, deviations, and waivers; and (5) enabling product descriptions.

Build-to descriptions include: (1) models, drawings, and specifications; (2) production planning; (3) tool design; (4) bill of materials; and (5) statistical process control plan.

NOTE—Multidisciplinary teamwork is essential to ensure the accuracy and completeness of technical manuals and the technical data package. |
| g) | Manage information database | Relevant data and information are maintained and controlled for the project, including inputs and outputs of control process tasks and ensuring back-ups, if applicable, of digital databases. Relevant data includes:
1. Inputs and outputs of technical process activities:
    a) work products (e.g., specifications, drawings, and code lists);
    b) archival data (e.g., decisions made [including rationale], assumptions, lessons learned, changes, and empirical data);
    c) stakeholder requirements (e.g., technical objectives, constraints, and interfaces);
    d) requirement, functional, and physical architectures;
    e) physical models developed (e.g., prototypes, breadboards, brassboards, and mock ups);
    f) simulation model outputs and assumptions;
    g) metrics (e.g., cost and technical performance measures);
    h) planning documents (e.g., engineering plan and technical event plan);
    i) technologies.
2. Process models used for:
    a) analysis of problem (analysis of requirements and analysis of functions) (e.g., Quality Function Deployment, behavior, and time);
    b) solution definition (synthesis) (e.g., for design);
    c) validation and verification;
    d) systems analysis (e.g., for tradeoff analyses, risk analyses, and effectiveness analyses);
    e) control (e.g., interfaces, data, configurations, schedules, costs, product performance, reviews, and assessments).
3. Tools used:
    a) automated tools (e.g., traceability, analysis, and design);
    b) validation and verification tools;
    c) tradeoff analysis support tools;
    d) communication tools;
    e) status reporting/projection tools. |
| h) | Manage and track requirements | The following are maintained and controlled: (1) input requirements (acquirer and other stakeholder), system technical requirements, logical solution representations, physical logical solution representations, derived technical requirements, and specified requirements; (2) validation results; (3) requirement changes resulting from resolution of variances; and (4) changes made to requirements through formal change procedures from Configuration Management, Change Management, and Interface Management tasks. |

Table C.13—Requirement 13 (Control Process - Information Dissemination)

Representative tasks	Expected outcomes
a) Provide progress status	Process and product metric data have been disseminated according to the agreement, engineering plan, and enterprise policies and procedures, and to meet approved requests.
b) Provide planning information	Work packages and appropriate technical plans have been disseminated to project teams and other required or approved recipients.
c) Disseminate approved and controlled requirements	Acquirer/assigned, other stakeholder, system technical and derived technical requirements, and all changes to requirements are distributed in a timely manner to all stakeholders to ensure that all work is conducted in accordance with the latest approved requirements.
d) Provide information for and from reviews	The following have been disseminated, as appropriate: (1) read-ahead technical review package to technical review board members, (2) information and items necessary to demonstrate that event-based criteria have been satisfied for initiation of the review, (3) information packages and presentation materials at the review, (4) minutes of the review, action items required for closure, and final close-out approval.
e) Make available design data and schema	Data pertinent for the technical effort have been disseminated to project teams and team members to ensure information availability for decisions and events, and to other authorized recipients requesting information
f) Make available lessons learned	Lessons learned have been disseminated to other projects within the enterprise and to other teams within the project.
g) Report variances	Product and process variances have been reported along with (1) recommended actions to return the product or process metric to established expectations or requirements, (2) cost and schedule impacts, and (3) effects on the project if no action is taken.
h) Disseminate data deliverables	Data deliverables have been disseminated as required by the agreement, enterprise policies and procedures, the engineering plan, and other technical plans.
i) Disseminate approved changes	Approved requirements and design changes and updated plans have been distributed to approved or required recipients
j) Disseminate directives	Work directives resulting from management decisions have been disseminated to intended recipients that initiate or change work by project teams or support organizations within the enterprise.

C.3   System Design task outcomes

Table C.14—Requirement 14 (Requirements Definition Process - Acquirer Requirements)

Representative tasks	Expected outcomes
a) Identify, collect, and prioritize acquirer's system requirements	User, customer, or assigned requirements for a system, or portion thereof, have been identified and defined in terms of needs, expectations, capabilities, and priorities, or of assigned requirements for a system, or portion thereof, as expressed in specifications. Specifically, the following have been identified, as applicable: 1) concept of operation 2) what the acquirer wants the products of the system to accomplish (functional requirements) 3) how well each function must be accomplished (performance requirements) 4) natural and induced environments in which the system products must operate or be used 5) design constraints such as use of non-developmental or reusable items 6) requirements pertaining to availability, electro-magnetic compatibility, health factors, human factors. interoperability, maintainability, reliability, safety, and security 7) measures of effectiveness (MOEs) that reflect overall expectations against which satisfaction will be determined 8) constraints pertaining to development, production, test, deployment/installation, training, support/maintenance, and disposal.
b) Ensure completeness and consistency of the set of collected acquirer requirements	The collected user, customer, or assigned requirements are validated. Resolution of all conflicts and variances is competed. Invoked the Requirements Validation Process, Requirement 26.
c) Record set of acquirer requirements	Validated set of acquirer requirements is captured in the established information database.

Table C.15—Requirement 15 (Requirements Definition Process - Other Stakeholder Requirements)

Representative tasks	Expected outcomes
a) Identify and collect other stakeholders' end product requirements	Other types of requirements that can constrain the engineering of the system's end products are identified, collected, and defined, such as: 1) project plans 2) team assignments and organization 3) automated tools availability and approval for use 4) required metrics 5) decisions from management or technical reviews 6) enterprise standards, guides, policies, and procedures 7) enterprise technologies 8) enterprise physical and financial resources
b) Identify and collect other stakeholders' enabling product requirements	Enabling product requirements associated with manufacturing/production, test, deployment/installation, training, support, and disposal (including disposal) processes including enterprise capacities (facilities, equipment, tools, and staff) to accomplish these processes are identified, collected, and defined.
c) Identify and collect other stakeholders' external constraints	Other end product and development process constraints from external sources are identified, collected, and defined, such as: 1) national and international standards, laws, and regulations (including environmental protection, hazardous material exclusion list, and waste disposal) 2) technology base 3) industry and international standards and general specifications 4) competitor product capabilities and trends 5) interfaces with other existing or evolving systems and platforms

	Representative tasks	Expected outcomes
d)	Ensure completeness and consistency of the set of other stakeholders' requirements	The collected set of other stakeholder requirements is validated. Resolution of all conflicts and variances is completed. Invoked the Requirements Validation Process Requirement 27.
e)	Record set of other stakeholder requirements	Validated set of other stakeholder requirements is captured in the established information database.

Table C.16—Requirement 16 (Requirements Definition Process - System Technical Requirements)

	Representative tasks	Expected outcomes
a)	Establish required transformation rules, priorities, inputs, outputs, states, modes, and configurations	Transformation rules, priorities, inputs, outputs, states, modes, and configurations that will influence and affect the other tasks for definition of system technical requirements are identified and defined, as appropriate to each system product.
b)	Define operational requirements	The range of anticipated uses of the end products, as identified in the concept of operations or specification, or for potential end products, is defined, including for each operational profile, definition of: 1) the utilization environment and factors, natural or induced, that can affect end product performance 2) the events to which end products must respond 3) the physical and functional interfaces (e.g., mechanical, electrical, thermal, data, and procedural) including physical interactions (e.g., form and fit), system boundaries (what is controlled by the developer) and interactions (e.g., information flows and behaviors) of products or environments within developer control and those systems or environments outside system boundaries 4) what system end products must be able to accomplish (functional requirements) to satisfy acquirer identified requirements. Includes factors such as producibility, testability, transportability, installability, operability, supportability, disposability, reliability, availability, maintainability, security, and safety 5) how often end products will be used, cycle time between uses, and how often each product function will be accomplished.
c)	Define Performance Requirements	The following are defined: (1) the performance expectations for each functional requirement (how well the function must be accomplished), (2) the set of measure of performance (MOPs), made up of the functional and performance requirement combinations, associated with each MOE, (3) the critical performance parameters (TPMs) selected from the MOPs that will be key indicators of end product or system performance, and if not met, that will cause the associated MOE to not be satisfied and will put the project in cost, schedule, or performance risk, and (4) functional and performance testability approach for each requirement statement.

d)	Analyze acquirer and other stakeholder requirements to: 1) Define human factors effects 2) Establish capacities and timing 3) Define technology constraints 4) Define product design constraints 5) Define enabling product requirements 6) Identify conflicts 7) Determine tradeoff analysis criteria	The following are identified and defined, as applicable: 1) the user or operator roles, as applicable, and the human factors effects (ergonomic limitations, work space, eye movement, access, cultural background, natural and induced environmental constraints, work tasks, and time constraints) associated with functional and performance requirements on potential users, operators, installers, or recipients and handlers of system end products 2) required capacities (e.g., memory, storage, and flows) of end products and timing of events, states, modes, and functions related to each operational profile 3) any constraints or limitations from use of existing technologies and the risks associated with using any unproven technologies 4) any constraints that will influence or affect end product design (e.g., materials, special skills, and automated tools), required physical characteristics (e.g., size, color, texture, weight, and buoyancy), operator safety, system security, reuse requirements, standardization of end products, open system architecture, maintainer access, handling and storage, transportability, and other attributes of end products or design processes for which tradeoffs cannot be made 5) technical requirements for enabling products associated with processes to develop, produce, test, deploy/install, operate, support/maintain, train, and retire/dispose of end products under development or being improved 6) conflicts among the requirements set 7) the set of risk, cost, schedule, and performance criteria to be used in conducting tradeoff analyses for conflict resolution. NOTES 1 Developers are to ensure that residual risks from constraints are not significant to harm or otherwise prevent the system from performing its functions, create unacceptable costs, or price the system's end products out of competitiveness. 2 Analyses of system requirements can necessitate consideration of existing or possible physical solutions to ensure feasibility.
e)	Challenge questionable requirements	Acquirer and other stakeholder requirements that are of questionable utility or that have an unacceptable risk of satisfaction are identified and resolved.
f)	Resolve identified conflict of requirements	Any conflicts between combinations of functional requirements, performance requirements, or constraints, as well as within respective sets of those requirements, are resolved. Invoked the Systems Analysis Process, Requirement 23.
g)	Prepare a set of acceptable system technical requirement statements	Associated assumptions and technical requirement statements for the system are prepared and then validated. Invoked the Requirements Validation Process Requirement 25.
h)	Ensure completeness and consistency of the set of system technical requirements	System technical requirements are validated. Resolution of variances is completed. Invoked the Requirements Validation Process, Requirement 28.
i)	Record the set of system technical requirements	The validated set of system technical requirements and associated assumptions is captured in the project's information database and maintained and controlled throughout the life of the project. NOTE—Controlled maintenance of the system technical requirements in the information database allows for traceability, supports validation, and is essential for change management.

Table C.17—Requirement 17 (Solution Definition Process - Logical Solution Representations)

Representative tasks	Expected outcomes

a)	Select and implement one or more of the four approaches below, or other approach designated by enterprise policies, guides, or standards: 1) Functional analysis 2) Object-oriented analysis 3) Structured analysis 4) Information modeling 5) Other techniques	An abstract definition of the solution is provided in the form of: 1) functional flow, timelines, behaviors, data and control flows, states and modes, functional failure modes and effects. 2) objects encapsulating a partition and mapping of System Technical Requirements and characterized by services (behaviors, functions, and operations) provided and by encapsulated attributes (values, characteristics, and data) 3) model data and functions with algorithms derived from contextual diagrams and data flow diagrams used to decompose functions while explicitly showing the data needed for each function 4) data structures with their functions and processing flows related to the data and associated with assigned system technical requirements 5) outcomes from other techniques (dependent on the nature of that particular methodology)
b)	Establish sets of logical solution representations by: 1) Performing tradeoff analyses 2) Identifying and defining interfaces 3) Analyzing behaviors 4) Identifying and defining states and modes 5) Identifying and defining timelines 6) Identifying and defining data and control flows 7) Analyzing failure modes and defining failure effects	NOTE—There is no set format or form for the various definitions of logical solutions. The format or form selected is that which best defines the functional, behavior, or data flow or data structure, as appropriate, and that will allow best assignment to potential end products, manual operations, or enabling products for generating physical solution representations. One or more sets of logical solution representations that are appropriate to the engineering life cycle phase and the system being engineered or reengineered have been formed and defined, and include: 1) Acceptable logical arrangements and sequencing, or derivative representations (e.g., subfunctions, timelines, objects, data structures, and threads) defined by invoking the Systems Analysis Process, Requirement 23. 2) Interfaces related to logical arrangements and sequencing, or derivative representations, to include, for example, start and end of states and inputs and outputs defined. Interface attributes identified and defined that trigger, for example, a behavioral response, change of state or mode, or data flow. 3) The responses (outputs) of the subfunction, group of subfunctions, objects, etc., to stimuli (inputs) for each operational profile identified and defined, as appropriate. Executable threads identified and defined, as appropriate, through the logical arrangements and sequencing, or derivative representations. 4) The states and modes for which subfunctions, groups of subfunctions, groups, objects, etc., exhibit different behaviors are identified and defined. 5) Timelines associated with a sequence of functions, objects, etc., for each operational profile are defined, as appropriate. Ranges for execution time and conditions that cause normal and abnormal performance are identified and defined. 6) The following are defined, as appropriate, (1) data flows among subfunctions, groups of subfunctions, objects, etc., for each operational profile, and (2) execution controls of each subfunction, and among groups of subfunctions or objects, for each operational profile 7) The functional or behavioral consequences of any specific functional failure that represent significant safety, security, human factor, performance, or environmental hazards are determined and prioritized. Alternative actions to resolve high-priority failure consequences are determined.
c)	Assign system technical requirements (including performance requirements and constraints)	System technical requirements (including performance requirements of a functional requirement and constraints) assigned to appropriate subfunctions, groups of subfunctions, objects, data structures, etc. NOTE—There can be unassigned system technical requirements after the tasks of Requirement 17 are completed (see the note under Requirement 17, Task c).
d)	Identify, define, and validate derived technical requirement statements	Derived technical requirement statements prepared that (1) reflect requirements associated with defined logical solution representations from tasks a) and b), (2) constitute expansion of previously defined derived technical requirements into more detailed lower level requirements, (3) represent system technical requirement statements (such as range) that are not appropriate for logical solution representations but through analysis can be made more specific (such as fuel capacity, engine efficiency, and vehicle resistance), and (4) individually and as a set, are well formulated in accordance with Requirement 25).

e)	Ensure completeness and consistency of logical solution representations	Logical solution representations and assumptions are validated. Resolution of identified variances is completed. Invoked the Validation Process Requirement 29.
f)	Record logical solution representations and derived technical requirements	The following are captured in the information database: (1) the data generated, selected arrangements and sequencing, assignments of system performance requirements, and constraints, (2) the validated sets of logical solution representations, (3) the derived technical requirements, along with source rationale and assumptions, and (4) any unassigned system technical requirements [see the note under Requirement, Task 17 c)].

Table C.18—Requirement 18 (Solution Definition Process - Physical Solution Representations)

Representative tasks	Expected outcomes
a) Analyze logical solution representation sets, assigned system and derived technical requirements.	The following are determined: 1) which logical solution set or assigned requirement provides a requirement for an enabling product associated with development, production, test, deployment/installation, training, support/maintenance, or retirement/disposal. 2) which logical solution set or assigned requirement can best be accomplished manually or by facilities, material, or data. 3) which logical solution set or assigned requirement can best be accomplished by hardware, software, or firmware products (new or existing). Invoked the Systems Analysis Process, Requirements 22 and 23, as necessary.
b) Assign representations, derived technical requirements and unassigned system technical requirements to appropriate physical entities:	The appropriate sets of functions, groups of functions, objects, behaviors, derived technical requirements, etc., are assigned to appropriate physical entities (e.g., sensor, engine, power source, storage device, structural frame, communication device, and computer) that will make up a physical solution. NOTE—This assignment to physical entities and generation of alternative solutions composed of these entities is tightly coupled and iterative.
c) Generate and evaluate alternative physical solution representations by performing the following tasks: NOTE—Appropriate models (digital, hardware or software, or both, partial or complete) or prototypes are normally created to help avert risk, identify critical product characteristics and enabling product requirements, identify control requirements for product integrity, perform sensitivity analyses to establish design margins, provide quantitative performance assessments, and select preferred physical solution representation.	
1) Identify and Define Physical Interfaces	Physical interfaces (human, form, fit, function, data flow, and interoperability) among specific physical entities that make up each end product physical solution alternative, among end products that make up the system, among end products and enabling products, and along with end products and other interfacing systems, are identified and defined. Physical interfaces (internal to the system and external) among specific solutions selected for each physical entity that make up the selected physical solution are designed and described.
2) Identify and Analyze Critical Parameters	For each identified critical performance parameter (TPM), the variability and the sensitivity of each alternative physical solution to that variability are identified and defined.
3) Identify and assess physical solution options:	
(a) Technology requirements	The technological needs necessary to make each alternative solution effective, the risks associated with introduction of new or advanced technologies to meet requirements, and alternative lower-risk technologies that could be substituted for unacceptable higher risk technologies are identified and assessed.
(b) Off-the-shelf availability	The availability of off-the-shelf end products (non-developmental hardware or reusable software) are identified and assessed.
(c) Competitive considerations	The effect of design considerations to maintain or make a physical solution representation alternative competitive with potential or existing competitor products is identified and assessed.
(d) Failure modes, effects, and criticality	Further design efforts are identified that will be needed to accommodate redundancy and to support graceful degradation when the results of failure modes, effects, and criticality of failure analyses have an unacceptable or high criticality rating.
(e) Performance assessment	The degree to which the performance requirements are satisfied by each alternative physical solution is identified and assessed.
(f) Life cycle considerations	The degree to which producibility, testability, ease of deployment, installability, operability, supportability, trainability, and disposability are considered in each alternative physical solution is identified and assessed. Enabling product needs, requirements and constraints for the associated processes are identified, assessed, and defined.

	(g) Capacity to evolve	The capacity of each alternative physical solution to evolve, or be reengineered, incorporate new technologies, enhance performance, increase functionality, or other cost-effective or competitive improvements, once solution end products are in production or in the marketplace, are identified and assessed. Limitations that can preclude the capability of the system to evolve are identified and documented.
	(h) Make vs. buy	The advantages and disadvantages of making the products of the solution within the enterprise or going to an established supplier are identified and assessed.
	(i) Standardization considerations	The advantages and disadvantages of using standardized end products, protocols, interfaces, etc., for the physical solution are identified and assessed.
	(j) Integration concerns	The following are identified and assessed: (1) potential hazards to other systems, operators, or the environment; (2) built-in test and fault-isolation test requirements; (3) ease of access, ready disassembly, use of common tools, part count effect, advantage of modularity, standardization, and less need for cognitive skills; and (4) dynamic or static conflicts, inconsistencies, and improper functionality of the integrated products of the solution.
	4) Perform systems analyses	Which physical solution option is best for each alternative solution representation, based on each option individually or in sets, (Requirements 22, 23, and 24) is determined.
d)	Identify and define derived technical requirements	Derived technical requirement statements identified and defined that are (1) the consequence of design choices associated with the above tasks, (2) used to form alternative physical solution representations, as appropriate, and (3) individually and as a set (including physical interface requirements) well formulated (Requirement 25).
e)	Select preferred physical solution	The preferred physical solution representation is selected, based on the results of an evaluation of each physical solution representation (Requirements 22, 23, and 24).
f)	Ensure selected physical solution representation consistency	The selected physical solution representation is determined to be consistent with assigned logical solution representations, derived technical requirements, and the identified subset of unassigned system technical requirements [see the note under Requirement, Task 17 c)].
g)	Record the outcomes of a) through g)	The following are captured in the information database: selected physical solution representation, along with selection rationale, assumptions, and outcomes from tasks a) through g).

Table C.19—Requirement 19 (Solution Definition Process - Specified Requirements)

	Representative tasks	Expected outcomes
a)	Fully characterize design solution	For each specific physical entity of the selected physical solution: hardware drawings and schematics, software design documents, parts lists, interface descriptions, procedural manuals, data or other applicable design descriptions, based on the requirements assigned to the selected physical solution and engineering life cycle phase exit criteria, are completed, as applicable.
b)	Ensure design solution consistency	The defined design solution is verified as being consistent with the selected physical solution representation as described by its encapsulated requirements for the assigned logical solution representations, associated system technical requirements, and derived technical requirements. Invoked the Verification Process Requirement 30.
c)	Specify requirements	System, subsystem, and interface specifications that describe the specified requirements (functional and performance requirements, and physical characteristics) are documented. Test requirements to ensure that end products satisfy their specified requirements are determined and included in the related specification, as appropriate to the engineering life cycle phase.
d)	Record design solution and related specified requirements	The design solution work products, including the specified requirements, are captured and recorded in the established information database, along with all tradeoff analyses, design rationale, assumptions, and key decisions to provide traceability of requirements up and down the system structure.
e)	Establish projects for development of enabling products	A project is established to engineer the enabling products associated with the processes for development, production, test, deployment/installation, training, support/ maintenance, and retirement/disposal. NOTE—The requirements for enabling products come from (1) user or customer or assigned requirements and other stakeholder requirements for the system, and (2) derived technical requirements for end products and their subsystems generated by tasks of the Solution Definition Process. Thus, initiation of enabling product development is dependent on the completion of the design solution for the system (building block) being engineered or reengineered.

C.4 Product Realization task outcomes

Table C.20—Requirement 20 (Implementation Process)

Representative tasks	Expected outcomes
a) Acquire products (Goods or Services)	Hardware, software, firmware end products, or composites of end products built or coded to their specified requirements, drawings or descriptive documents; or other needed physical entities [for example, trained personnel, certified facilities, special techniques (manual procedures or processes), manuals)] are acquired. Hardware items were (1) purchased off-the-shelf from a supplier or vendor; (2) fabricated in-house; or (3) from in-house, off-the-shelf supply. Software items were (1) purchased from a supplier or vendor; (2) coded in-house; or (3) reused.
b) Validate acquired products	Acquired products are validated that each acquired end product or aggregation of end products is in conformity with its user, customer, or assigned requirements. Invoked the End Products Validation Process, Requirement 33. NOTE—This validation is accomplished by the supplier as per the agreement or by the acquirer, with or without supplier participation. This validation includes product certification or acceptance testing, as appropriate.
c) Assemble/integrate validated end products	End products or aggregations of end products already validated are physically integrated or assembled into the required test article or the end product that will be verified and delivered to an acquirer.
d) Verify integrated end products	End products are verified that each end product of the system under development complies with its specified requirements. Invoked the System Verification Process, Requirement 31.
e) Verify enabling products for each associated process	Enabling products for production, test, deployment/installation, training, support/maintenance, and retirement/disposal, as appropriate, are verified that they will be ready to perform the support functions required by the system's end products. Associated processes are proofed, as applicable. Invoked the System Verification Process, Requirement 32.
f) Validate the verified end product	End products are validated prior to delivery to their acquirer, if required in the agreement, using the End Products Validation Process, Requirement 33.

Table C.21—Requirement 21 (Transition to Use Process)

	Representative tasks	Expected outcomes
a)	Acquire and put in place enabling products	Appropriate enabling products for supporting the Transition to Use Process are acquired and put in place.
b)	Prepare end products for shipping or storage	In accordance with the agreement, (1) packing materials and containers are prepared, and (2) end products are packaged and appropriately labeled for either storage or delivery.
c)	Store or deliver end products	End products awaiting shipping are appropriately stored or, in accordance with the agreement, delivered to intended usage sites in a condition suitable for application, use, installation, or integration with other end products or composites of end products.
d)	Prepare the operational sites	Sites where products will be stored, installed, used, or maintained, or where services will be performed, are prepared, as required by the agreement.
e)	Installation of products	End products are installed at appropriate sites, as required by the agreement.
f)	Perform commissioning	Delivered or installed products are brought to operational readiness, with appropriate acceptance and certification tests completed, as required by the agreement.
g)	Provide ghosting	Parallel operation of a new and a legacy end product provides continuing service until the new system is fully on line and accepted by the customer, as required by the agreement.
h)	Train users and maintenance personnel	Training of users, operators, maintainers, and other necessary personnel is completed, as required in the agreement.
i)	Provide in-service support	In-service support is provided, as required in the agreement.

C.5 Technical evaluation task outcomes

Table C.22—Requirement 22 (Systems Analysis Process - Effectiveness Analysis)

Representative tasks	Expected outcomes
a) Plan effectiveness analyses	A plan is prepared to include the purpose, objectives, execution and data collection requirements, schedule of tasks, availability of required resources, expected outcomes, and the general approach for required effectiveness analyses.
b) Analyze system cost effectiveness	For each alternative physical solution representation, as well as for the design solution, the system cost effectiveness is determined with respect to the following attributes, as applicable: accuracy, availability, capacity, maintainability, reliability, responsiveness, operability, safety, security, survivability, spare requirements, transportability, vulnerability, etc.
c) Analyze total ownership cost	Costs to the enterprise and to the acquirer for alternative physical solution representations, for alternative tradeoff analysis options, or for proposed changes, and the known uncertainties (risks) in these costs are determined. NOTE—The following costs are typically included in a total ownership cost analysis: development, production, test, deployment/installation, training, operations, support/maintenance, and retirement/disposal.
d) Analyze environmental impacts	Applicable federal, state, municipal, and international environmental statutes and applicable hazardous material lists affecting the project and endurance of compliance by each physical solution are determined; the effect on and by each end product and enabling product on the infrastructure, land and ocean, atmosphere, water sources, and animal, plant and human life, as applicable, has been determined, from an enterprise-based life cycle perspective.
e) Analyze system effectiveness	For each operational profile, each alternative physical solution representation and the design solution are assessed by analytic confirmation to satisfy appropriate requirements.
f) Record outcomes of effectiveness analyses	Effectiveness analysis outcomes, as well as the details of the analyses performed, including rationale, assumptions, and lessons learned, are captured and recorded in the established information database.

Table C.23—Requirement 23 (Systems Analysis Process - Tradeoff Analysis)

Representative tasks	Expected outcomes
a) Plan tradeoff analysis	A plan is prepared to include: 1) the availability of required resources, level of importance, execution and data collection requirements, expected outcomes, objectives, schedule of tasks, and the type. NOTES—The types of tradeoff analyses typically performed include: 1 Formal—formally conducted, with results reviewed at technical reviews. Specific formal tradeoff analyses are normally identified in an agreement. 2 Informal—follows the same methodology of a formal tradeoff analysis but requires less documentation and is of less importance to the acquirer. 3 Judgmental—selection of a recommended option, based on judgment of the analyst or designer after a less rigorous analysis than that required by a formal tradeoff analysis and for which the consequences are not too important. One option is clearly superior to others or time is not available for a more formal approach. Most tradeoff analyses performed for engineering a system are of the judgmental type. 2) selection criteria that characterize what makes a specific option desirable or undesirable, such as (1) cost, schedule, performance, and risk; (2) life-cycle concerns; (3) -ility concerns (e.g., producibility, testability, maintainability, supportability, disposability); (4) size, weight, and power consumption for the type of tradeoff analysis selected; and (5) effectiveness analysis outcomes. 3) weighting factors for each criterion that will help distinguish its degree of importance for the defined tradeoff analysis. 4) applicable models (representative or simulation) that will support conduct of the tradeoff analysis, as well as determination that the model selected is valid for the tradeoff analysis to be performed. 5) list of viable optional solutions or courses of action to be evaluated.
b) Perform tradeoff analysis	Tradeoff analyses are completed according to the plan, with determination of: 1) quantitative basis for evaluating the tradeoff analysis options from appropriate effectiveness analysis tasks (Requirement 22). 2) quantitative assessment of the risk level associated with each option from appropriate risk analysis tasks (Requirement 24). 3) collection of data pertaining to each option evaluated and analysis of the data to determine the effect of each option on the system or project if implemented. Determination that the methodologies and data collection were sufficient to support a fair and complete evaluation. 4) identification and definition of the recommended option, based on the comparison of each option and its effects against the established success criteria. 5) presentation of the recommendations to the appropriate decision makers, as applicable.
c) Record outcomes of tradeoff analysis	Recommendations and the selection, as well as the details of the tradeoff analysis performed, including rationale, assumptions, and lessons learned, are captured and recorded in the established project information database.

Table C.24—Requirement 24 (Systems Analysis Process - Risk Analysis)

Representative tasks	Expected outcomes
a) Identify risks	Technical risks, and resulting project risks, are identified, based on exposure to the probability of an undesirable consequence and the effect of that consequence for each tradeoff analysis option or each physical solution representation option. Considerations include how expectations from a decision or design selection are affected by (1) commitments resulting from a choice, (2) validity of assumptions, (3) capabilities to implement and control, and (4) other organizational or technical constraints such as resources and time.
b) Characterize risks	Risk causes, possible effects or consequences, likelihood of occurrence, options for dealing with identified risks, how long options are available, and coupling among identified risks are determined.
c) Prioritize risks	Risks that would likely cause harm, would have the greatest effect, and would need immediate attention are prioritized.
d) Evaluate ways to avert risks	The cost, schedule, and performance effects on the project are determined from evaluation of options or courses of action that would (1) eliminate a specific risk possibility; (2) implement acts to reduce a risk's probability or effect; (3) transfer the risk (get someone else to assume the risk, e.g., a warranty); or (4) provide a contingency to address the consequences, if the risk occurs, including identity of appropriate and timely triggers for taking action (will they give sufficient time to act?) such as metrics or events to monitor.
e) Define and implement a plan or approach for averting each significant risk	The significant risks to the project are identified and adequate risk aversion approaches are defined. Triggers are defined that will provide a signal when it is appropriate to implement aversion action. Implemented planned actions or approach to avert risk.
f) Capture and communicate risk analysis outcomes	The effects of the risk analysis, as well as the details of the risk analysis performed, including assumptions, are captured and recorded in the established project information database. Risks effects have been reported or used, as appropriate.

Table C.25—Requirement 25 (Requirements Validation Process - Requirement Statements Validation)

Representative tasks	Expected outcomes
a) Analyze and ensure each technical requirement statement is stated with: 1) ability to preserve competitiveness—permits preservation of a competitive stance and is only as constraining on competitive stance as is justified by benefits delivered by requirement. 2) clarity—requirement statement is readily understandable without analysis of meaning of words or terms used. 3) correctness—requirement statement does not contain an error of fact. 4) feasibility—requirement can be satisfied within (1) natural physical constraints, (2) state of the art as it applies to the project, and (3) all other absolute constraints applying to the project. 5) focus—requirement is expressed in terms of 'what' and 'why,' or form, fit and function, not in terms of how to develop the products or the materials to be used — detailed requirements that are required to guide detailed design of a product are an exception to this. 6) implementability—requirement statement contains information necessary to enable requirement to be implemented. 7) modifiability—necessary changes to a requirement can be made completely and consistently. 8) removal of ambiguity—allows only one interpretation for meaning of the requirement, e.g., not defined by words or terms such as 'excessive,' 'sufficient,' and 'resistant' that cannot be measured. 9) singularity—requirement statement cannot be sensibly expressed as two or more requirements having different agents, actions, objects, or instruments. 10) testability—existence of finite and objective process with which to verify that the requirement has been satisfied. 11) verifiability—can be verified at the level of system structure at which it is stated.	
b) Analyze and ensure technical requirement statements in pairs and as a set are stated with: 1) absence of redundancy—each requirement is specified only once. 2) connectivity—all terms within a requirement are adequately linked to other requirements and to word and term definitions, so that individual requirements relate properly to other requirements as a set. 3) removal of conflicts—requirement is not in conflict with other requirements or within itself.	

Table C.26—Requirement 26 (Requirements Validation Process - Acquirer Requirements)

Representative tasks	Expected outcomes
a) Select methods and define procedures	The methods and procedures for validating the set of defined acquirer requirements are selected and defined, consistent with the level of system structure, enterprise-based life cycle phase, and Validation Plan, as appropriate.
b) Establish downward traceability	The downward traceability of stated, documented, or otherwise determined, acquirer needs and expectations to the set of defined acquirer requirements is determined.
c) Establish upward traceability	The upward traceability of the individual acquirer requirements, from the set of defined acquirer requirements, to stated, documented, or otherwise captured, acquirer needs and expectations is determined.
d) Identify and resolve variances	Identified voids, variances, and conflicts have been resolved. When the set of defined acquirer requirements is not upward-traceable to acquirer needs and expectations, whether non-sourced (orphaned) requirements or constraints were introduced and whether they are desired by the acquirer, have been determined, and appropriate action has been taken. When acquirer needs and expectations are not reflected in the set of defined acquirer requirements, the omitted needs and expectation are added to the set of defined acquirer requirements, as appropriate.
e) Record validation results	Validation procedures, outcomes, assumptions, corrective actions, lessons learned, etc., are captured and recorded in the established information database.

Table C.27—Requirement 27 (Requirements Validation Process - Other Stakeholder Requirements)

Representative tasks	Expected outcomes
a) Select methods and define procedures	The methods and procedures for validating the set of defined other stakeholder requirements are selected and defined and are consistent with the level of system structure, enterprise-based life cycle phase, and Validation Plan, as appropriate.
b) Establish downward traceability	The downward traceability of stated, documented, or otherwise determined, other stakeholder needs and expectations to the set of defined other stakeholder requirements is established.
c) Establish upward traceability	The upward traceability of the individual other stakeholder requirements, from the set of defined other stakeholder requirements, to stated, documented, or otherwise captured, other stakeholder needs and expectations is established.
d) Identify and resolve variances	Identified voids, variances, and conflicts are resolved. When the set of defined other stakeholder requirements was not upward-traceable to other stakeholder needs and expectations, whether non-sourced (orphaned) requirements or constraints were introduced, has been determined, and appropriate actions were taken to eliminate non-sourced requirements. When other stakeholder needs and expectations were not reflected in the set of defined other stakeholder requirements, omitted needs and expectation were added to the set of defined other stakeholder requirements, as appropriate.
e) Record validation results	Validation procedures, outcomes, assumptions, corrective actions, lessons learned, etc., are captured and recorded in the established information database.

Table C.28—Requirement 28 (Requirements Validation Process - System Technical Requirements)

Representative tasks	Expected outcomes
a) Select methods and define procedures	The methods and procedures for validating the set of defined system technical requirements are selected and defined and are consistent with the level of system structure, enterprise-based life cycle phase, and Validation Plan, as appropriate.

b)	Establish downward traceability	The downward traceability of the validated sets of stakeholder (acquirer and other stakeholder) requirements to the set of defined system technical requirements is determined.
c)	Establish upward traceability	The upward traceability of the individual system technical requirements, from the set of defined system technical requirements, to the validated sets of stakeholder requirements is determined.
d)	Analyze assumptions	Assumptions regarding consistency of the system technical requirements with the system being engineered are determined.
e)	Analyze other system technical requirements	Other system technical requirements derived as essential to design and subsequent life cycle phases are consistent with the system being engineered and other system technical requirements are determined.
f)	Identify and resolve variances	Identified voids, variances, and conflicts are resolved. When the set of defined system technical requirements was not upward-traceable to validated sets of stakeholder requirements, whether non-sourced (orphaned) requirements or constraints were introduced was determined, and appropriate actions to eliminate non-sourced requirements or revise the appropriate set of stakeholder requirements were taken. When validated stakeholder requirements were not reflected in the set of defined system technical requirements, omitted requirements were added to the set of defined system technical requirements or determine the need for the requirement, as appropriate.
g)	Perform revalidation	When a change is needed to one of the validated sets of stakeholder requirements, the appropriate tasks of acquirer or other stakeholder requirements definition from the Requirements Definition Process were reaccomplished and the set was revalidated. When the set of system technical requirements must be changed, the appropriate tasks of system technical requirements definition from the Requirements Definition Process were reaccomplished and the set was revalidated.
h)	Record validation results	Validation procedures, outcomes, assumptions, corrective actions, lessons learned, etc., are captured and recorded in the established information database.

Table C.29—Requirement 29 (Requirements Validation Process - Logical Solution Representations)

Representative tasks	Expected outcomes
a) Select methods and define procedures	The methods and procedures for validating the defined sets of logical solution representations and derived technical requirements are selected and defined and are consistent with the level of system structure, enterprise-based life cycle phase, and Validation Plan, as appropriate.
b) Establish downward traceability	The downward traceability of the validated set of system technical requirements to each set of logical solution representations and the derived technical requirements is determined.
c) Establish upward traceability	The upward traceability of individual logical solution representations from a set of logical solution representations and the derived technical requirements to the validated set of system technical requirements is determined.
d) Analyze assumptions	Assumptions made while defining the sets of logical solution representations to ensure that they are consistent with the system technical requirements and the system being engineered are assessed and considered valid.
e) Identify and resolve variances	Identified voids, variances, and conflicts are resolved. When validated system technical requirements were not reflected in a set of logical solution representations, omitted requirements were added to the set of logical solution representations. The need for added requirements was confirmed, and it was determined whether these requirements were to be assigned directly to physical solutions. When a set of logical solution representations was not upward traceable to the validated set of system technical requirements, it was determined whether non-sourced (orphaned) requirements and constraints had been introduced. Appropriate actions were taken either to eliminate non-sourced requirements, to establish derived requirements, or to revise the set of system technical requirements.
f) Perform revalidation	When a change was needed to the validated set of system technical requirements, the appropriate tasks from the Requirements Definition Process were reaccomplished and the set was revalidated. When one or more sets of logical solution representations had to be changed, the appropriate tasks for definition of logical solution representations from the Solution Definition Process were reaccomplished and the set was revalidated.
g) Record validation results	Validation procedures, outcomes, assumptions, corrective actions, lessons learned, etc., are captured and recorded in the established information database.

Table C.30—Requirement 30 (System Verification Process - Design Solution Verification)

Representative tasks	Expected outcomes
a) Plan the design solution verification in accordance with the Verification Plan, the agreement, and the applicable enterprise-based life cycle phase, and level in the system structure	1) The appropriate method needed to verify the system's fully characterized design solution is identified and defined. NOTE— Design solution verification methods include**:** inspection (for example, inspection of drawings), analysis (for example, using simulation or virtual reality prototype), demonstration (for example, using mockups or physical models), or test (for example, by testing physical prototypes, breadboards, or brassboards). 2) Verification procedures are defined, based on (1) procedures for each method selected, (2) purpose and objective of each procedure, (3) pre-test and post-test actions, and (4) criteria for determining the success or failure of the procedure. 3) The verification environment (for example, facilities, equipment, tools, simulations, measuring devices, personnel, and climatic conditions) in which the verification methods and procedures will be implemented is established and checked-out for adequacy, completeness, readiness, and integration.
b) Perform the planned design solution verification using selected methods and procedures within the established verification environment	Verification outcomes to show completion of verification objectives and to determine untraceable requirements and constraints, voids, conflicts, variations and anomalies are collected and evaluated. Specifically, it was shown that: 1) the system design solution descriptions and interfaces (internal or external) are upward-traceable to requirements of the selected physical solution representation; 2) source requirements are downward-traceable to the system design solution descriptions; 3) the design solution satisfied the functional and performance requirements of the identified subset of unassigned system technical (see note under Requirement, Task 17 c) and the set of derived technical requirements; 4) intended functions are correctly implemented; 5) constraints, including interfaces, are satisfied. When defined variances were not downward-traceable from source documents, appropriate tasks of the Requirements Definition and Solution Definition Processes were repeated to correct the omissions. When defined variances showed inconsistencies with source requirements (not upward-traceable), the followed were determined: why new requirements were introduced, and if they were to be assigned as derived technical requirements, were to be removed from the design solution definition, or had to be reflected in the set of logical solution representations or set of system technical requirements. The necessary tasks of the Requirements Definition and Solution Definition Processes were reaccomplished as required for corrections and reverification.
c) Perform reverification	When test outcome variations and anomalies were traced to poor verification conduct or to inadequate verification environment, verifications are repeated to obtain valid outcomes.
d) Record verification results	The verification procedures, together with the outcomes achieved, variations, corrective actions taken, rationale justifying the design solution, tradeoff analyses and effectiveness analyses completed with resulting key decisions, verified design solution definition, lessons learned, etc., are recorded in the project information database according to the verification plan and test procedure requirements. NOTE—The verified design solution and its related specified requirements are placed under configuration management control.

Table C.31—Requirement 31 (System Verification Process - End Product Verification)

Representative tasks	Expected outcomes
a) Plan the end product verification in accordance with the Verification Plan, the agreement, and the applicable enterprise-based life cycle phase, and level in the system structure.	1) The appropriate methods needed to verify the system's end products against their specified requirements are selected and defined. NOTE— Design solution verification methods include**:** inspection (for example, inspection of drawings), analysis (for example, using simulation or virtual reality prototype), demonstration (for example, using mockups or physical models), or test (for example, by testing physical prototypes, breadboards, or brassboards). 2) Verification procedures are established and based on (1) procedures for each method selected, (2) purpose and objective of each procedure, (3) pre-test and post-test actions, and (4) criteria for determining the success or failure of the procedure. 3) The verification environment (for example, facilities, equipment, tools, simulations, measuring devices, trained personnel, special techniques, and climatic conditions) in which the verification methods and procedures will be implemented is established and checked out for adequacy, completeness, readiness, and integration. 4) Test articles are on hand, assembled, and integrated with the verification environment according to verification plans and schedules, and appropriate sets of specified requirements are available.
b) Perform the planned end product verifications using selected methods and procedures within the established verification environment.	Verification outcomes are collected and evaluated to show completion of verification objectives and used to determine 1) variations and anomalies, and out-of-compliance conditions; 2) data quality, integrity, correctness, consistency, and validity; 3) whether fabricated, integrated, or purchased end products (including end products, composites of end products, or software or firmware builds) comply with their respective specified requirements; 4) that end product test articles were appropriately integrated with the test environment and each requirement was properly tested for; and 5) that system end products function together and with interfacing products throughout their performance envelope. For variations and anomalies not caused by poor test conduct or conditions, appropriate tasks of the processes in this Standard, including replanning, changing requirements, redefining requirements and the design solution, and verification, are accomplished to resolve discrepancies.
c) Perform reverification	When test outcome variations and anomalies were traced to poor verification conduct or conduct or inadequate verification environment, end product verification is reaccomplished.
d) Record verification results	The verification methods and procedures, together with the outcomes achieved, variations and anomalies, corrective actions taken, rationale justifying corrections, tradeoff analyses, and effectiveness analyses completed with resulting key decisions, lessons learned, etc., are recorded in the project information database according to the verification plan and test procedure requirements. Recorded test result data includes the following: 1) The version of the set of specified requirements (specification) used. 2) The version of the end product tested. 3) The version or reference standard for tools and equipment used, together with applicable calibration data. 4) The results of each test including pass or fail declaration. 5) The discrepancy between expected and actual results. 6) A statement of success or failure of the testing process, including its relation to the verification process. Delivery or disposition of verified compliance articles and compliance data is completed in accordance with the acquirer-supplier agreement, verification plan instructions, or project directives or procedures.

Table C.32—Requirement 32 (System Verification Process - Enabling Product Readiness)

Representative tasks	Expected outcomes

a)	Plan enabling product readiness determination in accordance with the agreement, the applicable enterprise-based life cycle phase, and level in the system structure	1) The appropriate methods needed to determine enabling product readiness and maturity of development, based on the applicable enterprise-based life cycle phase and level in the system structure, the purpose and objective of each method selected, the appropriate plan, and the acquirer-supplier agreement, are selected and defined. 2) Procedures based on (1) each method selected, (2) purpose and objective of each method, (3) pre-test and post-test actions, and (4) criteria for determining the success or failure of the method are established. 3) The environment (for example, facilities, equipment, tools, simulations, measuring devices, trained personnel, special techniques, and climatic conditions) in which the methods and procedures will be implemented is established and checked out for adequacy, completeness, readiness, and integration. 4) Required information regarding the status and maturity of enabling product development or requirements definition is on hand. Non-developmental enabling products are on hand and integrated appropriately.
b)	Perform planned enabling product readiness determination, using selected methods and procedures	Outcomes are collected and evaluated, and any enabling product readiness anomalies, variations, or out-of-compliance conditions (such as lack of requirements for manuals or training equipment or disposal of hazardous materials) are discovered. The following have been determined 1) whether development for required enabling products is progressing satisfactorily or will be ready to perform its life cycle function when needed or if there are out-of-compliance conditions 2) that plans and selected methods, procedures, and tools for each associated process can accomplish their intended purpose 3) whether the development is on schedule and that the schedule meets critical end product needs 4) the interfaces between planned enabling products and their intended end products have no potential conflicts in implementation concepts, intended functions, or interdependencies 5) that enabling products meet the requirements of the end products or composites of end products they are intended to support. For variations and anomalies not caused by poor readiness assessments, appropriate tasks of the processes in this Standard, including replanning, changing requirements, redefining requirements and the design solution, and readiness determination, are accomplished to resolve discrepancies.
c)	Reaccomplish readiness determination	For discrepancies caused by poor readiness assessment, the appropriate tasks of enabling product readiness determination are reaccomplished.
d)	Record readiness determination results	Enabling product readiness determination outcomes are recorded in the information database.

Table C.33—Requirement 33 (End Products Validation Process)

Representative tasks	Expected outcomes
a) Determine validation exit criteria	The type of validation required and the requirements to be used are determined. The types include: (1) validation against acquirer requirements in the anticipated usage environment, with test conditions that span the expected range of actual operating conditions, to the extent practical, and in conjunction with stakeholders, as appropriate; (2) certification tests against established certification requirements; (3) acceptance tests using operational processes and personnel in operational environments; or (4) as specified in the agreement. NOTES 1 Validation tests are conducted during the Test and Evaluation Phase of the engineering life cycle, after end products have been verified against specified requirements, from the lowest level of the system structure upward to the end products that will be delivered to the marketplace to satisfy validated acquirer requirements. 2 Validations of Types 1 through 3 are satisfied with the same test, when appropriate. 3 Validation can be for a single end product or an aggregation of end products for the same building block.
b) Acquire appropriate test article	The test article, or test articles, used for the validation is determined to be appropriate to the enterprise-based life cycle phase and the level of system structure. NOTE—End Products Validation consists of one or more tests using a version of the product (or products) as nearly like the final version as is practical and necessary, taking into account the enterprise-based life cycle phase and the nature of the product. If the nature of either the product, its operating conditions, or the enterprise-based life cycle phase of development precludes use of actual products or prototypes, then breadboards, brassboards, hardware-in-the-loop simulations, virtual-reality simulations, or other models and simulations are applicable for End Products Validation.
c) Conduct validation	1) Validation is completed in accordance with the Validation Plan, as required in the agreement. 2) Validation outcomes are compiled, analyzed, and compared to the validation exit criteria; variations and anomalies have been identified; and corrective actions are defined. 3) When outcome variances from exit criteria were not caused by improper test conditions, by improper performance of validation procedures, or by improper data collection: Replanning, redefinition of the design solution, and the Implementation Process, as appropriate, are reaccomplished. NOTE—Care is to be taken to ensure that the requirements derived to remove variances do not conflict with acquirer or other stakeholder requirements, or other validated technical requirements without coordinating such changes with the appropriate stakeholders.
d) Perform revalidation	If variances were caused by poor test conduct, retesting, using improved or correct test equipment and procedures, is performed.
e) Record validation results	Validation procedures, compliance data, outcomes, assumptions, corrective actions, lessons learned, etc., are recorded in the established project information database.