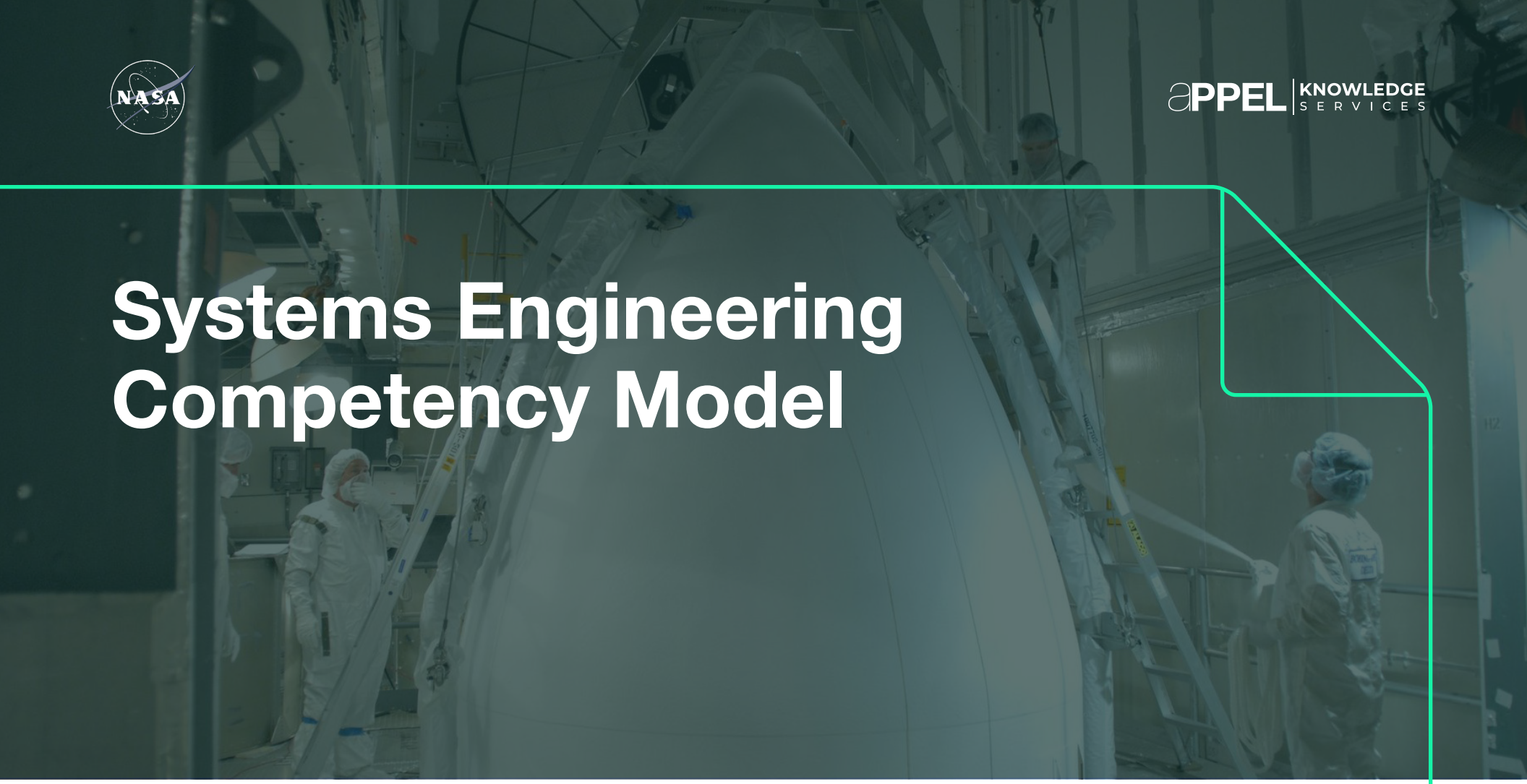

Systems Engineering Competency Model

We deliver world-class learning and development opportunities, and identify, maintain, and advance critical knowledge that empowers NASA to attain successful outcomes across missions and projects.

Academy of Program/Project & Engineering Leadership (APPEL) Knowledge Services

Overview

Through its world-class training curriculum, knowledge-sharing initiatives, development resources, and strategic communications, the Academy of Program/Project & Engineering Leadership (APPEL) Knowledge Services helps ensure NASA's technical workforce has the skills and knowledge needed to advance mission success.

Competencies are the foundation of training and developing project and program managers. NASA APPEL Knowledge Services developed the Systems Engineering Competency Model to support the professional development of NASA's technical workforce. At NASA, "systems engineering" is defined as a methodical, multi-disciplinary approach for the design, realization, technical management, operations, and retirement of a system (Systems Engineering Handbook). This model outlines distinct competency areas for systems engineers, as well as shared competencies that encompass both project management and systems engineering. There are 17 systems engineering competencies, which are categorized into 3 overall areas. The 14 shared competencies, common to both project management and systems engineers, are categorized into 5 general areas. Regularly reviewing and assessing competencies will help determine where skill gaps exist and need to be addressed.

Competency Model Categories

SE 1.0 System Design

- SE 1.1 Stakeholder Expectation Definition & Management
- SE 1.2 Technical Requirements Definition
- SE 1.3 Logical Decomposition
- SE 1.4 Design Solution Definition

SE 2.0 Product Realization

- SE 2.1 Product Implementation
- SE 2.2 Product Integration
- SE 2.3 Product Verification
- SE 2.4 Product Validation
- SE 2.5 Product Transition

SE 3.0 Technical Management

- SE 3.1 Technical Planning
- SE 3.2 Requirements Management
- SE 3.3 Interface Management
- SE 3.4 Technical Risk Management
- SE 3.5 Configuration Management
- SE 3.6 Technical Data Management
- SE 3.7 Technical Assessment
- SE 3.8 Technical Decision Analysis

SE 1.0 – SYSTEM DESIGN				
Definition	Developing stakeholder expectations, defining technical requirements, performing logical decomposition, and defining design solutions to result in a validated set of requirements and a design solution that will meet requirements and satisfy the set of stakeholder expectations.			
SE 1.1 – Stakeholder Expectation Definition & Management				
Definition	Eliciting and defining use cases, scenarios, the concept of operations, and stakeholder expectations. This includes identifying stakeholders, establishing support strategies, establishing a set of Measures of Effectiveness (MOEs), validating stakeholder expectation statements, and obtaining commitments from the customer and other stakeholders, as well as using the baselined stakeholder expectations for product validation during product realization.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the Stakeholder Expectation Definition and Management Process and to gain initial experience in the competency.	• Leads teams at the subsystem level in stakeholder expectation definition and management. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in stakeholder expectation definition and management. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships for the highest level of internal, external, and international contacts.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations	Technical Engineers should be able to: • Understand the Stakeholder Expectation Definition Process. • Participate as part of a team to identify key internal stakeholders. • Participate as part of a team to interview internal stakeholders. • Assist in recording responses. Support the team to synthesize into needs, goals, and objectives (NGOs). • Begin to develop relationships with key internal stakeholders.	Subsystem Leads should be able to: • Identify key internal and external stakeholders. • Perform solo interviews with internal stakeholders. • Participate as part of a team for interviews of external stakeholders. • Translate stakeholder expectations into needs, goals, and objectives for review by the team. • Create measures of effectiveness (MOEs) from some of the stakeholder expectation statements for review by the team. • Participate as part of a team to validate the set of expectations.	Project Systems Engineers should be able to: • Lead the team to identify key internal and external stakeholders. • Perform interviews with external stakeholders. • Obtain internal key stakeholder commitments to validate expectations.	Chief Engineers should be able to: • Manage the overall effort. Approve final results. • Perform interviews and maintain relationships with the highest level internal and external stakeholders. • Identify, describe, and define stakeholder expectation definition policies for the agency and/or center.

Underlying Skills	• Clear verbal and written communications • Developing and maintaining professional relationships • Effective interviewing • Win-win negotiating
Fundamental Knowledge of	• Project mission, goals, objectives, and requirements • Internal (to project) organizational structure • External (to project) NASA organizational structure and political environment

SE 1.2 – Technical Requirements Definition

Definition	Transforming the baseline stakeholder expectations into unique, quantitative, and measurable technical requirements expressed as "shall" statements that can be used for defining the design solution. This includes analyzing the scope of the technical problems to be solved, defining constraints affecting the designs, defining the performance requirements, validating the resulting technical requirement statements, defining the Measures of Performance (MOPs) for each MOE, and defining appropriate Technical Performance Measures (TPMs) by which technical progress will be assessed.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the Technical Requirements Definition Process and to gain initial experience in the competency.	• Leads teams at the subsystem level in technical requirements definition. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in technical requirements definition. Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level internal, external, and international contacts.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the Technical Requirements Definition process.	Subsystem Leads should be able to: • Interpret some stakeholder functional and performance expectations into technical terms within a discipline for review by the team.	Project Systems Engineers should be able to: • Lead the team in developing and validating a set of requirements.	Chief Engineers should be able to: • Manage the overall effort. • Approve final results.
Proficiency Illustrations	• Participate as part of a team to gather and integrate requirements developed by Subject Matter Experts. • Input some results into the requirements tool. • Identify inconsistencies within a discipline area. • Review and comment on selected MOPs and TPMs.	• Participate in identifying constraints from stakeholder expectations. • Collaborate with Subject Matter Experts to refine requirements within a discipline. • Identify inconsistencies across some discipline areas. • Review requirements for proper format.	• Identify inconsistencies and proper format across the entire set of requirements. • Define and selects a set of measures to be used.	• Provide guidance and mentoring regarding the requirements definition and validation efforts of the team. • Identify, describe, and define technical requirement policies for the Agency and/or Center.
Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Effective use of selected requirements capturing and tracking tools • Working in teams			

Fundamental Knowledge of	• Project mission, goals, and objectives • Project Concept of Operations, use cases, and expected scenarios • Requirements management process

SE 1.3 – Logical Decomposition

Definition	Transforming the defined set of technical requirements into a set of logical decomposition models and their associated set of derived technical requirements for lower levels of the system and for input to the design solution efforts. This includes decomposing and analyzing by function, time, behavior, data flow, object, and other models. It also includes allocating requirements to these decomposition models, resolving conflicts between derived requirements as revealed by the models, defining a system architecture for establishing the levels of allocation, and validating the derived technical requirements.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the Logical Decomposition Process and to gain initial experience in the competency.	• Leads teams at the subsystem level in logical decomposition. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in logical decomposition. Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level internal, external, and international contacts.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the Logical Decomposition Process. Participate as part of a team to gather and integrate flow diagrams developed by Subject Matter Experts. • Input some results into the modeling tool. • Identify inconsistencies within a discipline area. • Review and comment on the proposed architecture.	Subsystem Leads should be able to: • Develop some flow/behavior diagrams and models for review by the team. • Collaborate with Subject Matter Experts to refine models within a discipline. • Support the architecture definition activities. • Allocate requirements to architecture. • Identify inconsistencies across some discipline areas.	Project Systems Engineers should be able to: • Lead the team in developing and validating diagrams, models, architecture, and requirements allocation. • Identify inconsistencies across the entire architecture.	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the logical decomposition efforts of the team. • Identify, describe, and define logical decomposition policies for the agency and/or center.

Underlying Skills	• Clear verbal and written communications • Development and effective use of flow charts, behavior diagrams, and other selected modeling tools • Effective application of NASA's SE Engine • Systems thinking • Working in teams			
Fundamental Knowledge of	• Project mission, goals, and objectives • Project Concept of Operations, use cases, and expected scenarios • Project requirements			
SE 1.4 – Design Solution Definition				
Definition	Translating the decomposition models and derived requirements into one or more design solutions and using the Decision Analysis process to analyze each alternative and for selecting a preferred alternative that will satisfy the technical requirements. A full technical data package is developed describing the selected solution. This includes generating a full design description for the selected solution; developing a set of "make-to," "buy-to," "reuse-to," specifications; and initiating the development or acquisition of system products and enabling products.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the Design Solution Definition Process and to gain initial experience in the competency.	• Leads teams at the subsystem level in design solution definition. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in design solution definition. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level internal, external, and international contacts.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the Design Solution Definition Process. • Participate as part of a team to perform market surveys and to gather designs from Subject Matter Experts. • Input some results into modeling tools. • Identify inconsistencies within a discipline area. • Review and comment on proposed solutions.	Subsystem Leads should be able to: • Develop criteria for selecting the design solution for review by team. • Collaborate with Subject Matter Experts to develop and review design solutions within a discipline. • Identify inconsistencies across some discipline areas. • Review design descriptions.	Project Systems Engineers should be able to: • Lead the team in developing design solutions. • Identify inconsistencies across designs. • Coordinate peer reviews of the design and the design descriptions. • Recommend designs for selection.	Chief Engineers should be able to: • Manage the overall effort. Approve final results. • Provide guidance and mentoring in the design solution efforts of the team. • Identify, describe, and define design solution policies for the agency and/or center.
Underlying Skills	• Clear verbal and written communications • Deep understanding of one or more technical disciplines • Effective application of design and visualization tools • Effective application of NASA's SE Engine • General understanding of all disciplines involved in the design • Systems thinking • Working in teams			

Fundamental Knowledge of	• Project mission, goals, and objectives • Project Concept of Operations, use cases, and expected scenarios • Project requirements • Project architecture • Functional and behavior diagrams or models • Existing suitable designs that could be reused or purchased off-the-shelf

SE 2.0 – PRODUCT REALIZATION	
Definition	Delivering the completed system of interest that meets the design specifications and stakeholder expectations. This includes producing products; acquiring, reusing, or coding products; integrating products into higher-level assemblies; verifying products against design specifications; validating products against stakeholder expectations; and transitioning products to the next level of the system.
SE 2.1 Product Implementation	
Definition	Generating a specific product through buying, making, or reusing so as to satisfy the design requirements. This includes preparing the implementation strategy; building or coding the product; reviewing vendor technical information; inspecting delivered, built, or reused products; and preparing product support documentation for integration.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Level	• Participates as a team member to gain an overall understanding of the Product Implementation Process and to gain initial experience in the competency.	• Leads teams at the subsystem level in product implementation. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in product implementation. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level internal, external, and international contacts.
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the Product Implementation Process. • Understand the processes for product purchasing, manufacturing, and inspection. • Participate as part of a team to perform market surveys, gather the status of activity progress, and review technical information.	Subsystem Leads should be able to: • Develop criteria for selecting the implementation strategy for review by the team. • Collaborate with Subject Matter Experts to develop and review implementations of a product within a discipline. • Review and identify incorrect technical information supplied for a product.	Project Systems Engineers should be able to: • Lead the team in developing implementation strategies. • Identify inconsistencies across received products and associated technical information. • Coordinate reviews of technical information or product compliance. • Direct development or acquisition of enabling products.	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the product implementation efforts of the team. • Collaborate with other centers or external organizations to obtain agreements. • Resolve complex issues in the procurement or manufacturing of the product.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations		• Cooperate with acquisition and manufacturing teams to identify issues.	• Cooperate with organizational points of contact to identify and resolve issues in procurement or manufacturing. • Direct and make recommendations for acceptance of the product.	• Identify, describe, and define product implementation policies for the agency and/or center.
Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Systems thinking • Win-win negotiating • Working in teams			
Fundamental Knowledge of	• Project mission, goals, and objectives • Project Concept of Operations, use cases, and expected scenarios • Existing suitable products that could be reused or purchased off-the-shelf • The procurement organizations, processes, and contacts • The manufacturing organizations, processes, and contacts			

SE 2.2 – Product Integration

Definition	Assembling and integrating lower-level validated end products into the desired end product of the higher-level product. This includes preparing the product integration strategy, performing detailed planning, obtaining products to integrate, confirming that the products are ready for integration, preparing the integration environment, and preparing product support documentation.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the Product Integration Process and to gain initial experience in the competency.	• Leads teams at the subsystem level in product integration. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in product integration. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level internal, external, and international contacts.
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the processes for product integration. • Participate as part of a team to gather the status of activity progress. • Review technical information.	Subsystem Leads should be able to: • Develop procedures for simple product integration for review by the team. • Collaborate with Subject Matter Experts to participate in the integration of products within a discipline. •	Project Systems Engineers should be able to: • Lead the team in developing integration strategies for complex projects. • Identify inconsistencies across assembled products and associated technical information. •	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the product integration efforts of the team. • Cooperate with other centers or external organizations to obtain agreements.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations		• Review and identify incorrect technical information supplied for a product. • Collaborate with integration teams to identify and resolve subsystem issues.	• Collaborate with organizational points of contact to identify and resolve internal issues during integration. • Direct and make recommendations for acceptance of the assembled product.	• Resolve complex issues arising during integration. • Identify, describe, and define product integration policies for the agency and/or center.
Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Systems thinking • Win-win negotiating • Working in teams			
Fundamental Knowledge of	• Project mission, goals, and objectives • Project Concept of Operations, use cases, and expected scenarios • Capabilities of internal and external facilities for integration • Assembly tools and processes			

SE 2.3 – Product Verification

Definition	Proving the end product conforms to its requirements. This includes preparing for the verification efforts, analyzing the outcomes of verification (including identifying anomalies and establishing recommended corrective actions), and preparing a product verification report providing evidence of product conformance with the applicable requirements.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the Product Verification Process and to gain initial experience in the competency.	• Leads teams at the subsystem level in product verification. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in product verification. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level of internal, external, and international contacts.
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the processes for product verification. • Participate as part of a team to define verification activities. • Gather the status of activity progress. • Review verification reports.	Subsystem Leads should be able to: • Develop procedures for simple product verification for review by the team. • Work with Subject Matter Experts to participate in the verification of products within a discipline.	Project Systems Engineers should be able to: • Lead the team in developing verification strategies for complex projects. • Look for inconsistencies across verified products and associated verification results and configurations.	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the product verification efforts of the team. • Work with other centers or external organizations to obtain agreements.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations		• Review and identify discrepancies between verification results and requirements. • Work with verification teams to identify issues. • Propose corrective actions.	• Obtain verification enabling products. Coordinate reviews to determine the completeness of verification activities. • Work with organizational points of contact to identify and resolve internal issues during verification. • Direct and make recommendations for corrective actions for products that don't meet the requirements.	• Resolve complex issues arising during verification. Identify, describe, and define product verification policies for the agency and/or center.
Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Systems thinking • Working in teams • Win-win negotiating			

Fundamental Knowledge of	• Project mission, goals, and objectives • Project Concept of Operations, use cases, and expected scenarios • Requirements for each product being verified • Capabilities of internal and external facilities for verification • Verification tools and processes • Anomaly/discrepancy and corrective action process

SE 2.4 – Product Validation

Definition	Confirming that a verified end product satisfies the stakeholder expectations for its intended use when placed in its intended environment and ensuring that any anomalies discovered during validation are appropriately resolved prior to product transition. This includes preparing to conduct product validation, performing the product validation, analyzing the results of validation (including identifying anomalies and establishing recommended corrective actions), and preparing a product validation report providing evidence of product conformance with the stakeholder expectations baseline.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the product validation process and to gain initial experience in the competency.	• Leads teams at the subsystem level in product validation. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in product validation. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products resolves issues, and maintains relationships with the highest of internal, external, and international contacts.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the processes for product validation. • Participate as part of a team to define validation activities. • Gather the status of activity progress. • Review validation reports.	Subsystem Leads should be able to: • Develop procedures for simple product validation for review by the team. Work with Subject Matter Experts to participate in the validation of products within a discipline. • Review and identify differences between validation results and expectations. • Collaborate with validation teams to identify issues. • Propose corrective actions.	Project Systems Engineers should be able to: • Lead the team in developing validation strategies for complex projects. • Identify inconsistencies across validated products and associated validation results and configurations. • Obtain validation enabling products. • Coordinate reviews to determine the completeness of validation activities. • Cooperate with organizational points of contact to identify and resolve internal issues during validation. • Direct and make recommendations for corrective actions for products that don't meet expectations.	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the product validation efforts of the team. • Work with other centers or external organizations to obtain agreements. • Resolve complex issues arising during validation. Identify, describe, and define product validation policies for the agency and/or center.

Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Systems thinking • Working in teams • Win-win negotiating
Fundamental Knowledge of	• Project mission, goals, and objectives • Project Concept of Operations, use cases, and expected scenarios • Expectations and intended environment for each product being validated • Capabilities of internal and external facilities for validation • Validation tools and processes • Anomaly and corrective action process

SE 2.5 – Product Transition

Definition	Transitioning the verified and validated product to the customer at the next level in the system structure. This includes preparing to conduct product transition, evaluating the product and enabling product readiness for product transition, preparing the product for transition (including handling, storing, and shipping preparation), preparing sites, and generating required documentation to accompany the product.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the product transition process and to gain initial experience in the competency.	• Leads teams at the subsystem level in product transition. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in product transition. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level internal, external, and international contacts.
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the processes for product transition. • Participate as part of a team to perform facility surveys. • Gather the status of activity progress. • Review product documentation.	Subsystem Leads should be able to: • Develop procedures for simple product transitioning for review by the team. • Work with Subject Matter Experts to participate in the transitioning of products within a discipline.	Project Systems Engineers should be able to: • Lead the team in developing transition strategies for complex projects. •	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the product transition efforts of the team. • Work with other centers or external organizations to obtain agreements.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations		• Review and identify transition issues. • Propose corrective actions.	• Identify inconsistencies between planned product security needs and selected transitioning strategies, procedures, and configurations. • Coordinate reviews to determine the readiness for transition. • Work with organizational points of contact to identify and resolve internal issues during the transition. • Direct and make recommendations for corrective actions for issues arising from shipping or handling.	• Resolve complex issues arising during the transition. Identify, describe, and define product transition policies for the agency and/or center.
Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Systems thinking • Working in teams • Win-win negotiating			

Fundamental Knowledge of	• Project mission, goals, and objectives • Project Concept of Operations, use cases, and expected scenarios • Shipping and handling methods and procedures • Capabilities of internal and external facilities and capabilities for transitioning a product • Process for identification and resolution of shipping/handling issues

SE 3.0 – TECHNICAL MANAGEMENT	
Definition	Managing technical activities during the project life cycle.
SE 3.1 – Technical Planning	
Definition	Planning for the application and management of each common technical process, as well as identifying, defining, and planning the technical effort necessary to meet project objectives. This includes preparing or updating a planning strategy for each of the technical processes, and determining deliverable work products from technical efforts; identifying technical reporting requirements; identifying entry and success criteria for technical reviews; identifying product and process measures to be used; identifying critical technical events; defining cross-domain interoperability and collaboration needs; defining the data management approach; identifying the technical risks to be addressed in the planning effort; identifying tools and engineering methods to be employed; and defining the approach to acquire and maintain technical expertise needed. This also includes preparing the Systems Engineering Management Plan (SEMP) and other technical plans; obtaining stakeholder commitments to the technical plans; and issuing authorized technical work directives to implement the technical work. Defining the approach to acquire and maintain the technical expertise needed. This also includes preparing the Systems Engineering Management Plan (SEMP) and other technical plans; obtaining stakeholder commitments to the technical plans; and issuing authorized technical work directives to implement the technical work.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Level	• Participates as a team member to gain an overall understanding of the technical planning process and to gain initial experience in the competency.	• Leads teams at the subsystem level in technical planning. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in technical planning. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level internal, external, and international contacts.
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the processes for technical planning. • Participate as part of a team to provide inputs to planning activities. • Assist in documenting the plans.	Subsystem Leads should be able to: • Obtain agreements for non-controversial plans. Collect information for technical planning. • Define and organize the work for non-complex activities. • Develop some work directives and agreements.	Project Systems Engineers should be able to: • Lead the team in performing strategic planning for complex projects. • Identify inconsistencies, overlaps, and gaps across all project plans. • Coordinate reviews of the technical plans. • Resolve internal issues.	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the technical planning efforts of the team. • Work with other centers or external organizations to obtain external agreements and work directives. • Resolve complex issues arising during planning.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations			• Gain commitments from internal organizations on plans and work agreements.	• Identify, describe, and define technical planning policies for the agency and/or center.
Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Strategic planning • Systems thinking • Working in teams • Win-win negotiating			
Fundamental Knowledge of	• Project mission, goals, and objectives • Project Concept of Operations, use cases, and expected scenarios • Workforce capabilities of civil servant and contractor organizations • Capabilities of internal and external facilities and capabilities • Process for obtaining work commitments			

SE 3.2 – Requirements Management

Definition	Managing the product requirements, including providing bidirectional traceability, and managing changes to establish requirement baselines over the life cycle of the system products. This includes preparing or updating a strategy for requirements management; selecting an appropriate requirements management tool; training technical team members in established requirement management procedures; conducting expectation and requirements traceability audits; managing expectation and requirement changes; and communicating expectation and requirement change information.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the requirements management process and to gain initial experience in the competency.	• Leads teams at the subsystem level in requirements management. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in requirements management. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships for the highest level internal, external, and international contacts.
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the processes for requirements management.	Subsystem Leads should be able to: • Identify or review proposed changes needed within subsystems. • Obtain agreements for non-controversial changes.	Project Systems Engineers should be able to: • Develop strategies for requirements management.	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the requirements management efforts of the team.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations	• Participate as part of a team to gather and coordinate change requests from organizations. • Review requirement statements to ensure compliance with proper format.	• Identify inconsistencies and impacts across subsystems for a proposed requirement change. • Ensure approved changes are implemented and communicated across the subsystem team.	• Lead the team in performing requirement management for complex projects. • Identify inconsistencies, overlaps, and gaps across all project requirements. • Review change proposals and recommend dispositions. • Develop or review change impacts for completeness. • Coordinate impact discussions. • Resolve internal issues. • Gain commitments from internal organizations on change dispositions and impacts.	• Communicate with other centers or external organizations to obtain external agreements on proposed changes and their impacts. • Resolve complex issues arising during requirement management. • Identify, describe, and define requirements measurement policies for the agency and/or center.

Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Effective application of selected requirements capturing and tracking tool • Systems thinking • Working in teams • Win-win negotiating
Fundamental Knowledge of	• Project mission, goals, and objectives • Project Concept of Operations, use cases, and expected scenarios • Current requirements baselines • Applicable change board organization and operation

SE 3.3 – Interface Management

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Definition	Establishing and using formal interface management to maintain internal and external interface definition and compliance among the end products and enabling products. This includes preparing interface management procedures, identifying interfaces, generating and maintaining interface documentation, managing changes to interfaces, disseminating interface information, and conducting interface control.			
Proficiency Level	• Participates as a team member to gain an overall understanding of the interface management process and to gain initial experience in the competency.	• Leads teams at the subsystem level in interface management. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in interface management. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level of internal, external, and international contacts.
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the process for interface management. • Participate as part of a team to gather, document, and coordinate change requests from organizations.	Subsystem Leads should be able to: • Identify or review proposed interface changes needed within subsystems. • Obtain agreements for non-controversial changes.	Project Systems Engineers should be able to: • Develop strategies and procedures for interface management. • Lead the team in performing interface management for complex projects.	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the interface management efforts of the team.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations		• Identify inconsistencies and impacts across subsystems for a proposed interface change. • Ensure approved changes are implemented and communicated across the subsystem team.	• Identify interface inconsistencies, overlaps, and gaps across all project designs. • Review change proposals. • Develop change impacts and recommend dispositions. • Coordinate impact discussions. • Resolve internal issues. • Gain commitments from internal organizations on change dispositions and impacts.	• Communicate with other centers or external organizations to obtain agreements on external interfaces, proposed changes, and their impacts. • Resolve complex issues arising during interface management. • Identify, describe, and define interface management policies for the agency and/or center.
Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Systems thinking • Working in teams • Win-win negotiating			

Fundamental Knowledge of	• Project mission, goals, and objectives • Project Concept of Operations, use cases, and expected scenarios • Current design configurations • Current interface baselines • Applicable change board organization and operation

SE 3.4 – Technical Risk Management

Definition	Examining on a continual basis the risks of technical deviations from plans and identifying potential technical problems before they occur. Planning, invoking, and performing risk-handling activities as needed across the life of the product or project to mitigate impacts on meeting technical objectives. This includes developing the strategy for technical risk management, identifying technical risks, conducting technical risk assessment; preparing for technical risk mitigation, monitoring the status of each technical risk, and implementing technical risk mitigation and contingency action plans when applicable thresholds have been triggered.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the technical risk management Process and to gain initial experience in the competency.	• Leads teams at the subsystem level in technical risk management. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in technical risk management. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level of internal, external, and international contacts.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the processes for technical risk management. • Participate as part of a team to gather, document, and coordinate technical risks. • Understand and use the selected risk management tool.	Subsystem Leads should be able to: • Identify or review proposed risks within subsystems. • Obtain agreements for non-controversial risks. • Identify inconsistencies and impacts across subsystems for a proposed risk. • Ensure approved risks are implemented into the risk tool and communicated across the subsystem team.	Project Systems Engineers should be able to: • Develop strategies and procedures for technical risk management. • Lead the team in performing risk management for a complex project. Identify inconsistencies, overlaps, and gaps across all project risk sources. • Review risk proposals. • Develop risk impacts and recommended risk mitigations and corrective actions. • Coordinate impact discussions. • Resolve internal issues. • Gain commitments from internal organizations on risk dispositions and impacts.	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the technical risk management efforts of the team. • Communicate with other centers or external organizations to obtain agreements on external risks, proposed impacts, and their mitigations. • Resolve complex issues arising during technical risk management. • Identify, describe, and define the technical risk management policies for the agency and/or center.

Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Effective application of selected risk tools and methodology • Systems thinking • Working in teams • Win-win negotiating
Fundamental Knowledge of	• Project mission, goals, and objectives • Project Concept of Operations, use cases, and expected scenarios • Current design configurations • Current risk baselines • Applicable risk board organization and procedures

SE 3.5 – Configuration Management

Definition	Identifying the configuration of the product at various points in time, systematically controlling changes to the configuration of the product, maintaining the integrity and traceability of product configuration, and preserving the records of the product configuration throughout its life cycle. This includes establishing configuration management strategies and policies, identifying baselines to be under configuration control, maintaining the status of configuration documentation, and conducting configuration audits.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the configuration management process and to gain initial experience in the competency.	• Leads teams at the subsystem level in configuration management. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in configuration management. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level of internal, external, and international contacts.
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the processes for configuration management. • Participate as part of a team to gather, document, and coordinate configuration changes.	Subsystem Leads should be able to: • Identify or review products within subsystems that need to be placed under configuration management. • Obtain agreements for items to be controlled.	Project Systems Engineers should be able to: • Develop strategies and procedures for configuration management.	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the configuration management efforts of the team.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations	• Understand and use the selected configuration management tool(s).	• Identify inconsistencies and impacts across subsystems. • Ensure approved configuration items are implemented into the configuration management tool and communicated across the subsystem team. • Develop strategies to conduct configuration audits.	• Lead the team in performing configuration management for complex projects. • Identify inconsistencies, overlaps, and gaps across all project configuration items during audits. • Review proposed changes to configuration-controlled items and recommends dispositions. • Coordinate discussions. • Resolve internal issues. • Gain commitments from internal organizations on items to be placed under configuration management and change dispositions.	• Head configuration control boards for critical items under configuration management. • Communicate with other centers or external organizations to obtain agreements for proposed changes and audit results. • Identify, describe, and define the configuration management policies for the agency and/or center.

Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Effective application of selected configuration management tools and methodology • Systems thinking • Working in teams • Win-win negotiating
Fundamental Knowledge of	• Project mission, goals, and objectives • Current configuration baselines • Proposed configuration changes • Organization and procedures for the applicable configuration change board

SE 3.6 Technical Data Management

Definition	Identifying and controlling product-related data throughout its life cycle; acquiring, accessing, and distributing data needed to develop, manage, operate, support, and retire system products; managing and disposing of data as records; analyzing data use; obtaining technical data feedback for managing the contracted technical efforts; assessing the collection of appropriate technical data and information; maintaining the integrity and security of the technical data, effectively managing authoritative data that defines, describes, analyzes, and characterizes a product life cycle; and ensuring consistent, repeatable use of effective Product Data and Life-cycle Management processes, best practices, interoperability approaches, methodologies, and traceability. This includes establishing technical data management strategies and policies; maintaining revision, status, and history of stored technical data and associated metadata; providing approved, published technical data; providing technical data to authorized parties; and collecting and storing required technical data.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Level	• Participates as a team member to gain an overall understanding of the technical data management process and to gain initial experience in the competency.	• Leads teams at the subsystem level in technical data management. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in technical data management. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level of internal, external, and international contacts.
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the processes for data management. • Participate as part of a team to gather, document, and coordinate data. • Understand and use the selected data management tool(s). • Generate and capture some data items.	Subsystem Leads should be able to: • Identify or review data products within subsystems that need to be placed under data management. • Obtain agreements for data to be controlled. Identify inconsistencies and impacts across subsystems.	Project Systems Engineers should be able to: • Develop strategies and procedures for data management. • Lead the team in performing data management for complex projects. • Identify inconsistencies, more than one authorized source, and data gaps across all project data items during audits.	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the technical data management efforts of the team. • Communicate with other centers or external organizations to obtain agreements for proposed data access, security, and audit results.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations		• Ensure approved data items are implemented into the data management tool and communicated across the subsystem team. • Develop strategies to conduct data security audits.	• Review proposed security measures for sensitive data and the authorization of users. • Coordinate discussions. • Resolve internal issues. • Gain commitments from internal organizations on items to be placed under data management and security protocols.	• Resolve complex issues arising during data management. • Identify, describe, and define the technical data management policies for the agency and/or center.
Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Effective application of selected data management tools and methodology • Systems thinking • Working in teams • Win-win negotiating			
Fundamental Knowledge of	• Project mission, goals, and objectives • Security regulations for accessing, storing, and distributing data and for the identification of authorized users • Selected data management tool(s) • Organizations and teams that will need to produce or access technical data			

SE 3.7 – Technical Assessment

Definition	Monitoring progress of the technical effort and providing status information for support of the system design, product realization, and technical management efforts. This includes developing technical assessment strategies and policies, assessing technical work productivity, assessing product quality, tracking and trending technical metrics, and conducting technical, peer, and life cycle reviews.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the technical assessment process and to gain initial experience in the competency.	• Leads teams at the subsystem level in technical assessment. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in technical assessment. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships with the highest level of internal, external, and international contacts.
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the processes for conducting, participating in, and documenting results from peer, technical, and life cycle reviews.	Subsystem Leads should be able to: • Identify and track process and product measures for subsystems. • Obtain agreements for a set of subsystem measures to be tracked.	Project Systems Engineers should be able to: • Develop strategies and procedures for technical assessments. • Lead the team in performing technical assessments for complex projects. • Identify corrective actions.	Chief Engineers should be able to: • Manage the overall technical assessment effort. • Approve final results. • Provide guidance and mentoring in the technical assessment efforts of the team.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations	• Participate as part of a team to gather, plot, and coordinate the selected set of technical measures.	• Identify trending inconsistencies and issues. • Analyze trends across subsystems and recommend corrective actions. • Identify the type of reviews needed for the subsystem. • Conduct peer reviews for subsystem products. • Provide subsystem information for project life cycle reviews.	• Analyze performance measures for issues or potential problems. • Conduct technical reviews for complex systems. • Coordinate discussions. • Resolve internal issues. • Gain commitments from internal organizations on technical measures to be tracked and readiness of system to support a life cycle review.	• Approve corrective actions resulting from reviews or trends necessary to bring project back into compliance with plans and requirements. • Conduct technical reviews for complex projects or programs. • Communicate with other centers or external organizations to obtain agreements for proposed actions, trend trigger points, and entrance/success criteria. • Identify, describe, and define technical assessment policies for the agency and/or center.
Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Systems thinking • Working in teams • Win-win negotiating			

Fundamental Knowledge of	• Project mission, goals, and objectives • Objectives of life cycle reviews • Organizations and stakeholders that will need to participate in the peer, technical, and life cycle reviews • Current project baselines and configurations

SE 3.8 – Technical Decision Analysis

Definition	Evaluating technical decision issues, identifying decision criteria, identifying alternatives, analyzing alternatives, and selecting alternatives. Performed throughout the system life cycle to formulate candidate decision alternatives, and evaluate their impacts on health and safety, technical, cost, and schedule performance. This includes establishing guidelines for determining which technical issues are subject to formal analysis processes; defining the criteria for evaluating alternative solutions; identifying alternative solutions to address decision issues; selecting evaluation methods; selecting recommended solutions; and reporting the results and findings with recommendations, impacts, and corrective actions.			
Role	**Discipline Engineer**	**Subsystem Lead**	**Project Systems Engineer**	**Chief Engineer**
Proficiency Level	• Participates as a team member to gain an overall understanding of the technical decision analysis process and to gain initial experience in the competency.	• Leads teams at the subsystem level in technical decision analysis. • Provides guidance and expertise at the subsystem level, identifying subsystem issues.	• Leads teams at the project level in technical decision analysis. • Provides guidance and expertise at the project level, resolving project issues.	• Leads overall effort, reviews and approves products, resolves issues, and maintains relationships for the highest level of internal, external, and international contacts.

Role	Discipline Engineer	Subsystem Lead	Project Systems Engineer	Chief Engineer
Proficiency Illustrations	Discipline Engineers should be able to: • Understand the process for performing decision analysis. • Participate as part of a team to identify decision criteria and recommend evaluation methods. • Perform simple evaluations.	Subsystem Leads should be able to: • Initiate ideas for selection criteria. • Perform subsystem evaluations. • Make recommendations for alternative selections. • Develop reports and make presentations.	Project Systems Engineers should be able to: • Develop strategies and procedures for technical decision analysis, including guidelines for when to apply formal decision-making procedures. • Lead effort in selecting decision criteria to be used for complex decisions. • Collaborate with project personnel to determine weighting factors	Chief Engineers should be able to: • Manage the overall effort. • Approve final results. • Provide guidance and mentoring in the technical decision analysis efforts of the team. • Communicate with other centers or external organizations to obtain agreements for proposed selection strategies, selection criteria, and recommended alternative selection. • Identify, describe, and define the technical decision analysis policies for the agency and/or center.

Underlying Skills	• Clear verbal and written communications • Effective application of NASA's SE Engine • Effective application of decision tools and methods such as pro/con analysis, SWOT, quality function deployment, etc. • Systems thinking • Working in teams • Win-win negotiating
Fundamental Knowledge of	• Current cost, schedule, and technical performance trends • Project mission, goals, and objectives • Customer expectations • Project Concept of Operations, use cases, and expected scenarios • Political environment