DISSERTATION

INVESTIGATING ORGANIZATIONAL FACTORS, TRAINING NEEDS, AND ROLE ALLOCATION TO AID THE AEROSPACE WORKFORCE IN THE TRANSITION TO MODEL-BASED SYSTEMS ENGINEERING

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ABSTRACT

INVESTIGATING ORGANIZATIONAL FACTORS, TRAINING NEEDS, AND ROLE ALLOCATION TO AID THE AEROSPACE WORKFORCE IN THE TRANSITION TO MODEL-BASED SYSTEMS ENGINEERING

The increasing complexity of modern systems is driving the aerospace engineering community to update its legacy systems engineering (SE) approaches to embrace more modernized digital engineering (DE) methods. A key component of DE is Model-Based Systems Engineering (MBSE), where interconnected models support all aspects of the system lifecycle and enable focus on collaboration, integration, and responsiveness to changing requirements. The transition to MBSE has proven difficult for the industry to conceptualize and plan, and the aerospace industry needs to better understand the steps to make this change and the challenges involved. Successful transition results from a combination of technology and organizational factors. The technical and process aspects of digital transformation have been the subjects of research and development, but fewer conclusions are available on the required training for the current workforce to make this transition successful, or on how organizational factors such as composition, roles, size, and culture affect it. Culture includes habits like processes or specific ways of thinking, which can be partly influenced by effective training. The Department of Defense (DoD) and organizational bodies like the International Council on Systems Engineering (INCOSE) have developed competency frameworks to provide input on the required skills for DE. Still, more refinement and alignment with industry needs are necessary to make these useful to all types of organizations and to train all roles involved in executing SE projects involving MBSE.

This research examines artifacts and survey results from industry and government SE projects to identify which roles and associated tasks are involved in a set of projects that use MBSE and how those roles are allocated to personnel. To understand the influence of team sizes, information was solicited from a panel of DE and SE experts to define project roles, allocating tasks to roles and roles to personnel for their current projects and for ideal teams ranging from 10 to 100 personnel. The findings suggest that these experts would prefer that projects define more specialized roles to perform MBSE and SE activities. Their ideal teams allow technical engineers to focus more on core technical tasks and less on cross-functional responsibilities, and the experts' responses represent a desire for clear role distinctions to optimize team effectiveness, particularly in small teams. The results and associated discussion demonstrate both the reinforcement of and some challenges to existing literature on the organizational structures of effective MBSE projects.

Following the task and role allocation, this research develops a comprehensive list of the competencies and level of proficiency required for each role when executing an example project that uses MBSE, leveraging the Digital Engineering Competency Framework (DECF) v1.1. Findings from this research indicate a variety of lessons that can inform workforce development and digital transformation in the aerospace industry. For example, this research finds that engineering roles spanning both program management and technical tasks require higher DE proficiency in management-focused activities than in technical execution. The Systems Engineer role also demonstrated broader competency needs, extending beyond modeling and analysis to digital enterprise environments and data engineering. Results highlight that most roles that execute technical tasks share a common competency baseline, suggesting that training programs can emphasize universal foundations while tailoring DE workforce development to select roles. The resulting mapping between SE projects that use MBSE, workforce needs, and competencies is a novel contribution to our field's understanding of the DE transition and demonstrates how DECF v1.1 competencies can be applied across roles in MBSE-enabled projects and inform training program design.

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DEDICATION

I dedicate this dissertation to Errol Reksten, who was not here to be part of this adventure but was still with me on the journey.

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CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 The Need for Digital Engineering

Systems Engineering (SE) has many definitions, but the one used in this research describes SE as the "art and science of developing an operable system capable of meeting requirements within often opposed constraints."[1] It is a field that encompasses and balances the contributions of many different disciplines to accomplish a specific goal. Digital Engineering (DE) is a modernized approach to SE that helps streamline the lifecycle processes of a system by employing computer-readable models to represent all aspects of that system. The DE Ecosystem is composed of digital models, digital and information technology (IT) infrastructure, data, and stakeholders and users,[2] and model-based systems engineering (MBSE) is one of the key frameworks of this DE Ecosystem.[3] Frameworks and processes must also be considered when discussing DE and MBSE. The International Council on Systems Engineering (INCOSE) defines MBSE as "the formalized application of modeling to support system requirements, design, analysis, verification, and validation activities beginning in the conceptual design phase and continuing throughout development and later lifecycle phases."[4] MBSE represents a new methodology and toolkit for SE that aims to address the need to develop and analyze increasingly complex systems,[5] evolving from the traditional document-based systems engineering (DBSE) methodology, which has been used throughout the engineering community for decades.

Notable cost overruns and functional failures in large systems have driven the engineering community to seek a better methodology for managing system complexity.[6] As one example, the former Administrator of the National Aeronautics and Space Administration (NASA), Michael Griffin, noted in 2010 that many system failures occur at interfaces, primarily between elements that engineers thought to be completely separate. He challenged the community to control requirements better, understand system interfaces better, and devise more effective tools and methods to meet these demands.[7] Additionally, SE communities in different enclaves (e.g., government, academia) often have shown that many new advanced programs or capabilities have failed in their schedules, budgets, or objectives.[8] This indicates a systemic issue throughout the industry, an industry that made DBSE central to its value proposition and function.

DBSE uses "written documents based on text as sources of managerial information,"[9] and as such, the legacy DBSE approach has its fundamental weaknesses.[10] Because DBSE manages system information through numerous disconnected documents for different users across various system lifecycle phases, it is not conducive to rapid changes and managing complexity.[11] These documents independently collect and connect information over time, require manual updates, and can frequently become out of synchronization, making this process labor-intensive and prone to errors.[12,13] Additionally, DBSE relies on the reader's ability to mentally link the information they read in the different documents and contexts to generate connections and meaning.[14] Figure 1 shows a model of this approach and the disconnected documents it relies on.[15]

In contrast to DBSE, a modern MBSE approach enables the connection of the various users in different lifecycle phases to a system model they share, which is consistently refined incrementally and in parallel,[14,15] as shown in Figure 2. The MBSE model, therefore, reflects changes so that all users can access the latest information for the system, see the latest changes, and understand their impacts throughout the system. MBSE processes do not alter the need for sound SE principles; instead, they enhance them by being inherently more rigorous and better maintaining consistency across SE products and artifacts.[5]

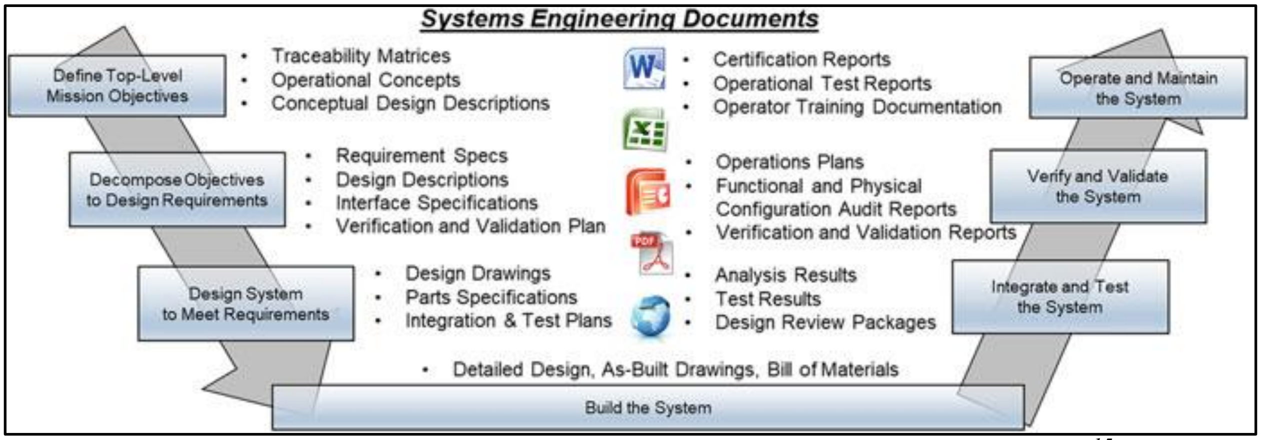

Figure 1. Systems Engineering Lifecycle Process "Vee" Model, pre-MBSE[15]

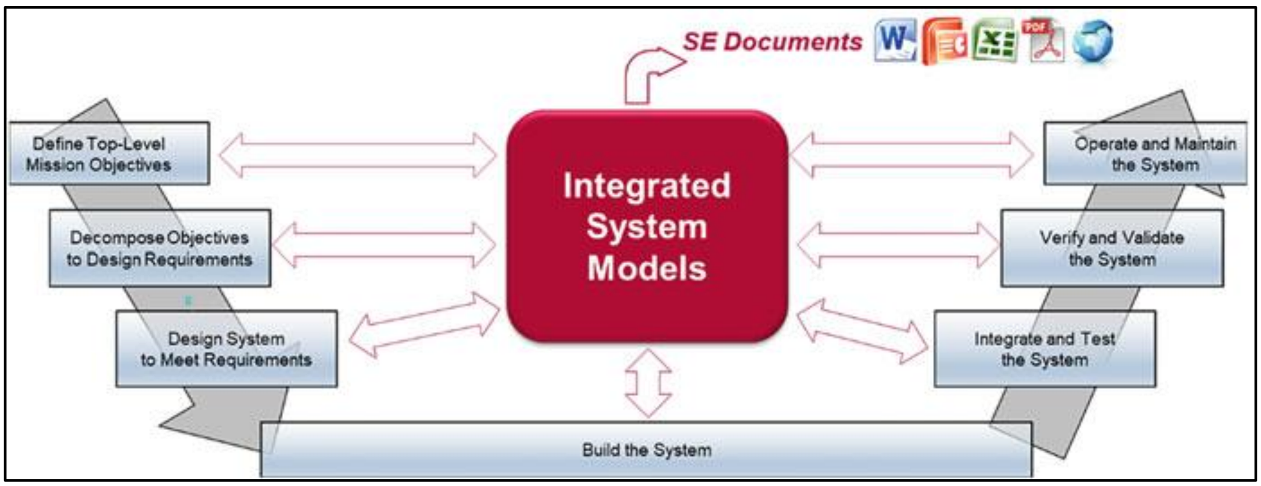

Figure 2. Systems Engineering Lifecycle Process "Vee" Model, MBSE[15]

1.2 Benefits of Digital Engineering

Although the industry is still transitioning to a model-based approach, advocates state that employing it to manage a complex development should provide advantages over managing the same development using a document-based methodology.[16,17] Numerous studies have attempted to provide practitioners with more concrete evidence of the value of MBSE over DBSE.[11,13,18,19] Still, it is difficult to provide quantitative evidence in the context of in-situ acquisition and design projects, and much of the current evidence is anecdotal, with almost all of the benefits being perceived instead of measured.[10,16,20,21] This is because using traditional return on investment

(ROI) methods (e.g., "apples-to-apples" comparisons) to evaluate model-based approaches to complex aerospace system design is very difficult. The main reason for this is that there is not usually a system that is developed both with and without DE that would provide for a direct comparison.[22] Also, model-based methods typically reduce errors by identifying and mitigating issues early in the lifecycle, making it impossible to count issues later that never end up existing.[23] Most current studies assert MBSE benefits via literature reviews, case studies, industry surveys, or some combination thereof. The following is a list of qualitatively asserted advantages of MBSE relative to DBSE:

- Improved design integration[21,24,25]
- Reduced errors[3,5,12,14,21,26,27]
- Improved engineer experience[5,21,26,28]
- Improved defect detection[3,12,20,23,26]
- Improved system design[3,21,25,26,28]
- Improved acquisition[25]
- Increased model/data reuse[3,12,21,24,26,28,29]
- Increased standards conformance[24]
- Reduced program cost[11,12,21,26]
- Improved design validation[3,12,21,25,28]
- Improved trade-space exploration[10,25,28]
- Increased programmatic efficiency[5,10,21,24,25,30]
- Increased design velocity/agility[2,3,10,12,14,21,26,28]
- Technical and programmatic risk reduction[3,21,24-26,28]
- Increased consistency/traceability of requirements[2,3,5,10,12,17,18,21,26,27,28]

- Increased communication/knowledge transfer[2,3,5,10,12,14,17,21,24,31]

The few studies that have provided quantitative evidence of the ROI for MBSE have limited their examination to specific programs or a small portion of a program's development. One study used cost and schedule metrics to find that employing an MBSE approach improved defect prevention.[18] Another quantified the efforts associated with an MBSE approach versus a non-MBSE approach in a side-by-side comparison for only the modeling and simulation portion of a component in development on a program. The improvements of the MBSE approach included a reduced burden of SE tasks and effort on the engineers, and a higher level of support for automation.[19] Another study by a legacy submarine program that transferred from a DBSE to an MBSE methodology found that MBSE activity corresponded to an overall reduced cost while providing higher-quality SE products, more baseline and variant designs, and cheaper downstream integration after implementing the change.[13] Additionally, one study looked at the transition from an economic standpoint and decomposed notional costs for DBSE and MBSE throughout a program's lifecycle. It found that while MBSE costs were higher than DBSE costs in earlier phases of a program lifecycle, they were lower than DBSE costs from preliminary design to program end-of-life because of gains related to factors like early defect detection, model reuse, and risk reduction. They observed that MBSE required more investment than DBSE at the beginning of a program because of the need to use funding for resources like training, infrastructure, and model start-up costs.[11]

Although the community widely accepts that transitioning from DBSE to MBSE is advantageous and necessary, the steps to making this transition and the actual state of progress across the industry must be clarified and better understood.[26] Enterprises across the aerospace community, including government, development contractors, and Federally Funded Research and

Development Centers (FFRDCs), are at various stages of progress in adopting MBSE, with government organizations lagging behind industry. Best practices for this change do not exist largely because the transformation across the enterprise needs to be closer to the end state to identify these best practices.[28] The evolution to DE, and MBSE specifically, demands a significant shift of decades-old processes, methodology, and habits and requires the involvement of many roles and disciplines within an organization.[12,17,32] Many organizations want to "Be Digital," but few understand the meaning of the term or the steps needed to achieve this; the change is only on the surface. These organizations might currently perform work digitally but still use legacy processes in a different version.[33] As noted in the literature, there is currently no guide for successful DE transition.[28]

1.3 Barriers to Digital Transformation

While the benefits of the change from DBSE to MBSE are well-established, the challenges of adopting MBSE are less understood.[24] Progress in the implementation of MBSE has been relatively slow to date, and researchers are trying to understand why and if there are ways that organizations or the community at large can help accelerate this. Additionally, the perception of the amount of progress that has been accomplished against MBSE implementation is widely different between leadership and the engineers who are implementing the changes to the processes, tools, and methodology. To help with this change, the industry needs an improved understanding of barriers and enablers to MBSE adoption.[28] Several studies have attempted to uncover what these barriers and enablers could be. Depending on the organization, a particular element could be either an enabler or a barrier. A literature review identified several common enablers and barriers to MBSE adoption:

- Organizational culture[5,9,12,14,17,18,26,33,34]

- Leadership commitment[9,14,17,26,28,35]
- People in SE roles or roles supporting systems engineers[18,26,28]
- Personnel knowledge/skills[10,18,26,28,30]
- DE/MBSE methods and processes[9,10,12,14,26,28,29,34]
- Training[5,9-11,17,26,28,30,34,35]
- Security classification levels within the model[14,34]
- DE/MBSE tools availability[9,26,28]
- Change management process design[11,26,28]
- Willingness to use MBSE tools[5,26,28]
- Infrastructure for DE/MBSE implementation[11,26,28]
- Communities of practice[26,28]
- Alignment with customer requirements[26,28]
- Need for change[9,26,28]
- MBSE terminology/ontology/libraries[26,28]
- Champions[9,26,28]
- Leadership understanding of MBSE[9,26]
- Organizational characteristics[26,35]
- Alignment with business strategy[26]
- MBSE cost[5,9-11,14,26]
- Competing organizational priorities[9,26]
- Workforce incentive[9,18,26,35]
- Perception of or demonstration of value[9,10,14,16,17,25,27]

The People, Processes, and Technology framework is a methodology for affecting organizational change that can be applied to digital transformation. The literature and industry focus heavily on the technology needed for digital transformation, but success depends on more than just new technology. It must also include a focus on people and processes.[36] Most of the items shown to be enablers or barriers to adoption are not technology-related in implementation but instead related to people in an organizational or cultural sense. For example, in a 2020 study, the top four most frequently reported obstacles to MBSE adoption were "organizational culture," "workforce knowledge/skills," "leadership support/commitment," and "the awareness of or demonstration of the value of MBSE."[26] These obstacles are consistent with several other studies, which noted that organizations need the right tools and technology, capable engineers with the right skills,[24,25] organizational and leadership commitment,[14,35] and a positive perception of MBSE's value[14,16] for this transition to be successful. The transition from DBSE to MBSE is not just a technology change but a culture change within the engineering community.[12,33] In his 2021 essay for the Department of the Air Force called "Bending the Spoon," the Assistant Secretary of the Air Force for Acquisition, Technology, and Logistics, Dr. Will Roper, also observed that workforce culture is vital to creating a solid digital foundation.[37] The Department of Defense (DoD) has five goals for DE transformation, one of which is transforming the culture and workforce.[25]

1.4 The Influence of Organizational Factors

As identified in the list of enablers and barriers, organizational factors influence the adoption of MBSE, but it is unclear which of these have the most impact and what the MBSE community can do to address the implementation challenges.[32] An organization must apply culture change throughout the entire organization for actual change to occur and be sustained.[33] Changing culture is notoriously difficult because of entrenched behavioral habits and processes[17,33] and because change challenges the norm. The transition moves whatever is changing from a state of the known to something uncertain.[38] Changing a culture can begin with training and workforce development, but needs to go beyond that to address perceptual challenges.[25]

Culture encompasses "the set of shared attitudes, values, goals, and practices that characterizes an institution or organization" along with "the set of values, conventions, or social practices associated with a particular field, activity, or societal characteristic."[39] Culture is social, and this social interaction can encourage the acceptance of new ideas and processes. SE itself is not just a science but an art,[7,40] and to succeed in the DE transition, the community needs to examine multiple social sciences, including the study of cognitive psychology and human interactions.[7]

There can be several reasons why a SE organization's culture resists change. Since most change initiatives fail, there is often stress and a negative association with change.[35,38] Organizations must fully embrace whatever they are changing and potentially restructure the entire organization to make the transition successful.[33] Additionally, seasoned engineers have formed habits and confidence in the processes they have developed over many years and may wonder why the change is even necessary.[14] They also may refrain from changing anything that threatens their expertise or current process.[17,35] The aerospace industry has additional cultural challenges, particularly in those organizations involved in Defense or Intelligence applications. The idea that models and organizations should be connected and communicate relatively freely is diametrically opposed to the highly compartmented paradigm in which engineers in this industry are trained to think and operate. These challenges are often exacerbated in the aerospace community because of the classified or proprietary nature of the work, where connectivity and information dissemination are tightly controlled.[14,34] This can limit the potential benefit of MBSE.

Other cultural or organizational factors that have been identified to affect engineers' attitudes toward the MBSE transition within their organizations include:

- Employee connectedness to and within an organization[35]
- The amount of extra work that the transition to MBSE may require[9,28,38]
- The extent of the engineers' ownership of the change and processes[9,35]
- Organizational structure characteristics[17,32]
- Lack of appropriate training for specific roles[9,32]
- The amount of employee engagement and leadership communication concerning the transition[35]
- The perceived value of MBSE[9,15,16]
- The organization's demographics[38]
- The organization's social support structure or mentoring programs available for employees[5,17,24,35,38]
- Communication within the organization (e.g., within functional areas during projects)[16,32,35]

1.5 Example Frameworks to Enable Workforce Transition

To help facilitate the adoption of DE, researchers have been considering the role of workforce transition. The DoD has tried to take steps to help transform its workforce to one that has proficiency in DE, including MBSE, methods, and digital artifacts across the acquisition lifecycle. To address this, the Office of the Under Secretary of Defense for Research and Engineering tasked the Systems Engineering Research Center (SERC) to develop a Digital

Engineering Competency Framework (DECF). The DECF v1.1 contains five competency groups, nine competency sub-groups, and thirty-one competencies, with six foundational digital competencies.[41]

The DECF v1.1, shown in the following figure, is directed toward the DoD acquisition workforce, although it can be applied to commercial industry as well. It categorizes the competencies and associated knowledge, skills, abilities, and behaviors (KSABs) required for personnel to implement DE successfully. For example, the DECF provides the ability to map a job title (e.g., Systems Engineer) to Job Descriptions and Responsibilities, DE Requirements, and Relevant DECF Competencies. To continue the example, several DECF competencies are shown for the Systems Engineer, including "Model-Based Systems Engineering Processes."[42] However, the DECF does not connect the level of proficiency required in "Model-Based Systems Engineering Processes" for the Systems Engineer, which can cause confusion when deciding how proficient a Systems Engineer needs to be in "Model-Based Systems Engineering Processes" and what training a Systems Engineer might need to gain that level of proficiency for the project that the Systems Engineer will be assigned to.

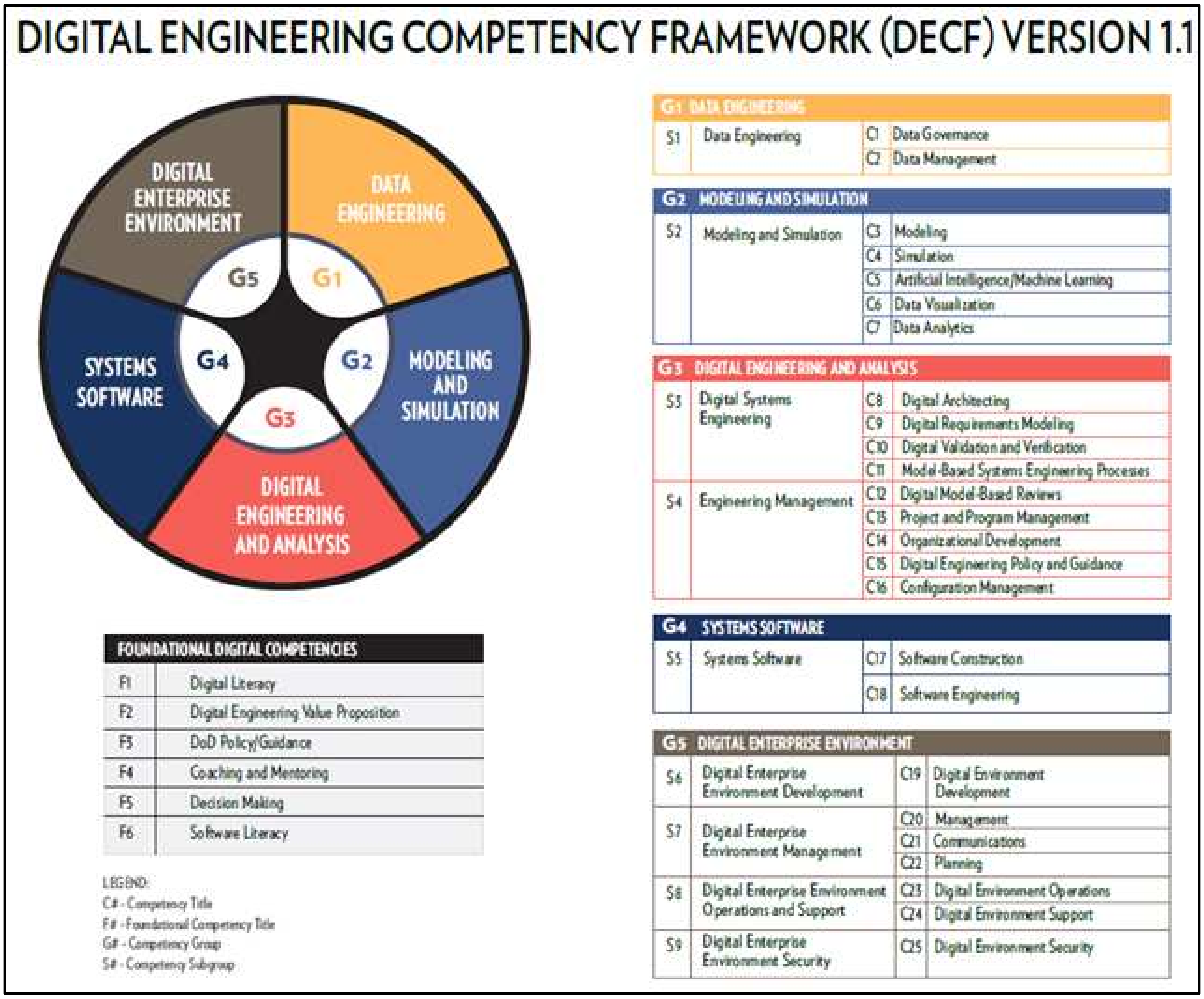

Figure 3. Overview of the DECF v1.1[42]

INCOSE has also developed a framework to show SE competencies, not just those limited to DE. They have created a Systems Engineering Competency Framework (SECF)[43] and a Systems Engineering Competency Assessment Guide (SECAG)[31] that, in part, show how the DECF can be used as a reference for predefined proficiency levels to write task lists for different positions.[31,43] However, this does not expand to the type of training or specific skills that the individuals in each role would need to accomplish the tasks required for a specific SE project that includes MBSE. New hires with a particular skill set may be able to perform some of these tasks, but the industry also needs to upskill its current workforce to be able to accomplish these tasks.

CHAPTER 2: RESEARCH AGENDA

Based on the above reflection on the state of the field, we recognize that there is a need for further research to understand and enable this organizational and cultural change for successful MBSE adoption. The common theme in current literature suggests that there is opportunity in focusing not on MBSE as a technology but on the organizational factors that may influence its adoption. It would be valuable to examine which roles within organizations and teams are necessary for successful MBSE adoption for different SE projects, how the role allocation varies with team size, and what competencies and level of proficiency apply to each role.[24,32,35] For example, most roles on a team do not need to have a deep proficiency in MBSE, but a proficiency and understanding that is specific to their role and the interactions they need to have with the models as part of that role.[44,45] Current competency frameworks do not provide enough information for organizations to efficiently train their workforce to gain the required skills to execute specific types of SE projects that may include MBSE. To enable organizations across the aerospace industry to progress in MBSE adoption, it would be useful to create a listing that leverages the DECF to provide insight into what DECF competencies each role needs for an example SE project that includes MBSE, along with the level of proficiency required for that competency for that role.

The above research agenda is proposed through Research Questions (RQs) and associated Research Tasks. The work required to answer each RQ is broken down into Research Tasks. Each Research Task provides outputs that contribute to answering the RQ and accomplishing subsequent Research Tasks. The following figure is a SysML Activity Diagram showing the research flow from Research Question 1 through Research Question 3, along with the outputs throughout this study. The details of each swimlane will be discussed in the following sections.

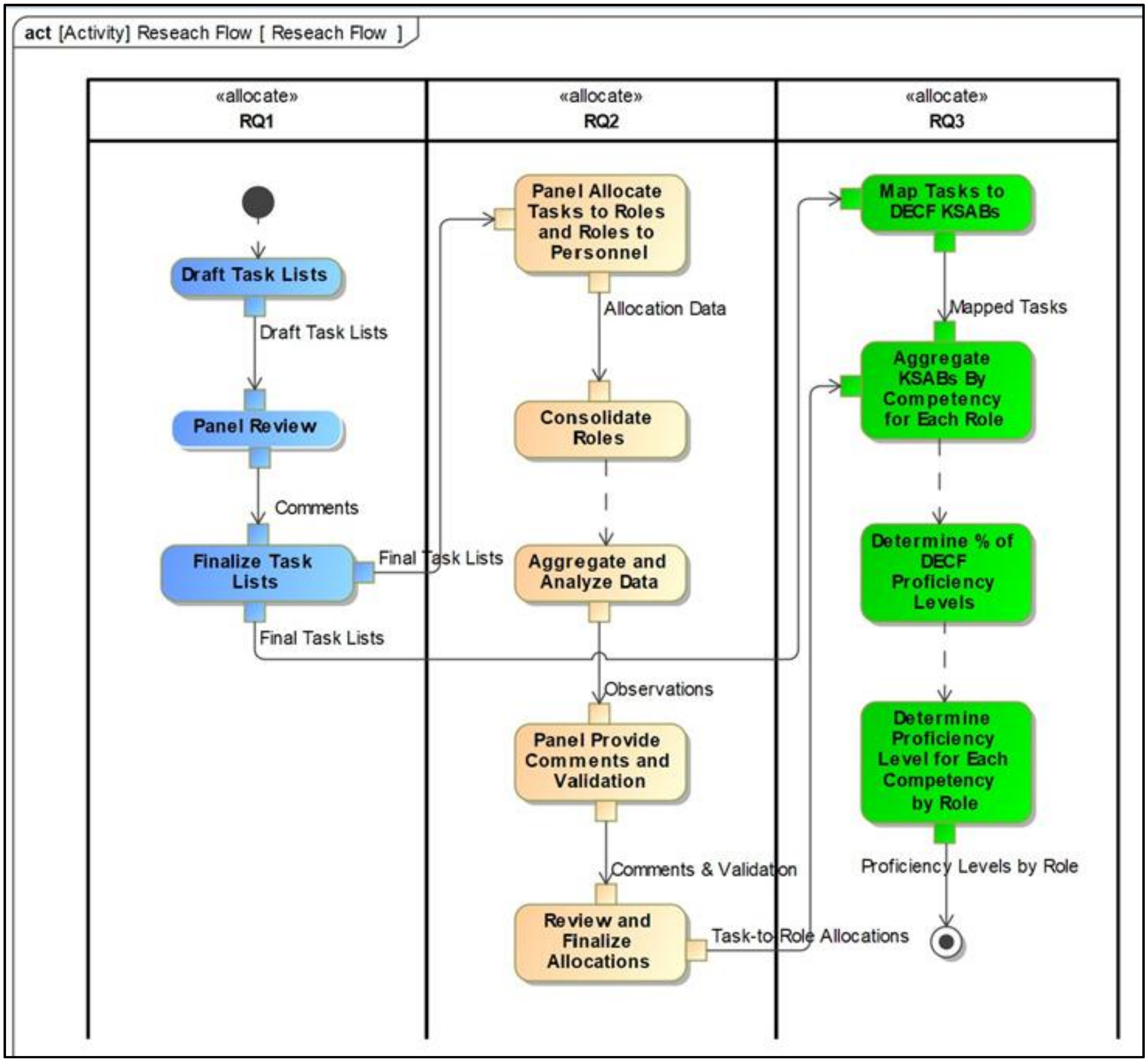

Figure 4. SysML Activity Diagram of Research Flow

2.1 Research Question 1 (RQ1)

What are the current and ideal organizational and team tasks for different SE projects that use MBSE?

The DE/MBSE community asserts that MBSE has comprehensive utility for SE programs and that MBSE will enable SE processes formerly executed via DBSE throughout the system lifecycle.[46] However, frameworks such as the DECF are DE-centric and do not describe specifically how MBSE will enable a comprehensive SE project. For example, model-based test[47] is not included in the DECF. This first RQ asks whether other MBSE-enabling SE activities not considered in existing frameworks are occurring in practice and whether a necessary and comprehensive listing can be derived from examining projects that employ MBSE. In this research, it is considered that a project "uses MBSE" if multiple roles on a team utilize an integrated portfolio of MBSE models to document program information and employ the models for review and technical decisions. The type of model or required level of fidelity is not specified. The following research tasks are associated with RQ1:

- **Task 1 (RQ1-T1): Develop draft lists of tasks organizations and teams need to accomplish for different SE projects that use MBSE.** To begin understanding the required training for personnel roles to transition to MBSE, the first step is determining the tasks needed for different SE projects that use MBSE. This Research Task will seek to build a draft set of tasks for various SE projects that employ MBSE for a system or architecture. This list will provide a starting point for community review.
- **Task 2 (RQ1-T2): Distribute the draft set of tasks to DE and SE experts in the aerospace industry for refinement and validation.** The task lists must be complete to address this and subsequent RQs as thoroughly as possible. A community review of these draft task lists by DE and SE leaders in the aerospace industry will help improve the quality and completeness of the set of tasks. The DE and SE experts will include representatives from development contractors, government, FFRDCs, University Affiliated Research

Centers (UARCs), and Systems Engineering and Technical Assistance (SETA) support contractors.

- **Task 3 (RQ1-T3): Finalize comprehensive lists of tasks required for different SE projects that use MBSE.** The results from the previous Research Task will inform an update to the draft lists from RQ1-T1, which will be developed into finalized, comprehensive lists of tasks the aerospace industry requires for its SE projects that use MBSE, sorted by project.

The result of RQ1 gives a deeper understanding of how organizations employ different tasks for different SE projects that use MBSE. The next logical step is to examine how those tasks are allocated among personnel roles, which will help determine how much of a specific type of role is required to execute a particular project and how that changes with team size so we can understand the influence.

2.2 Research Question 2 (RQ2)

How does the allocation of tasks to roles and roles to personnel differ for different SE projects that use MBSE, and does that change with team size?

The SE process is acknowledged to be tailorable to the needs of large and small projects and large and small enterprises.[48] Although there are examples of tailored MBSE processes that engage with technical limitations (for example, small businesses through the INCOSE Small Business Systems Engineering's Basic Profile Guide),[49] the implications of organizational structure and capability on the workforce's roles and tasks in projects that require MBSE have not been investigated. This second Research Question seeks to identify the effect of project and enterprise size and type on the workforce roles and tasks in performing SE projects that use MBSE.

- **Task 1 (RQ2-T1): Identify how tasks are allocated to roles and how roles are allocated to personnel when using MBSE for different SE projects.** To understand what training each role will require to execute a specific project, we must first discover which tasks each role needs to perform. This Research Task will begin by distributing the final task lists from RQ1 to the panel of DE and SE experts. They will provide feedback on how they allocate these tasks among roles within their current teams at their organizations and will repeat this exercise for how they would ideally allocate tasks to personnel roles in teams of 10, 50, and 100 people for different SE projects that use MBSE. This ideal allocation is how the experts themselves believe would make for a more ideal MBSE operation. Then, the experts will use the same process to provide input for allocating roles to personnel within a current team at their organization and ideal team sizes of 10, 50, and 100. The outcome of this Research Task will be the identification of personnel role allocations and associated tasks by project, along with data on how role allocation changes with team size.
- **Task 2 (RQ2-T2): Identify similarities and differences in how tasks are distributed to roles and how roles are distributed to personnel for different team sizes.** It is hypothesized that as teams are smaller, their personnel will have to individually be allocated more tasks or roles for projects that use MBSE than personnel on larger teams. Role and task allocation can influence the amount and type of training that smaller teams invest in. This Research Task will analyze the input from the DE and SE experts to examine whether tasks and roles are allocated to personnel differently based on the team size. The outcome of this Research Task will be to identify these similarities and differences for the SE projects that use MBSE that are part of this study.

- **Task 3 (RQ2-T3): Create a synthesized listing of roles and associated tasks for each SE project.** This Research Task aggregates the outcomes from RQ2-T1 and RQ2-T2 to create a table of roles and their task allocations, sorted by project and team sizes.

The result of RQ2 shows what and how many roles each individual may be assigned, decomposed further by team size. The amount of task allocation for individuals can provide areas of emphasis concerning training if common tasks are allocated to personnel roles for different MBSE purposes and can challenge the notion within an industry that believes that MBSE is highly technical and complex and, therefore, most people on the team should have a deep level of MBSE training. With this knowledge, organizations may determine how to reskill or upskill their personnel to execute these roles effectively. The next step is to list the DECF competencies needed to accomplish each task and the associated level of proficiency required for different personnel roles across projects that use MBSE, leveraging the DoD's DECF v1.1. These findings could ultimately provide recommendations for organizations transitioning to MBSE on how to structure their teams and train their workforce efficiently.

2.3 Research Question 3 (RQ3)

What are the competencies and the level of proficiency required by role for an example SE project that uses MBSE?

Because much of the research and competency frameworks focus on groups of skills or competencies rather than the specific level of proficiency needed to achieve the skills or competencies for an individual project, there is a void in guidance for systems engineers or managers who seek to undertake particular SE projects that include MBSE. This third Research Question aims to take the viewpoint of the current resources available and populate this information.

- **Task 1 (RQ3-T1): Identify the KSABs in DECF v1.1 that map to each task in an example SE project that uses MBSE.** Specific skills at a certain proficiency level are needed for various roles to execute different tasks within an SE project. This Research Task will map each task in one of the SE projects to the individual KSABs in DECF v1.1 that are required to accomplish that task. The outcome of this Research Task are tables organized by task showing the collection of KSABs at each proficiency level for each competency required to complete that task successfully.
- **Task 2 (RQ3-T2): For each role and team size, group the KSABs in each competency that are required for the tasks assigned to that role for an example SE project that uses MBSE.** To further understand which competencies are needed for various roles and their level of proficiency, it is essential to combine the KSABs for each task in which the individual roles are involved. This Research Task synthesizes the output from RQ2 with the data produced in RQ3-T1 to list all of the individual KSABs that a role will need for a project with ideal team sizes of 10 or 50.
- **Task 3 (RQ3-T3): Determine the required level of proficiency for each competency for each of the roles in the different team sizes.** The DoD has accomplished considerable work through the DECF to transform its workforce into a digitally fluent one. Still, as mentioned previously, this work provides only high-level guidance and does not help users identify the proficiency levels of the different competencies for a specific SE project that includes MBSE. This Research Task will examine the results from RQ3-T2 and determine, based on the number of KSABs for each proficiency level in each competency, the required proficiency level for each individual role for that project. The result of this Research Task

will be tables and figures for the different team sizes that show the level of proficiency needed in each competency for every role.

The results of RQ3 will be tables and figures showing the required competency and level of proficiency needed by role for the different team sizes. Organizations and individuals can use this as a guideline to understand the needs of various roles and develop the workforce toward DE competency. This will provide various kinds of organizations with an indicator of what training may be required for their teams so they can train their workforce effectively and efficiently should they undertake a particular project with a specific team size. It will also provide a guide for individuals in specific roles who may want to understand the level of proficiency for the different competencies that they may need to attain for potential future SE projects that include MBSE.

2.4 Organization of Chapters

This dissertation's research is presented in six chapters. Chapter 3 discusses RQ1, providing a final comprehensive list of tasks that the aerospace industry requires for four SE projects that employ MBSE. Chapter 4 addresses RQ2, providing insight into how the allocation of tasks to roles and roles to personnel can change for different SE projects that use MBSE and how that can vary with team size. Chapter 5 answers RQ3, showing a decomposition of the competencies and corresponding proficiency levels required by role. Chapter 6 provides a conclusion to this dissertation and recommendations for further research.

CHAPTER 3: ORGANIZATIONAL AND TEAM TASKS

3.1 Introduction and Methodology

The previous chapter outlined the necessity of analyzing the tasks required to be performed by different roles in order to understand what training investment may be more productive for an organization. This chapter seeks to address the query outlined in RQ1, which is as follows: *What are the current and ideal organizational and team tasks for different SE projects that use MBSE?*

Since this research aims to understand the competencies and their level of proficiency required for different personnel roles when executing SE projects that include MBSE, it is helpful to decompose the projects into a comprehensive set of tasks necessary to complete the project. These discrete tasks can then be mapped to needed skills. The task lists are drafted, reviewed, and finalized through three Research Tasks that are subordinate to RQ1:

- Task 1 (RQ1-T1): Develop draft lists of tasks that organizations and teams need to accomplish for different SE projects that use MBSE
- Task 2 (RQ1-T2): Distribute the draft set of tasks to DE and SE experts in the aerospace industry for refinement and validation
- Task 3 (RQ1-T3): Finalize comprehensive lists of tasks required for different SE projects that use MBSE

3.2 Develop draft lists of tasks that organizations and teams need to accomplish for different SE projects that use MBSE

Creating task lists for different SE projects should be simple, but SE projects are highly tailorable, so multiple ways exist to reach the same goal. With that in mind, the final listing used here for tasks might not be the method that a different organization would choose to execute the same project. Many sources were examined across the aerospace industry to begin drafting these task lists. To ensure that this research is realistic for program execution, Work Breakdown Structures (WBSs) were requested from different commercial and government organizations to use as a starting point. In response to solicitations, many organizations could not provide their WBSs for programs, stating that the specific programs themselves owned the WBSs. However, a couple of organizations did not claim ownership of the WBSs and contributed them to this research. It was essential to generalize the task lists that were derived from WBSs to make them program- or system-agnostic so these results can be applied to many different programs. Additionally, SE handbooks and other accepted industry guidance were synthesized. Multiple main tasks were derived for each project, each containing numerous sub-tasks.

The task list for one project, System Requirements Definition and Traceability, was drafted using the INCOSE Systems Engineering Handbook v5.[3] Two projects' task lists were drafted using WBSs from programs, one from government (Pre-Phase A Architecture Development) and one from industry (Concept Definition). The task list for the fourth project, Test & Evaluation, was drafted using the *Mission Assurance Guide* from an FFRDC.[51,52] The initial draft task lists are displayed in Appendix A. The following table summarizes the number of tasks from these original lists. Note that the Program Management (PM)/Admin tasks are the same for each project, so they are numbered the same across the projects (1.1).

Table 1. Number of Original Tasks Drafted for Each Project from Gathered Sources

	Number of Tasks
1.1 PM/Admin	10
1.2 Define System Requirements	7
1.3 Analyze System Requirements	3
1.4 Manage System Requirements	3
Total for System Requirements Definition and Traceability	23
1.1 PM/Admin	10
2.2 Define System-Level Architecture	8

2.3 Define Subsystem-Level Architecture	8
2.4 Define Assembly-Level Architecture	8
Total for Pre-Phase A Architecture Development	34
1.1 PM/Admin	10
3.2 System Analysis and Architecture Design	5
3.3 Subsystem Analysis and Architecture Design	4
3.4 Component Analysis and First Unit Architecture Design	4
Total for Concept Definition	23
1.1 PM/Admin	10
4.2 Pre-Key Decision Point (KDP) A Concept Studies (Phase 0) Efforts	4
4.3 Concept Development (Phase A) Efforts	13
4.4 Preliminary Design (Phase B) Efforts	10
4.5 Complete Design (Phase C) Efforts	5
4.6 Fabrication and Integration (Phase D1) Efforts	6
4.7 Fielding and Checkout (Phase D2) Efforts	4
4.8 Operations and Disposal (Phase D3) Efforts	5
Total for Test & Evaluation	57

To review and assess these work products, this research relied upon a curated group of DE and SE experts from the aerospace industry. The panel of DE and SE experts was composed of individuals from various government organizations, industry organizations, FFRDCs, UARCs, and SETA personnel. This group represents a sample of DE and SE thought leadership across the aerospace industry. The individuals have diverse expertise in DE, SE, MBSE, PM, Test & Evaluation (T&E), Operations, Technology, and System Maintenance and Sustainment and are in positions such as "Principal Engineer, Architecture and Design," "Space Systems Portfolio Lead," and "Engineering Program Manager and Systems Engineering Lead." Several members of the panel are deeply involved in efforts by INCOSE and other groups to drive DE and MBSE adoption and standards. They have a range of experience in the industry of 20 to 40 years, with an average of 25.3 years and a standard deviation of 6.6 years. Nineteen individuals initially responded that they would participate, and eleven answered at least one of the three email requests sent throughout this research. The following table summarizes the characteristics of the eleven DE and SE experts participating in this research. Respondents provided information for organization type and background based on their entire career experience, not just their current position or experience. For example, someone who was formerly a government employee but now works in industry would list experience in both organization types.

Table 2. Salient Characteristics of the DE and SE Experts

Characteristics		Number of Respondents With This Experience	Percent of Total
Organization Type			
	Government	4	36%
	Industry	6	55%
	FFRDC/UARC/SETA	6	55%
Background			
	PM	6	55%
	SE	8	73%
	DE Core Expertise	5	45%
	MBSE Core Expertise	6	55%
	T&E	7	64%
	Operations	4	36%
	System Maintenance/Sustainment	3	27%
	Program Security	1	9%
	Technical Subject Matter Expert (SME)	6	55%

To ensure the correctness and completeness of the task lists, the DE and SE experts were interviewed once the task lists were initially drafted. Throughout this RQ, a blend of research techniques was used. The DE and SE expert panel responded to the research requests in writing, but their responses functioned as an interviewing-style of qualitative research. This is because the panel of experts was prompted to share their knowledge and experience in an open-ended format, providing unstructured, experience-based responses to inform and refine the task lists. A reflexive journaling process accompanied their survey, in which the researcher's decisions, assumptions, and interpretations were documented while incorporating the experts' feedback. This journaling supported transparency and ensured that revisions to the task lists were grounded in both expert input and a clear audit trail of the process.

For this first research request, instructions to the DE and SE expert panel were as follows:

"This research investigates the training needs and role allocation of tasks to personnel when including MBSE as part of different types of SE activities/projects. Off the top of your head, without looking anything up, list sub-tasks that come to mind for the SE projects: System Requirements Definition and Traceability, Pre-Phase A Architecture Development, Concept Development, and Test & Evaluation. This research focuses on space systems, so please think about each project in that context."

With the input from their responses, the draft task lists were updated and prepared for distribution back to the panel of experts for another round of review and refinement, which takes place in the next Research Task. The following table shows the changes to the number of tasks and task additions to each section for each project based on these initial inputs from the experts.

Table 3. Updates to Tasks Based on Original Expert Input

	Original # of Tasks	Tasks Added	Tasks Changed	Final # of Tasks	% of Tasks Changed	% Change in Number of Tasks
1.1	10	3	8	13	80%	30%
1.2	7	0	4	7	57%	0%
1.3	3	3	1	6	33%	100%
1.4	3	1	2	4	67%	33%
Total	23	7	15	30	65%	30%
1.1	10	3	8	13	80%	30%
2.2	8	0	3	8	38%	0%
2.3	8	0	2	8	25%	0%
2.4	8	0	2	8	25%	0%
Total	34	3	15	37	44%	9%
1.1	10	3	8	13	80%	30%
3.2	5	1	0	6	0%	20%
3.3	4	1	0	5	0%	25%
3.4	4	1	0	5	0%	25%
Total	23	6	8	29	35%	26%
1.1	10	3	8	13	80%	30%
4.2	4	0	1	4	25%	0%
4.3	13	0	1	13	7%	0%

4.4	10	2	0	12	0%	20%
4.5	5	2	2	7	40%	40%
4.6	6	2	0	8	0%	33%
4.7	4	0	1	4	25%	0%
4.8	5	0	1	5	20%	0%
Total	57	9	14	66	25%	17%

In total, 107 original tasks were drafted before input from the experts, which counts the 1.1 PM/Admin tasks only once since they are repeated for each project. Based on the experts' input, 16 tasks were added (a 15% increase), and 28 tasks were changed or updated (a 26% change) from the original list. This counts the added and changed PM/Admin tasks only once.

3.3 Distribute the draft set of tasks to DE and SE experts in the aerospace industry for refinement and validation

The updated draft task lists were sent back to the DE and SE experts following their initial input for further review. The draft task lists from RQ1-T1 were organized into a spreadsheet document, separated by project and with each task numbered. This spreadsheet was distributed to the DE and SE experts, who could provide comments to change tasks and add or delete tasks as they felt necessary. This refinement functioned as a second round of interviewing-style expert panel elicitation. Although it was conducted through document review rather than through verbal interviews, the expert panel's open-ended annotations and revisions provided qualitative data that enhanced the accuracy of the task lists. The specific instructions to the panel were:

> *"Please review the tasks and sub-tasks for each project/activity that includes MBSE in the attached Excel file for quality and completeness, adding or moving tasks as necessary and striking through ones to delete. If you make a change, please highlight that using a different font color so it is obvious. Because SE projects and activities are highly tailorable, it is understood that what is listed in this document might not be exactly what you would choose in your organization. The goal is to ensure that these tasks look realistic for a program. The sub-tasks under each task are not listed in order of execution, and the Program Management/Admin tasks are the same for each program, although they do not have to be if you think otherwise. If you have any comments for any of the tasks or sub-tasks, note them in the column under 'Comments/Notes.'"*

3.4 Finalize comprehensive lists of tasks required for different SE projects that use MBSE

As shown above, input from the experts proved valuable to ensure the correctness and completeness of the task lists. Following the distribution of the updated task lists, the experts' comments were individually reviewed and adjudicated. Most of the comments were straightforward and resulted in updating the verbiage of a task for clarity or adding a task that needed to be included for completeness. There were no instances of the comments from the reviewers conflicting with one another, which provided a simple adjudication of their feedback. Based on their comments, the draft lists of tasks were updated and finalized into lists that will be used in subsequent RQs in this research.

Table 4. Updates to Tasks Based on Expert Feedback of Task Lists

	Original # of Tasks	Tasks Added	Tasks Changed	Final # of Tasks	% of Tasks Changed	% Change in Number of Tasks
1.1	13	3	6	16	46%	23%
1.2	7	0	5	7	71%	0%
1.3	6	1	1	7	17%	17%
1.4	4	0	1	4	25%	0%
Total	30	4	13	34	43%	13%
1.1	13	3	6	16	46%	23%
2.2	8	3	3	11	38%	38%
2.3	8	0	1	8	13%	0%
2.4	8	0	0	8	0%	0%
Total	37	6	10	43	27%	16%
1.1	13	3	6	16	46%	23%
3.2	6	1	1	7	17%	17%
3.3	5	1	1	6	20%	20%
3.4	5	0	1	5	20%	0%
Total	29	5	9	34	31%	17%
1.1	13	3	6	16	46%	23%
4.2	4	1	1	5	25%	25%
4.3	13	0	5	13	39%	0%

4.4	12	2	2	14	17%	17%
4.5	7	2	0	9	0%	29%
4.6	8	1	1	9	13%	13%
4.7	4	2	0	6	0%	50%
4.8	5	0	0	5	0%	0%
Total	66	11	15	77	23%	17%

Table 4 shows the changes to the number of tasks and the task additions following this second round of review. In total, 123 updated tasks were submitted back to experts, which again counts the 1.1 PM/Admin tasks only once since they are repeated for each project. Based on the experts' feedback, 17 tasks were added (14% increase), and 29 tasks were changed or updated (24% change) from the original list.

The following sections show tables of the finalized task lists for each SE project that uses MBSE. One note is that these projects are standalone projects, not projects that flow from one to the next.

3.4.1 System Requirements Definition and Traceability

The first SE project defined for this research is System Requirements Definition and Traceability. The tasks for this project were initially drafted using the INCOSE Systems Engineering Handbook v5[3] with review and updates from the DE and SE experts. The following table shows the finalized list of tasks for this project.

Table 5. Tasks for System Requirements Definition and Traceability

Project 1: System Requirements Definition and Traceability	
Task 1: Program Management/Admin	
1.1.1	Identify stakeholders and manage engagement, expectations, and needs
1.1.2	Define program/system scope, including system boundaries and work breakdown structure
1.1.3	Define and manage program/acquisition strategy and implement business rules
1.1.4	Define and drive vision and way-ahead for the team
1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/technical/cost/schedule decisions
1.1.6	Define and manage cost/budget

1.1.7	Define and manage schedule, ensuring focus on major milestones
1.1.8	Define and manage personnel, roles, teams, and organizational structure, to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
1.1.10	Define and manage risk and program compliance
1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc), and Quality Control
1.1.13	Define, manage, and execute required reviews
1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
1.1.15	Manage Security and maintain Security Classification Guide
1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Define System Requirements	
1.2.1	Define functional boundary in terms of the behavior and properties the system will provide, including system performance attributes, throughput, and responsiveness needs
1.2.2	Identify/obtain stakeholder key functional/performance requirements and iteratively review
1.2.3	Define functions and associated performance, system Concept of Operation (CONOPs), and Use Cases
1.2.4	Define constraints on the program/system, operating environment, interactions with external systems, externally-driven requirements, and required new interfaces; create required documentation
1.2.5	Identify and capture system requirements and attributes and create requirements baseline
1.2.6	Identify requirements that relate to risk, criticality, critical quality characteristics, and compliance with standards and regulations
1.2.7	Begin to define verification success criteria for each requirement, verification strategy, verification method, verification plan, and responsible organization, and continue to iterate
Task 3: Analyze System Requirements	
1.3.1	Analyze requirements to ensure they are correct, complete, consistent, traceable, understandable, appropriate to level, verifiable/measurable, and feasible, adjudicating and refining as necessary
1.3.2	Define critical performance measures
1.3.3	Review analyzed requirements with stakeholders and resolve any issues
1.3.4	Analyze requirements for criticality (e.g., impact of non-satisfaction) and sensitivity (e.g., impact of partial satisfaction)
1.3.5	Prioritize requirements, if needed

1.3.6	Develop performance models and analyses to model and/or test to validate and/or verify requirements
1.3.7	Determine system compliance criteria and margin to requirements
Task 4: Manage System Requirements	
1.4.1	Establish and sustain requirements traceability
1.4.2	Establish, document, and manage system requirements change process, including a means to identify impacts of a proposed requirements change
1.4.3	Establish and manage baselines for information items, work products, or other artifacts
1.4.4	Manage progress of requirements development, change, and satisfaction

3.4.2 Pre-Phase A Architecture Development

The task list for Pre-Phase A Architecture Development was drafted from a study by a NASA program for architecting a robotic space system[50] and reviewed by the panel of DE and SE experts. The following table shows the finalized list of tasks for this project.

Table 6. Tasks for Pre-Phase A Architecture Development

Project 2: Pre-Phase A Architecture Development	
Task 1: Program Management/Admin	
1.1.1	Identify stakeholders and manage engagement, expectations, and needs
1.1.2	Define program/system scope, including system boundaries and work breakdown structure
1.1.3	Define and manage program/acquisition strategy and implement business rules
1.1.4	Define and drive vision and way-ahead for the team
1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/technical/cost/schedule decisions
1.1.6	Define and manage cost/budget
1.1.7	Define and manage schedule, ensuring focus on major milestones
1.1.8	Define and manage personnel, roles, teams, and organizational structure, to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
1.1.10	Define and manage risk and program compliance
1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc), and Quality Control
1.1.13	Define, manage, and execute required reviews
1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents

1.1.15	Manage Security and maintain Security Classification Guide
1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Define System-Level Architecture	
2.2.1	Perform system-level trade study to research and generate possible system architectures and make a recommendation
2.2.2	Conduct system architecture peer review to ensure the appropriateness and potential success of recommended system architecture against key functional/performance requirements; iteratively review with appropriate stakeholder(s)
2.2.3	Capture final system CONOPs and define architecture ownership roles
2.2.4	Identify and elaborate on system Use Cases
2.2.5	Define system structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to the system
2.2.6	Define system internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed subsystems of the module
2.2.7	Define system element specifications to include relevant information, such as physical characteristics/constraints, environment, test support features, software features, links to drawings and specifications, etc.
2.2.8	Define system-level data, including the scope, structure, and location of the data, its flow to and from the module, and algorithm needs
2.2.9	Define system-level behavior within the context of its use
2.2.10	Define, map, and allocate system-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
2.2.11	Determine modeling strategy
Task 3: Define Subsystem-Level Architecture (performed for each subsystem)	
2.3.1	Perform subsystem-level trade study to research and generate possible subsystem concepts/architectures and make a recommendation based on ability to meet key requirements within cost/schedule
2.3.2	Conduct subsystem architecture peer review to ensure the appropriateness and potential success of recommended subsystem concepts
2.3.3	Define subsystem structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to each subsystem
2.3.4	Define subsystem internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed assemblies of the subsystem
2.3.5	Define subsystem element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
2.3.6	Define subsystem-level data, including the scope, structure, and location of the data, its flow to and from each subsystem, and algorithm needs
2.3.7	Define subsystem behavior within the context of its use

2.3.8	Define, map, and allocate subsystem-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Task 4: Define Assembly-Level Architecture (performed for each assembly that makes up the subsystems, e.g., individual actuators, mechanisms, structural elements, and sensors)	
2.4.1	Perform assembly-level trade study to research and generate possible assembly concepts and make a recommendation
2.4.2	Conduct assembly architecture peer review to ensure the appropriateness and potential success of recommended assembly concepts
2.4.3	Define assembly structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to each assembly
2.4.4	Define assembly internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed elements of the assembly
2.4.5	Define assembly element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
2.4.6	Define assembly-level data, including the scope, structure, and location of the data, its flow to and from the assembly, and algorithm needs
2.4.7	Define assembly behavior within the context of its use
2.4.8	Define, map, and allocate assembly-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria

3.4.3 Concept Definition

A third SE project for this research is Concept Definition. This set of tasks was derived from a WBS for a program by an industry development contractor and reviewed and finalized by the panel of DE and SE experts. The following table shows the list of finalized tasks for this project.

Table 7. Tasks for Concept Definition

Project 3: Concept Definition	
Task 1: Program Management/Admin	
1.1.1	Identify stakeholders and manage engagement, expectations, and needs
1.1.2	Define program/system scope, including system boundaries and work breakdown structure
1.1.3	Define and manage program/acquisition strategy and implement business rules
1.1.4	Define and drive vision and way-ahead for the team
1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/technical/cost/schedule decisions

1.1.6	Define and manage cost/budget
1.1.7	Define and manage schedule, ensuring focus on major milestones
1.1.8	Define and manage personnel, roles, teams, and organizational structure, to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
1.1.10	Define and manage risk and program compliance
1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc), and Quality Control
1.1.13	Define, manage, and execute required reviews
1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
1.1.15	Manage Security and maintain Security Classification Guide
1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: System Analysis and Architecture Design	
3.2.1	Identify and analyze stakeholder system requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; key performance requirements; and success criteria; decomposing the system requirements into subsystem requirements, as needed. Iteratively review with appropriate stakeholders.
3.2.2	Analyze desired stakeholder system Use Cases, including relationships, interfaces, exchanges, and interactions between the proposed system and its external environment
3.2.3	Perform system-level trade study to research and generate possible system concepts and make a recommendation
3.2.4	Define system functional architecture, relating the functions to system requirements
3.2.5	Allocate system functional architecture to structural elements
3.2.6	Parameterize system functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.
3.2.7	Develop modeling strategy and model/simulate system behavior
Task 3: Subsystem Analysis and Architecture Design	
3.3.1	Analyze stakeholder subsystem requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria; decomposing the subsystem requirements into component requirements, as needed. Iteratively review with appropriate stakeholders.
3.3.2	Perform subsystem-level trade study to research and generate possible subsystem concepts and make a recommendation
3.3.3	Define subsystem functional architecture, relating the functions to subsystem requirements

3.3.4	Allocate subsystem functional architecture to structural elements
3.3.5	Parameterize subsystem functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.
3.3.6	Revisit/assess modeling strategy and perform end-to-end modeling, simulation, and analysis through subsystems to ensure both CONOPs closure and likelihood of meeting key performance requirements
Task 4: Component Analysis and First Unit Architecture Design	
3.4.1	Analyze stakeholder component requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria. Iteratively review with appropriate stakeholders.
3.4.2	Perform component-level trade study to research and generate possible component concepts and make a recommendation
3.4.3	Define component functional architecture, relating the functions to component requirements
3.4.4	Allocate component functional architecture to structural elements
3.4.5	Parameterize component functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.

3.4.4 Test & Evaluation

The final SE project in this study is Test & Evaluation. These tasks were derived from a *Mission Assurance Guide* Technical Operating Report from an FFRDC, the Aerospace Corporation.[51,52] The following table shows the list of finalized tasks for this project.

Table 8. Tasks for Test & Evaluation

Project 4: Test & Evaluation	
Task 1: Program Management/Admin	
1.1.1	Identify stakeholders and manage engagement, expectations, and needs
1.1.2	Define program/system scope, including system boundaries and work breakdown structure
1.1.3	Define and manage program/acquisition strategy and implement business rules
1.1.4	Define and drive vision and way-ahead for the team
1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/technical/cost/schedule decisions
1.1.6	Define and manage cost/budget
1.1.7	Define and manage schedule, ensuring focus on major milestones
1.1.8	Define and manage personnel, roles, teams, and organizational structure, to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
1.1.10	Define and manage risk and program compliance

1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc), and Quality Control
1.1.13	Define, manage, and execute required reviews
1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
1.1.15	Manage Security and maintain Security Classification Guide
1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Pre-KDP A Concept Studies (Phase 0) Efforts	
4.2.1	Assess the testability of all concept alternatives (including T&E risks), validation strategy for ground support and special test equipment, test infrastructure, and test requirements
4.2.2	Define and evaluate Technical Performance Measures and mission requirements validation strategy
4.2.3	Identify and establish test organizational relationships (e.g., support agreements, Contractor Test teams, Developmental Test teams, Operational Test teams, required outside agencies)
4.2.4	Define certification requirements
4.2.5	Develop a Test & Evaluation Master Plan (TEMP); include specific organizational responsibilities for preparing for or executing test activities
Task 3: Concept Development (Phase A) Efforts	
4.3.1	Assess mission and system CONOPS and requirements for completeness and to support testability
4.3.2	Update TEMP
4.3.3	Assess system internal and external interface definition, completeness, and testability (including any test support features)
4.3.4	Examine the need for simulations, models, prototypes, and test beds, and evaluate long-lead planning and procurement
4.3.5	Assess testability of the integrated space and ground elements
4.3.6	Determine risk to the flight units/system concept due to the stress of ground testing
4.3.7	Assess the need for any test resources, ground support equipment, test operations procedures, test execution procedures and software, test parameter databases, and/or special test equipment, either existing or new
4.3.8	Develop the assembly and integration strategy
4.3.9	Connect with any necessary specialty engineering disciplines (e.g., electromagnetic compatibility, cybersecurity)
4.3.10	Develop Independent Test & Evaluation (IT&E) schedule that supports key decision points, including any margin for rework
4.3.11	Develop certification test strategy
4.3.12	Develop requirements verification architecture model (RVAM) and determine specific conditions and methods for testing and verification of each requirement

4.3.13	Collect necessary system operating environments to establish test needs (e.g., SMC-S-016 acoustic, shock, vibration levels)
Task 4: Preliminary Design (Phase B) Efforts	
4.4.1	Decompose and assess T&E certification requirements
4.4.2	Develop any Commercial-Off-the-Shelf (COTS)/heritage test requirements
4.4.3	Determine technology development strategy
4.4.4	Develop segment-to-segment verification/validation strategy (e.g., space-to-ground, space-to-launch)
4.4.5	Flow-down test requirements to lower-level assemblies
4.4.6	Develop space vehicle test program, including test conditions, test risks, test procedures, crypto handling, clean room/electro-static/radiation sensitivities for personnel and hardware, and validation for space-to-ground interface, software, and cyber
4.4.7	Develop plan for payload integration to bus
4.4.8	Assess supply chain test strategies and risks
4.4.9	Conduct space vehicle component testing and evaluate data
4.4.10	Conduct space vehicle subsystem testing and evaluate data
4.4.11	Conduct initial activation, fielding, and operations planning
4.4.12	Participate in Preliminary Design Review (PDR)
4.4.13	Define and manage external program hardware, software, units, personnel, and test-unique equipment
4.4.14	Update TEMP
Task 5: Complete Design (Phase C) Efforts	
4.5.1	Develop final system integration and test plan(s)
4.5.2	Develop final verification plan and schedule
4.5.3	Reevaluate test risks to flight hardware over the course of the entire planned test sequence
4.5.4	Evaluate any informal test data
4.5.5	Obtain interim Authority to Test (IATT) and/or Authority to Operate (ATO)
4.5.6	Update activation, fielding, and operations planning
4.5.7	Participate in Critical Design Review (CDR)
4.5.8	Conduct risk reduction testing (early integration tests, simulator tests, etc)
4.5.9	Develop and test any test unique equipment
Task 6: Fabrication and Integration (Phase D1) Efforts	
4.6.1	Develop launch vehicle/space vehicle integrated test plan
4.6.2	Develop assembly, test, and checkout procedures
4.6.3	Evaluate and document test risk items
4.6.4	Conduct pre-ship test and evaluate data
4.6.5	Conduct space vehicle integrated system test and evaluate data
4.6.6	Conduct validation and acceptance testing and evaluate results
4.6.7	Conduct Test Readiness Reviews (TRR)

4.6.8	Participate in Manufacturing Readiness Review (MRR)/Production Readiness Review (PRR)
4.6.9	Develop and validate operational procedures; conduct operator training and mission rehearsals
Task 7: Fielding and Checkout (Phase D2) Efforts	
4.7.1	Evaluate launch base checkout and readiness
4.7.2	Evaluate satellite deployment and initialization and establish baseline
4.7.3	Plan and conduct operational testing and evaluate data
4.7.4	Evaluate and resolve any anomalies
4.7.5	Participate in Mission Readiness Review/Flight Readiness Review (FRR)
4.7.6	Plan and conduct Operational Readiness Review (ORR) prior to turning system over to operations
Task 8: Operations and Disposal (Phase D3) Efforts	
4.8.1	Evaluate periodic mission performance testing, monitor trends, and assess and update reliability statistics
4.8.2	Evaluate periodic space vehicle subsystem calibration results
4.8.3	Evaluate system baseline changes impacting performance
4.8.4	Maintain ground test infrastructure
4.8.5	Develop software upgrade test strategies for ground support equipment and on-orbit software and test following upgrades

3.5 Conclusion

This RQ proved to be more challenging than initially expected because of how SE tasks can be tailored for different programs and circumstances. Most of the guidance and resources, except for the WBSs, show tasks for different SE projects at a high level but do not elaborate on specifics. DE and SE expert panel input and review were critical for drafting and finalizing these completed task lists, which will provide a basis for the rest of this research. Now that the tasks are defined, the next RQ will use these tasks from RQ1 to demonstrate task allocation to roles and role allocation to personnel and investigate how that changes based on team size.

CHAPTER 4: ROLE ALLOCATION AND VARIANCE

4.1 Introduction and Methodology

With the tasks for each project defined, it is now necessary to understand which roles will perform the different tasks and how team size can affect role allocation to personnel for these tasks. This chapter investigates the question posed in RQ2: *How does the allocation of tasks to roles and roles to personnel differ for different SE projects that use MBSE, and does that change with team size?*

To understand the competencies required for different personnel roles that execute an SE project that uses MBSE, one must first understand the tasks that the individual roles are expected to perform. Also, determining the training required for each individual necessitates understanding what and how many roles may be assigned to an individual, which could vary as the team size changes. This RQ gathers data from the DE and SE experts to examine which tasks are allocated to roles, which roles are allocated to personnel, and how those change based on team size. The lists of tasks from RQ1 can then be updated to include the roles that will execute these tasks, which will subsequently be mapped to their required skills in the next chapter. Assigning roles to the tasks for different-sized teams is accomplished through three Research Tasks that are subordinate to RQ2:

- Task 1 (RQ2-T1): Identify how tasks are allocated to roles and how roles are allocated to personnel when using MBSE for different SE projects
- Task 2 (RQ2-T2): Identify similarities and differences in how tasks are distributed to roles and how roles are distributed to personnel for different team sizes

- Task 3 (RQ2-T3): Create a synthesized listing of roles and associated tasks for each SE project

Figure 5 is a Systems Modeling Language (SysML) Activity Diagram depicting the process for soliciting, receiving, and finalizing task and role allocation data from the DE and SE expert panel, beginning with the task lists derived in RQ1. The following sections provide more information on each of the steps shown in the figure.

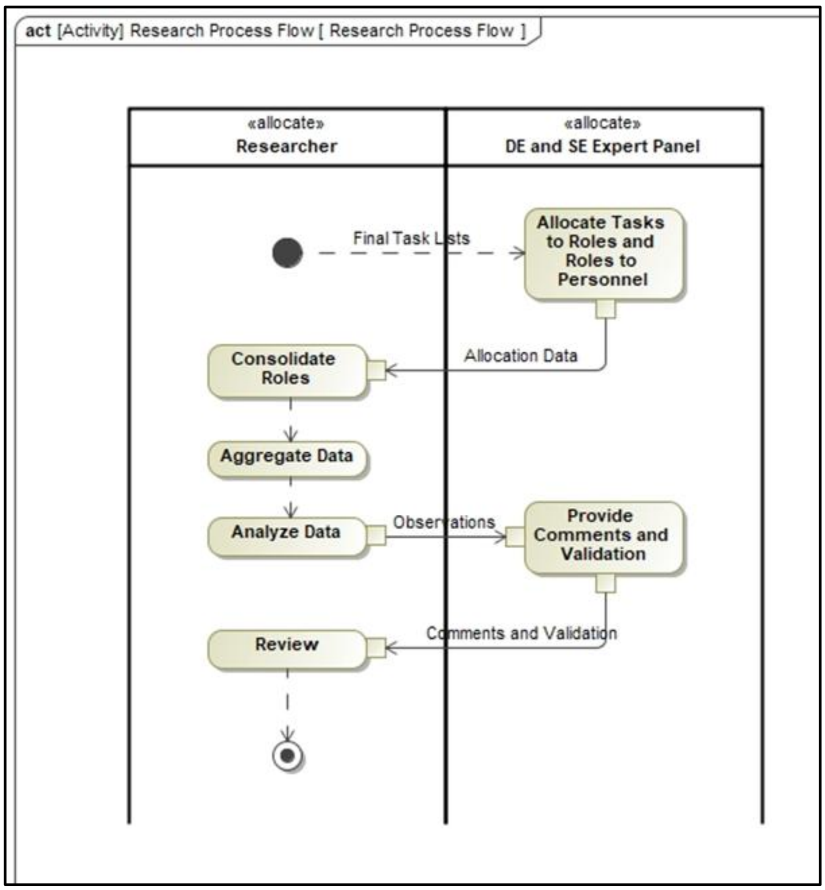

Figure 5. SysML Activity Diagram for Allocating Tasks to Roles and Roles to Personnel

4.2 Identify how tasks are allocated to roles and how roles are allocated to personnel when using MBSE for different SE projects

4.2.1 Task-to-Role Allocation

To determine task-to-role allocation, the DE and SE expert panel was first asked to provide feedback on how they would allocate tasks to roles in an SE project that uses MBSE for various team sizes. For this, the final task lists from Chapter 3 were distributed back to the panel of DE and SE experts in an Excel spreadsheet so they could assign tasks to roles. They were asked to complete these activities in different team sizes.

1. The first was with their organization's current or recent team executing these projects, which is referred to as the "current" team in the following analysis and results.
2. The second was with ideal teams of 10, 50, and 100 personnel. "Ideal" here means how the experts themselves believe would make for a more ideal MBSE operation. These are called the "ideal" teams in the analysis and results.

The spreadsheet that was sent to the panel of experts was prepopulated with all of the tasks for each SE project and included ten columns available to list roles. Nine of the columns contained a dropdown list of roles that the experts could choose to include for each task and a tenth column that was blank, where they could type in additional roles that they believed also executed that particular task. Similarly, they were also asked how they would ideally allocate tasks to roles if the teams contained 10, 50, and 100 personnel. This component of the research provided a further stage of interviewing-style expert elicitation, where the expert panel provided qualitative, experience-based assessments of role execution and task allocation across varying team sizes. For this part of the process, the specific instructions to the expert panel were:

> *"For each task in each of the projects, choose the role(s) that you believe is/are executing this task on a current or recent team at your organization. If there is more than one role executing this task on your team, also choose additional roles. You can choose as many roles as applicable to each task. If you have a role that is not displayed in the dropdown menu, please type it in the column labeled 'Other'. Complete this action for all the tasks in the listed project(s) that your organization is executing or has recently executed. Repeat this same process for how you would ideally like to see this allocation in teams of 10, 50, and 100 personnel for each project that would provide better MBSE operation."*

Once the spreadsheets were returned, the researcher used judgment to either add the "additional" roles or consolidate them into another role. For example, the roles of Hardware SME and Software SME were consolidated under Technical SME because they referred to the same skills in a broader sense: one who is an expert in a particular technology. In contrast, the "additional" role of Contracts Specialist was added because many experts had identified it as an essential role missing from the supplied pull-down menu.

The final roles included for the four projects are listed below, along with their definitions. The definitions for each role were typically derived from one or more sources and/or the author's professional experience. The abbreviation or word(s) in parentheses in the role names define how they are shown in the tables throughout the rest of this research.

- Program Manager (PM): "Designated individual with responsibility for and authority to accomplish program objectives for development, production, and sustainment to meet the user's operational needs. The PM shall be accountable for credible cost, schedule, and performance reporting."[53]
- Chief Engineer (Chief Eng): A senior-level role tasked with overseeing the development of a part or system and managing engineering teams.[54] This role includes the suggested roles of User Engagement and Lead Designer.
- Systems Engineer (Sys Eng): "A person who practices systems engineering and whose systems engineering capabilities and experience include sustained practice, specialization, leadership, or authority over systems engineering activities."[55] This role also includes the suggested roles of System Architect, Integration Lead, Requirements Lead, Interface Management, and Mission Assurance.
- Technical SME (Tech SME): An expert in a particular technology.[56] This role also includes the suggested roles of Software SME, Hardware SME, Robotic Systems Engineer,

Designer, Electrical Lead, Electrical SME, Software Lead, Motion Control Systems Engineer, Thermal Engineer, Ground Support Equipment Engineer, and Dynamicist.

- MBSE SME (MBSE SME): An expert in "the formalized application of modeling to support system requirements, design, analysis, verification, and validation activities beginning in the conceptual design phase and continuing throughout development and later system life cycle phases."[4] This role is by no means intended to be a stovepiped role that is disconnected from the rest of the team or other facets of the project outside of MBSE. The MBSE SME still needs a breadth of project knowledge, which is applied to the MBSE models. This role also includes the suggested roles of Lead Analyst and Modeling, Simulation, and Analysis SME.
- Program Security Officer (Prog Sec): A security professional who provides program-related security guidance during program development/operations, ensuring adherence to the Security Classification Guide (SCG) and applicable regulations, developing relevant security policies, plans, and procedures, and granting access to program spaces and information to appropriately cleared individuals on the program. This role also includes the suggested Information System Security Officer (ISSO) role.
- IT Specialist (IT): An IT expert who plans, develops, and maintains computers and digital networks. This includes installing software and any updates, implementing required and recommended security protocols, and troubleshooting and repairing any outages or issues.[57] This role also includes the suggested role of Equipment Custodian.
- Physical Security Specialist (Phys Sec): A security professional who ensures the protection and safety of the organization's employees, property, and visitors. This role also includes the suggested role of Facility Manager.

- Configuration Control and Management Specialist (Config Cntrl): A specialist who controls the baseline and changes to a configuration item, recording and reporting these changes to program team members and management.[58] This role also includes the suggested role of Technical Document Library Point of Contact (POC).
- T&E SME (T&E SME): An expert in the T&E process whereby the system and its components are assessed to provide indicators of risks, data for model and simulation validation, and technical performance, effectiveness, and suitability data.[59] This role also includes the suggested roles of Quality Control and Test Lead.
- Finance and Budgeting Analyst (Finance): An expert who tracks and forecasts a program's budget and spend plan, ensuring proper allocation of financial resources across the program's development and execution and adherence to all applicable regulations.
- Scheduling Specialist (Scheduler): A professional who manages and coordinates the schedules and timelines of different program areas, examining dependencies to ensure timely program development and execution and reporting updates to program team members and management.
- Contracts Specialist (Contracts): An expert in contract management and administration who creates, finalizes, and manages the contracts for a program with customers, external vendors, subcontractors, and other services, ensuring adherence to all applicable regulations.[60]

After the roles in the experts' spreadsheets were appropriately consolidated, all responses for the current team sizes were prepared for aggregation. The responses were first examined to determine how they should be grouped to best compare to the ideal team sizes, since the current teams in the responses could be any size. There were no responses for the current team sizes that were close to 50, so there is no final category for "Current Team Size of 50." The following table shows the different team sizes the respondents listed for a current team and the categories in which each response was included.

Table 9. Final Categories for Aggregation for Current Team Size Responses

Project	Current Team Size	Final Category
1	99	Current Team Size of 100
1	8	Current Team Size of 10
1	28	--
1	16	Current Team Size of 10
2	99	Current Team Size of 100
2	10	Current Team Size of 10
3	35	--
3	10	Current Team Size of 10
3	9	Current Team Size of 10
4	9	Current Team Size of 10

Following this aggregation, the final categories become:

- Current Team Size of 10
- Ideal Team Size of 10
- Ideal Team Size of 50
- Current Team Size of 100
- Ideal Team Size of 100

The responses from each spreadsheet from the DE and SE expert panel were included in the appropriate category. The responses were then analyzed based on the number of respondents who included a particular role for a task. The results were examined in three different decompositions:

1. All responses included
2. Responses included if greater than or equal to 50% of respondents agreed that a particular role should be assigned to a task

3. Responses included if all respondents agreed that a particular role should be assigned to a task

Since SE activities are highly tailorable, the remainder of this research will rely on the case where 50% or more of the respondents needed to agree on a role for that role to be included in a particular task.

4.2.2 Role-to-Personnel Allocation

After the panel of experts completed the task-to-role allocations in the spreadsheet, they were asked to assign roles to individual personnel. These results allow us to investigate the labor intensity of the roles allocated to these projects. For this portion of the process, roles were listed in columns across the top of the spreadsheet for each project, and numbers from 1 to 100 for individual personnel were listed in rows in the first column. This step extended the interviewing-style expert elicitation by gathering detailed, experience-based accounts of individual-level role assessments, which supported the analysis of labor intensity within each project. The specific instructions to the expert panel were:

> *"For a current or recent team size, record the number of personnel on your team above the project name. If you are in a government program office, you should include any FFRDCs and SETA personnel in your office. If your team was an integrator between (for example) two Primes, record the numbers just for your team and not the external organizations. If you are a development contractor, just include the development contractor team, not the customer team.*
>
> *For each team member (which is the numbered column), color/fill in the cell in the column for who performs that role. For example, if the same person is performing the PM, Chief Engineer, and MBSE SME roles, fill in the cell for each of those roles next to Person 1. If you wrote in a role for 'Other' when assigning tasks to roles, you can type that role in the 'Other' column as you color/fill in that cell and assign that role to a Person. Complete this action for all the projects in your organization that have a current or recent team. Repeat this same process for how you would like to ideally see this allocation in teams of 10, 50, and 100 personnel for each project."*

The final step in this activity is to examine whether roles are allocated to personnel differently based on the team size. Once the panel submitted their responses, the data from their spreadsheets were aggregated and normalized. Then, correlation matrices were constructed from the respondents' submitted data to facilitate a more thorough analysis of the results and to understand similarities and differences in personnel role allocations across teams of varying sizes in the current and ideal cases. Following the analysis of the correlation matrices, the respondents received the observations back for validation or member checking, which is a key step in qualitative analysis,[61] and their feedback was recorded in narrative form.

4.3 Identify similarities and differences in how tasks are distributed to roles and how roles are distributed to personnel for different team sizes

To better understand how to plan training more effectively for an organization or team, it is helpful to recognize which roles have more tasks allocated to them and which roles are potentially combined when allocated to individual personnel. The number of tasks an individual is allocated can influence the type and amount of training that individual needs and, therefore, what training an organization should invest in.

4.3.1 Task Allocation to Roles for Different Team Sizes

The first result of this RQ is a mapping of task allocation to roles for each team category by project. The columns down the left side of Figures 6-9 correspond to the task numbers shown in Tables 5-8 in Chapter 3 for these projects. However, the following results focus less on the content of the individual tasks themselves and more on the aggregation of how tasks are assigned to roles, the number of roles associated with each task, and whether discernible patterns emerge in task allocation across different team sizes. In Figures 6-9, the roles are shown across the top of each chart. If the role was assigned to that task by 50% or more of the DE and SE expert respondents, then the block at the intersection of the role and task is colored in. Showing the results in this manner allows for a visual comparison of how the tasks are allocated to the roles across the different team sizes. The number of responses from the DE and SE expert panel for each data set (e.g., *n=2*) is shown next to each team size.

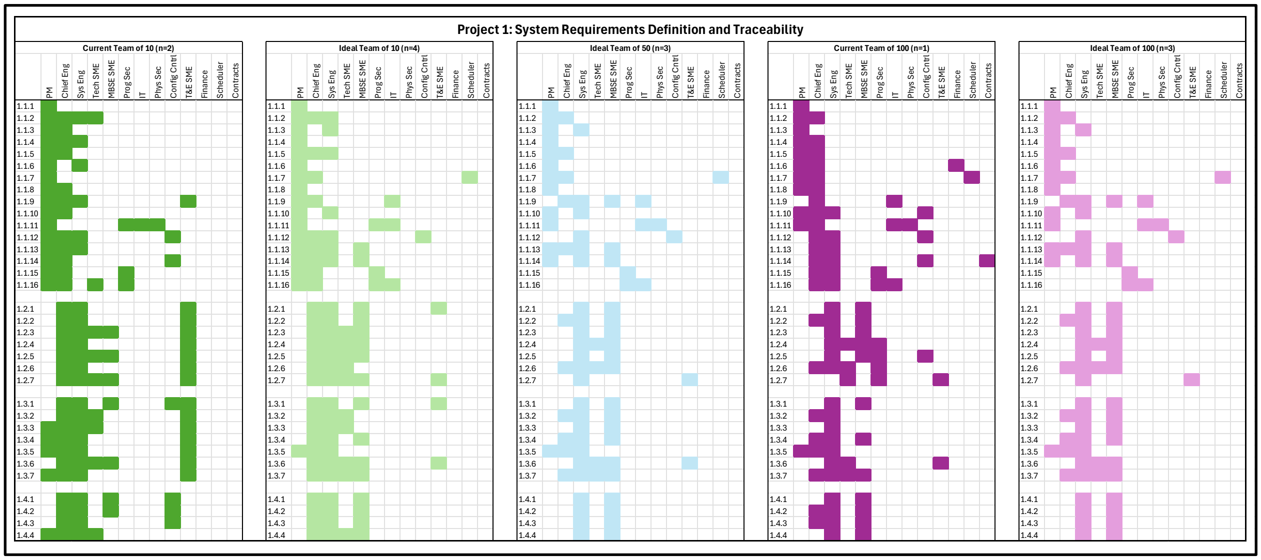

Figure 6. Task Allocation to Roles for System Requirements Definition and Traceability

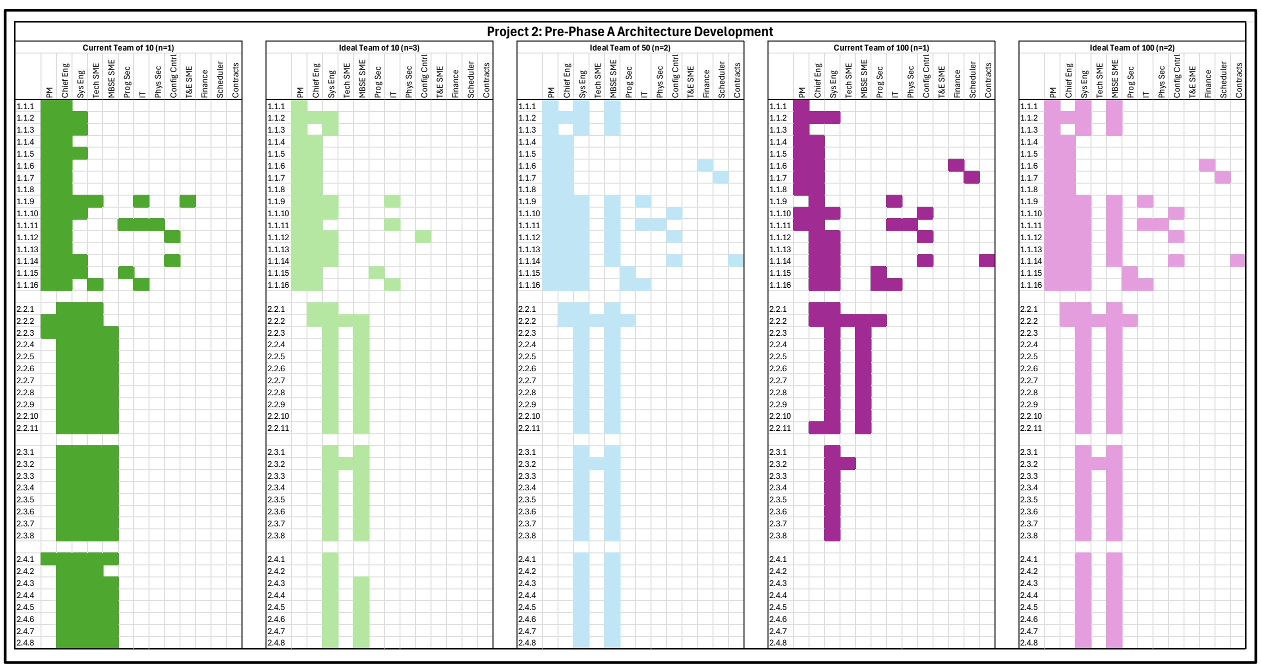

Figure 7. Task Allocation to Roles for Pre-Phase A Architecture Development

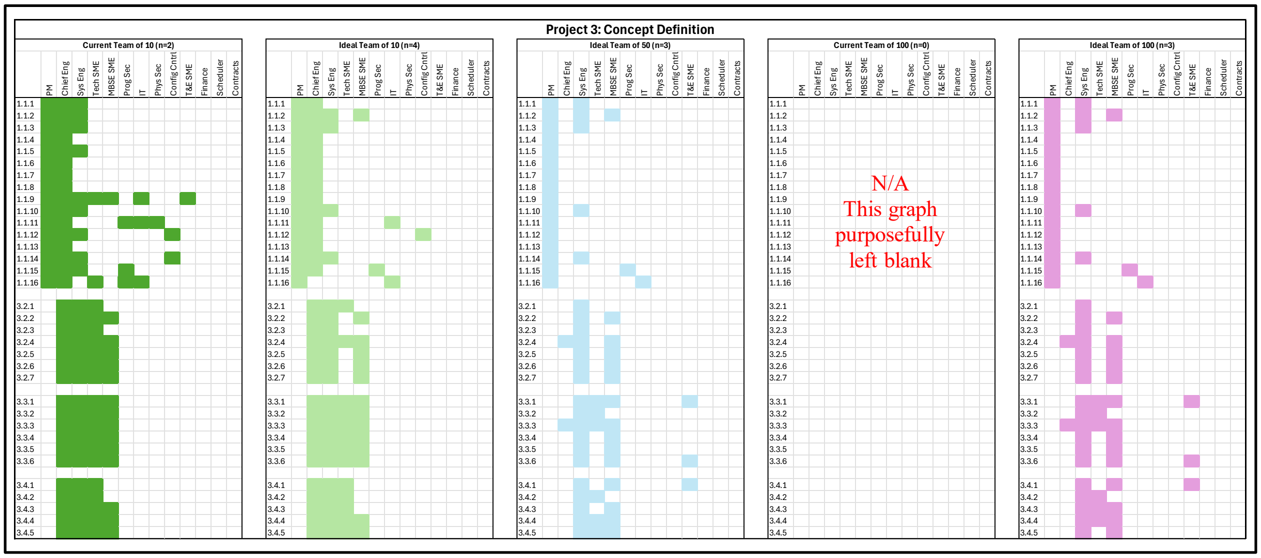

Figure 8. Task Allocation to Roles for Concept Definition

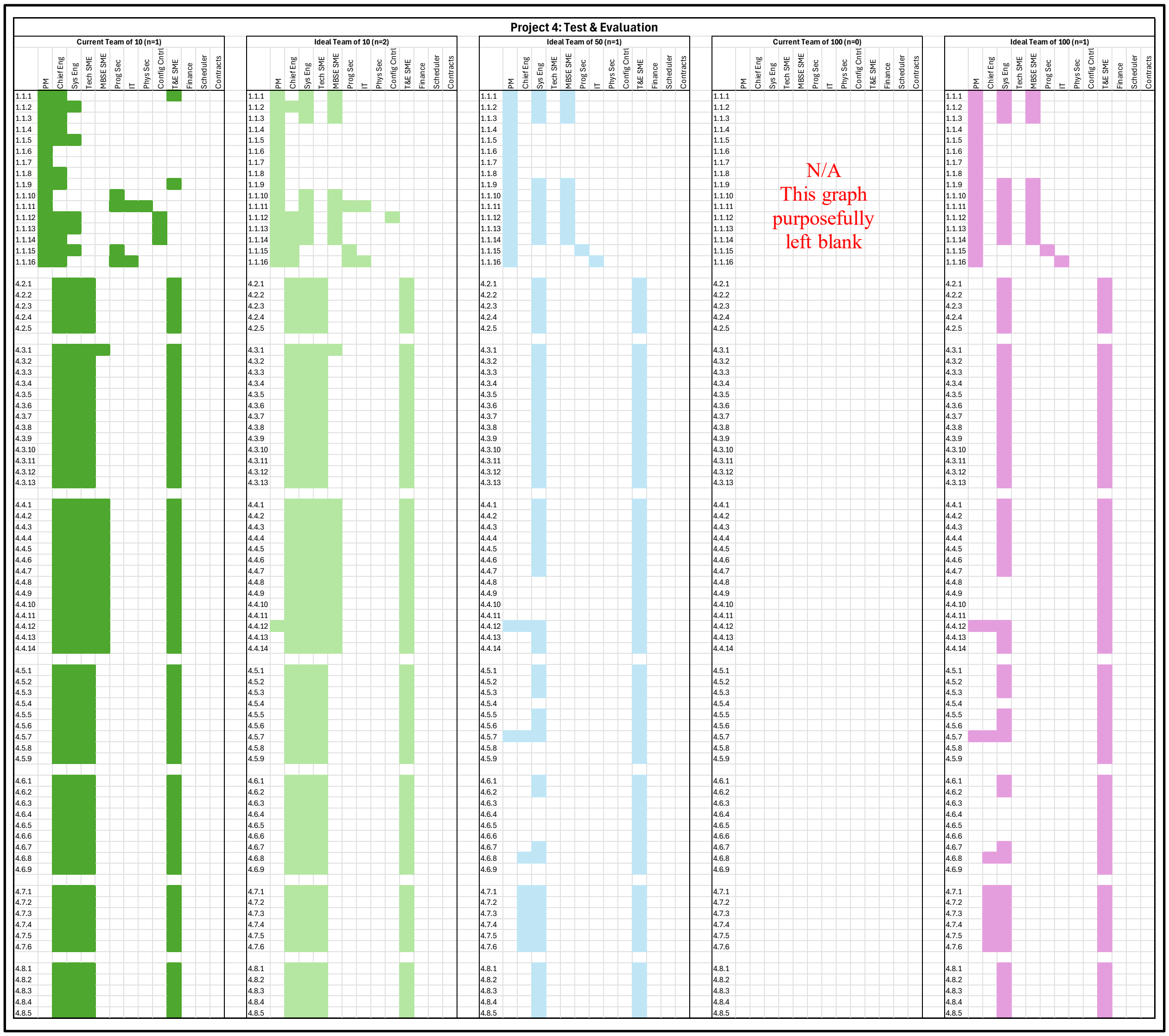

Figure 9. Task Allocation to Roles for Test & Evaluation

The following paragraphs illustrate the key results and lessons learned from analyzing this aggregated data. For this discussion, the first data set on the left (dark green) in Figures 6-9 will be referred to as Column A, which corresponds to the Current Team of 10. Column B is the next column (light green) and is the Ideal Team of 10. Column C is in the middle (light blue) and is the Ideal Team of 50. Column D is to the right of the center (purple) and is the Current Team of 100. Column E is on the far right (pink) and is the Ideal Team of 100.

4.3.1.1 More roles are participating in each task when teams are smaller.

The data from the panel of experts indicates that there are generally more roles assigned to each task as teams are smaller in SE projects that use MBSE, and this decreases as team size increases. For example, as illustrated in Figure 6 and Figure 9, when we compare column B (ideal team of 10) to column C (ideal team of 50), more roles tend to be involved in each task when only ten people are on a team. This is similar when comparing columns B (ideal team of 10) to E (ideal team of 100) in Figure 8. Additionally, larger teams more often include non-engineering roles, as shown in Figure 6 when comparing column B (ideal team of 10) to columns C and E (ideal teams of 50 and 100, respectively).

Based on the responses, the expert panel recommended less segmentation of activities among the roles in smaller MBSE project teams. These results also illustrate some of the canonical characteristics of engineering teams[62] in the ideal teams. For example, roles such as Finance, Scheduler, and Contracts are more often included in larger teams than smaller ones because larger teams have more resources to employ. Additionally, smaller teams tend to have a more collaborative environment, leading to greater involvement by different team members and roles in various tasks. On smaller project teams, more of the roles need to have familiarity with MBSE, while on larger teams, MBSE expertise may be concentrated in particular roles since more specialization occurs. These results could relate to several of the barriers to MBSE adoption that were listed in section 1.3, but most specifically to "organizational characteristics" since how the different roles are involved in projects is discussed. Additionally, the results relate to the "organization structure characteristics" organizational factor mentioned in section 1.4.

4.3.1.2 There is more MBSE SME involvement in ideal teams.

When comparing the allocation to tasks of the MBSE SME role, the results illustrate an increased MBSE SME involvement in ideal teams of all sizes compared to the current state. This is shown, for example, in Figure 6 when comparing column A to B and column D to E. In column A, for the current team of 10, the MBSE SME is only involved in 7 tasks. However, in column B, which is the ideal team of 10, the MBSE SME is involved in 16 tasks. This is similar to the ideal and current teams of 100 (columns D and E), where the MBSE SME is involved in 12 and 19 tasks, respectively.

This increased involvement of the MBSE SME in the ideal teams shows that as experts think about the current and desired composition of teams, they want to increase the level of task allocation and responsibility of the MBSE SME. First, the dearth of MBSE SMEs in current projects supports findings in the literature that indicate a shortage of skilled MBSE SMEs in the industry, despite the advantages of using MBSE in practice.[10,18,26,28,30] This directly relates to the "perception of or demonstration of value" barrier to MBSE adoption previously mentioned in section 1.3 and the "perceived value of MBSE" organizational factor listed in section 1.4. The results also indicate the respondents' desire for a process and culture shift toward improved MBSE involvement and MBSE competency. These responses provide evidence to support previous hypotheses in the literature. For example, future MBSE projects are often envisioned as realizing increased "integration," "competency," and MBSE "maturity" through technical means without asserting what the workforce implications of realizing those goals will be.[63] This relates to the "leadership commitment" barrier and supports studies that acknowledge workforce implications of the increasing use of MBSE, one specifically hypothesizing that "as the workforce knowledge/skills of modeling tools improves, the capability for people to fill MBSE support-type roles increases."[32] The results suggest that as government and industry acceptance of MBSE increases, the desire for MBSE SME involvement in the breadth of project activities will increase.

4.3.1.3 There is more Tech SME involvement in smaller team sizes for the ideal teams.

The results demonstrate that the expert panel allocated the Tech SME to be involved in more tasks in smaller teams than in larger teams for the ideal cases. This is illustrated in Figures 6, 8, and 9 when comparing columns B, C, and E. For example, in Figure 6, the Tech SME is involved in 10 tasks, as shown in column B (the ideal team of 10), and this decreases to 4 tasks for both columns C and E (the ideal teams of 50 and 100, respectively). The results are similarly reflected in Figures 8 and 9. This indicates that when the expert panel designs larger teams, they specialize the Tech SME's efforts by moving the Tech SME out of the SE tasks and allocating them to core technological and engineering tasks.

This allocation of the Tech SME can be contrasted to the allocation of the MBSE SME (as presented in 4.3.1.2). Whereas the experts allocated more tasks to MBSE SMEs in the cases of the ideal teams, broadening their responsibility and integration function, the Tech SMEs are allocated fewer tasks and less cross-functionality in the larger ideal teams. This finding supports the assertions of other quantitative studies, which determined that adopting an MBSE approach results in an increase in automation, a reduced burden of effort, and an increased specialization on high-value tasks for disciplinary engineers.[19] In these results, the expert panel acknowledges the need for the Tech SME role in teams of every size but allows those Tech SMEs to specialize as the team grows. The "traditional" roles of Tech SMEs in project integration and synthesis are allocated to Sys Eng and MBSE SME roles as the projects grow in size, shifting the Tech SME away from the need for deeper MBSE knowledge.

4.3.1.4 There are nearly identical responses for ideal teams of 50 and 100 in all projects.

It is observed that for the ideal teams of 50 and 100 people, the responses from the expert panel are almost always identical between the two different-sized teams. Figure 6 shows this by comparing columns C and E and seeing only one additional task for the T&E SME in the team of 50 (task 1.3.6 in column C) that does not exist in the team of 100. In Figure 8, there are only two differences in the tasks between columns C and E. In column C, the Tech SME is included in task 3.4.5 but not included in that task in column E. Similarly, in column E, the Tech SME is included in task 3.4.3 but not included in that task in column C. In Figures 7 and 9, columns C and E are identical, meaning that the task-to-role allocations for the ideal teams of 50 and 100 for the Pre-Phase A Architecture Development and Test & Evaluation projects were exactly the same.

Upon returning their completed spreadsheets, several respondents commented that performing this allocation for teams larger than 50 people was "mostly guesswork," and they had mainly extrapolated what they used for the team size of 50 when answering for the team size of 100. They offered reasoning that when teams grow larger than 50 people, the project is usually sufficiently large at that point to decompose into smaller pieces that focus on different aspects of the system. For example, there would not typically be a team of 100 people for a Test & Evaluation SE project. Instead, in an SE project with 100 personnel, 20 would work on the Test & Evaluation phase, with the other 80 engaged in engineering other parts of the SE lifecycle.

4.3.2 Role Allocation to Personnel for Different Team Sizes

Figures 10-13 show the correlation matrices for the different team sizes for each project's current and ideal cases. As displayed in the legend, the darkest green color indicates a strong positive correlation (*corr=1*), yellow relates to no correlation (*corr=0*), and the darkest red color corresponds to a strong negative correlation (*corr=-1*). Note that for the Concept Definition and

Test & Evaluation projects, there were no responses for the Current Team of 100, so there are no results for that category in those projects.

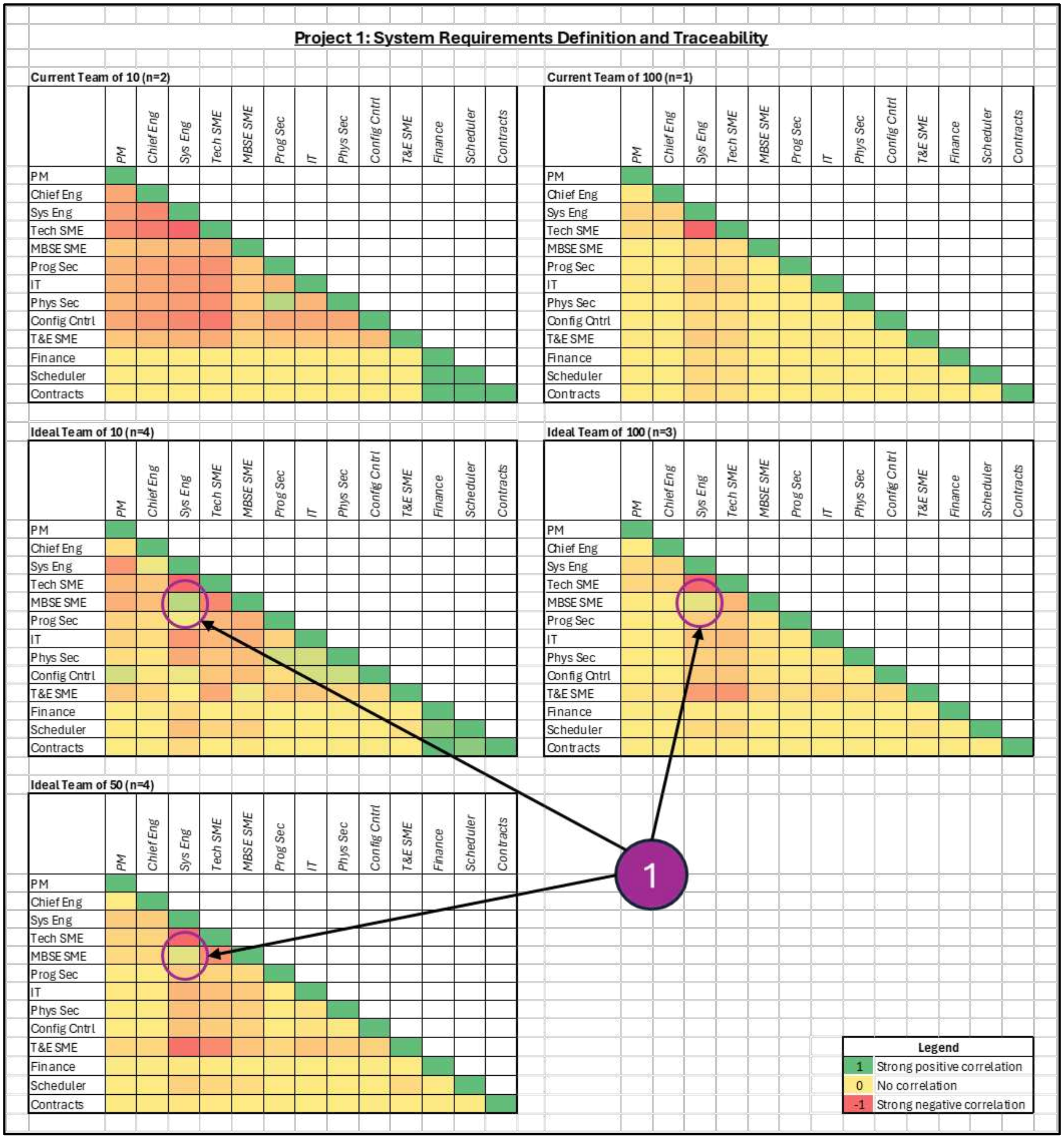

Figure 10. Role Allocation to Personnel Correlation for System Requirements Definition and Traceability

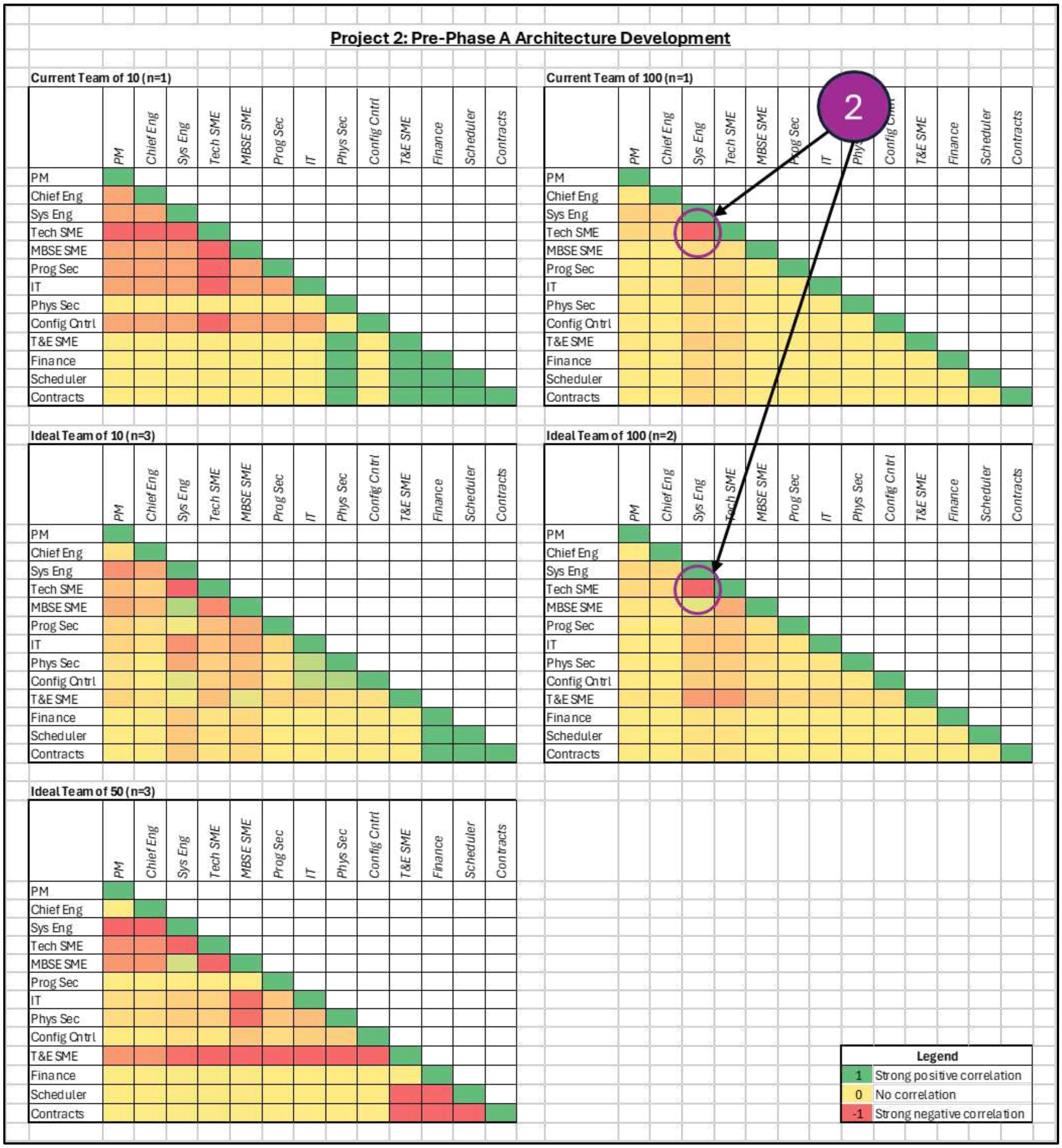

Figure 11. Role Allocation to Personnel Correlation for Pre-Phase A Architecture Development

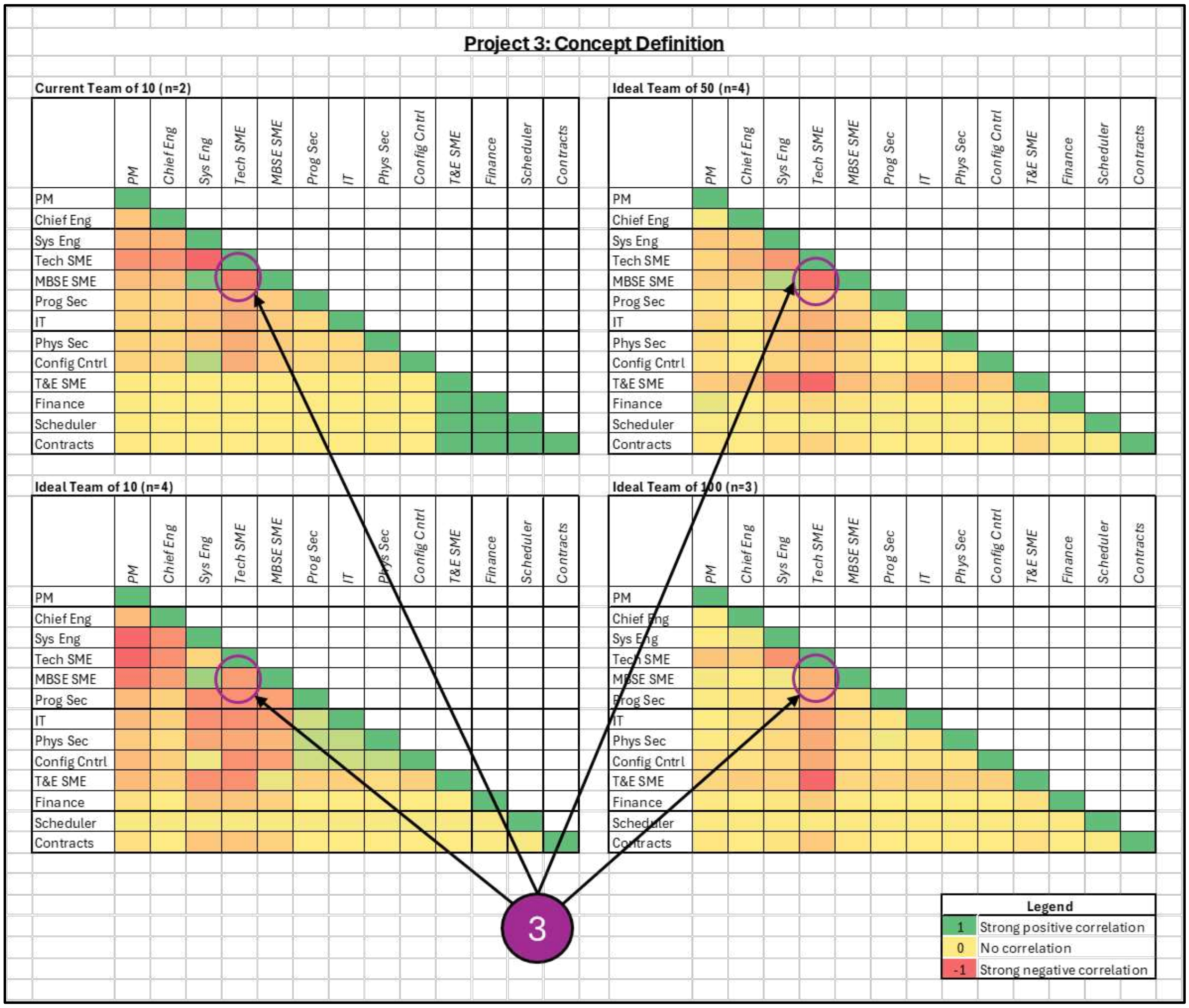

Figure 12. Role Allocation to Personnel Correlation for Concept Definition

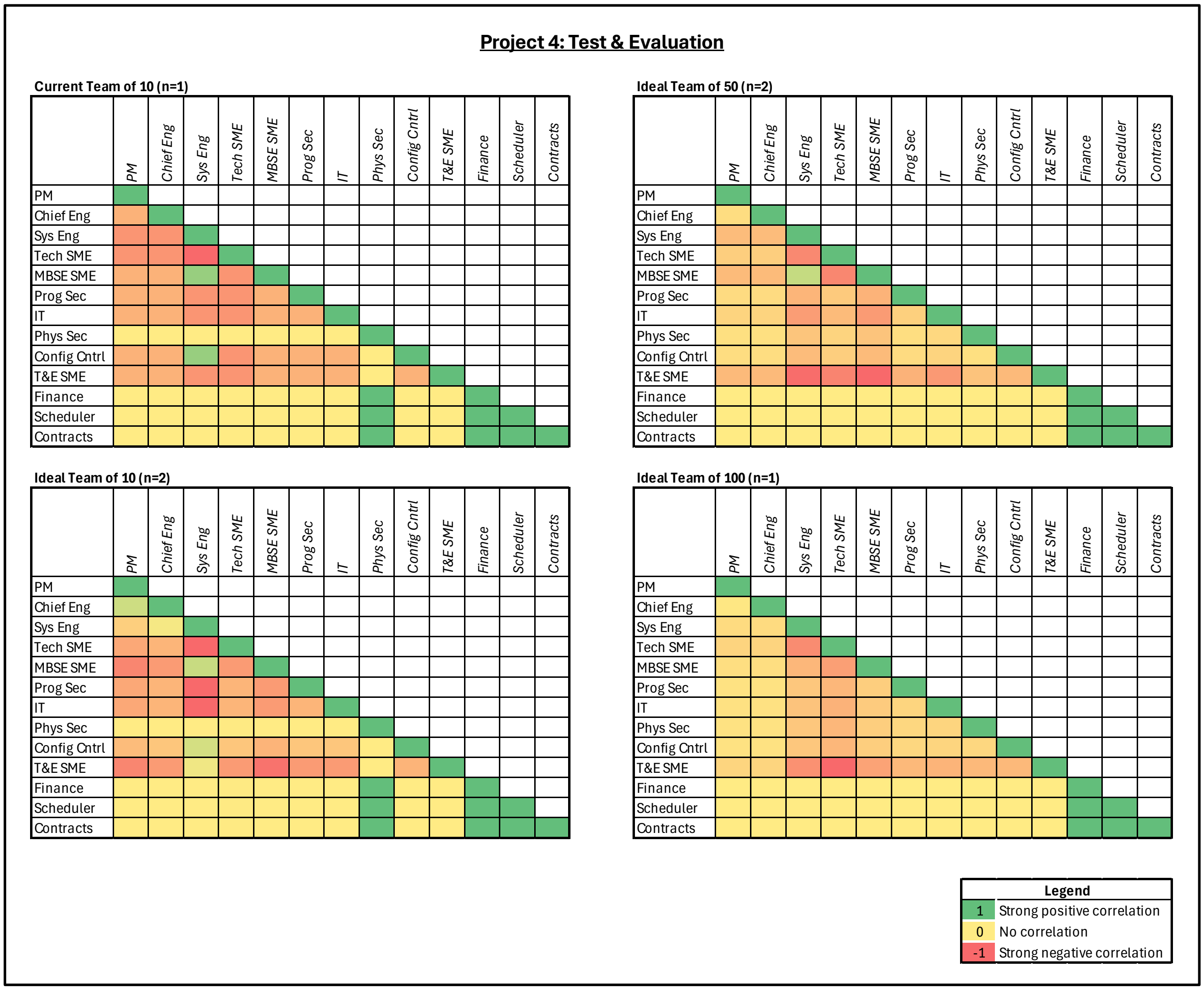

Figure 13. Role Allocation to Personnel Correlation for Test & Evaluation

The following paragraphs discuss the key results from analyzing the roles allocated to personnel, as shown in Figures 10-13.

4.3.2.1 A positive correlation exists between the Sys Eng and MBSE SME roles in the ideal teams.

A positive correlation exists between the Sys Eng and the MBSE SME across all projects for almost all ideal team sizes. An example of this is observed in Figure 10 with the "1" annotation showing the green color in the cell at the intersection of the row with MBSE SME and the column with Sys Eng for the ideal teams of 10, 50, and 100. Notably, in those cells, the green color becomes lighter as the team size increases from 10 to 100, indicating that the strong positive correlation is weakening as the team size increases.

This positive correlation suggests that these roles are typically assigned to the same person in small teams. As the teams grow in size, these roles are increasingly allocated to separate people, with one respondent noting, "The larger the team, the greater the opportunities and need for specialization." Many of the respondents agreed with the overall correlation and said that they, too, would expect a considerable overlap between Sys Engs and MBSE SMEs. They noted that in ideal teams, there would likely be a smaller set of MBSE SMEs who are truly specialized and focus primarily on things like advanced modeling techniques, managing the model configuration, and maintaining custom plugins. Similarly, there would be a smaller set of Sys Engs who focus on the SE content but are less familiar with MBSE in-depth. This is reinforced in the literature, which notes that different projects will require a different mix of SE skill sets and required roles.[64] Additionally, showing the positive correlation between the Sys Engs and MBSE SMEs bolsters the important point from the literature that there can and should be overlap between these two roles, which was found to be imperative to ensure the models are not created and used only by those who have a deep understanding of MBSE, but instead used by the entire team.[12,17,32] These results relate to several barriers to MBSE adoption mentioned in section 1.3, including "personnel knowledge/skills," "willingness to use MBSE tools," and "organizational characteristics." They also relate to the "organizational structure characteristics" and "lack of appropriate training for specific roles" as listed in section 1.4.

4.3.2.2 There is a negative correlation between the Sys Eng and Tech SME roles.

Figures 10-13 also show that there is a strong negative correlation between the Sys Eng and the Tech SME roles for all MBSE project team sizes in all projects in both the current and ideal teams. This can be seen with the orange-to-red color at the intersection of the Tech SME row and the Sys Eng column in each of the matrices in Figures 10-13. The "2" in Figure 11 points to an example of this. The strong negative correlation is one of the only strong correlations (positive or negative) that persists or sometimes grows stronger as team size increases. For team sizes of 100 in both the current and ideal teams, usually one of the only strong or moderately strong correlations in each project was between these two roles. For example, in Figure 11, the only darker red color in the current and ideal teams of 100 occurs at the intersection of the Tech SME row and the Sys Eng column, again, as noted by the "2".

This negative correlation suggests that these roles are not typically assigned to the same person, which is likely because these two roles have very different skill sets and responsibilities, particularly on larger teams. One respondent noted:

> *"The rest of the program might go to the Sys Engs for requirements specification, link budgets, or test procedure development, but they tend to be high-level generalists (top of the T). Whereas when detailed analysis, simulation, or design is needed to be done, the Tech SMEs typically get tapped (stem of the T)."*

The negative correlation between the Sys Eng and Tech SME roles that grows stronger or persists as the team size increases suggests that Sys Eng and Tech SME roles are less likely to be assigned to the same person as the team size grows. This, too, was also the experience of one of the respondents:

> *"On small teams, I have seen the Sys Engs be the Tech SMEs. However, on larger projects (like a Major System Acquisition), the SE department seems to manage the SE process but lacks domain knowledge. For smaller teams, people can fill both roles because process-only Sys Engs really don't have enough work on smaller teams."*

These results align with the premise in the literature that technical experts tend to have a deep understanding of their area of technical proficiency, but do not always have the full systems focus for what they are developing at the forefront. The Sys Eng is required to have different skills that cross disciplines, requiring them to synthesize technical expertise with PM knowledge.[5]

4.3.2.3 There is a negative correlation between the Tech SME and MBSE SME roles.

As illustrated in the strong negative correlations shown in Figures 10-13, there is also a strongly negative or moderately negative correlation between the Tech SME and the MBSE SME across all projects for all team sizes. An example of this can be seen in Figure 12, annotated by a "3" pointing to the intersection of the MBSE SME row and the Tech SME column. This negative correlation is observed for both the current and ideal teams.

This negative correlation suggests that Tech SME and MBSE SME roles are not typically assigned to the same person. Responses from the expert panel further validated this result. Their guidance was that MBSE expertise is usually undertaken by someone other than a specialist in a particular domain or discipline. One respondent noted that based on his experience, "discipline- or domain-specific SMEs generally prefer to work in that role than shed that role to focus more on the mechanics of modeling and enabling modeling." Another noted that "MBSE folks are hired for their MBSE experience. The domain knowledge is applied by others." This supports the assertion in the literature that Tech SMEs have a depth of domain knowledge but do not tend to focus on the system as a whole. In contrast, MBSE SMEs must examine the system as experts in their specialized MBSE tools, processes, and languages.[5]

4.3.2.4 There is no considerable difference in the current and ideal team sizes of 100.

Finally, comparing the matrices for the current and ideal teams of 100 (both on the right side of each figure) in Figures 10 and 11, there is not a large difference in the observed role allocation to personnel between the current and ideal teams of 100. Other than the negative correlation between the Tech SME and MBSE SME, as discussed in 4.3.2.3, most of the cells are yellow (*corr=0*) or slightly yellow-orange, indicating a slight negative correlation. The only cell that differs somewhat between the current and ideal team sizes of 100 in Figures 10 and 11 is the slight positive correlation in the ideal team size of 100, which is not seen in the current team size of 100 for the Sys Eng to MBSE SME roles. When quantifying the differences, a value of 0.25 was used. However, the average difference between the current and ideal teams of 100 for both of these projects was 0.03. For the System Requirements Definition and Traceability project in Figure 10, only 3.8% of the differences between the current and ideal teams of 100 were 0.15 or higher. This was only 2.6% for the Pre-Phase A Architecture Development project (Figure 11). The experts did not provide data for the current team size of 100 for the Concept Definition and Test & Evaluation projects (Figures 12 and 13).

This similarity suggests that there is little or no desired alteration between the current composition of teams executing projects that use MBSE and the way the respondents believe these teams should be structured for a large team size of 100. Guidance from the expert panel tells us that this is because large teams are structured at the beginning of the project in a manner that is consistent with projects of similar size and scope for that organization. As the project matures and issues arise, the team can quickly reallocate the staffing distribution to handle the changes since so many personnel and roles are already included. This correlation could also be because of the respondent's earlier comments about the difficulty of performing these allocations for such a large team size.

4.4 Create a synthesized listing of roles and associated tasks for each SE project

Following the aggregation of responses, the tables from Chapter 3 are updated to include the roles that are assigned to each task for each project and each team size category, with the new tables displayed in Appendix B. Recall that the task numbering for the PM/Admin tasks is the same for all projects because the tasks are the same. However, different roles were sometimes assigned to those tasks in the different team sizes, which is why those sections will be included in each of the projects and categories listed.

4.5 Conclusion

The results of this RQ showed similarities and differences between how tasks are allocated to roles for specific SE projects that use MBSE and how those roles are then allocated to personnel for teams of varying sizes, both in the current environment and an ideal state. This can provide organizations with insight into the roles and tasks their personnel perform across different projects and team sizes.

Feedback from the panel of DE and SE experts was aggregated and analyzed, showing results for cases where 50% or more of the respondents agreed that a task should be assigned to a particular role. Analysis of this aggregation showed:

- More roles are participating in each task when teams are smaller
- There is more MBSE SME involvement in the ideal teams
- There is more Tech SME involvement in smaller team sizes for the ideal teams
- There are nearly identical responses for ideal teams of 50 and 100 in all projects

As part of their feedback, the panel of DE and SE experts also allocated roles to individual personnel for all four projects in team sizes of 10, 50, and 100 members for the ideal teams and a current team in their organization. The results of these responses show how many roles individual personnel are expected to perform in different team sizes and the typical combinations of roles allocated to an individual. This data was aggregated into correlation matrices and analyzed to identify where there were positive or negative correlations between the role assignments. Understanding how these roles are combined into different personnel could aid organizations' training investment decisions. The results indicated that:

- A positive correlation exists between the Sys Eng and MBSE SME roles in the ideal teams
- There is a negative correlation between the Sys Eng and Tech SME roles
- There is a negative correlation between the Tech SME and MBSE SME roles
- There is no considerable difference in the current and ideal team sizes of 100

One challenge to this RQ was the small sample size of the responses. The spreadsheets sent to the respondents for feedback had eight different tabs to fill out, requesting a task-to-role allocation and role-to-personnel allocation for each project for a current team and ideal teams of 10, 50, and 100. This was lengthy and resulted in fewer responses. Each project and team size had anywhere from zero to four responses, providing some data but not enough to make the results statistically significant. Future work could explore a similar methodology with a larger sample size to validate the findings of this research.

The results of this exercise can guide the field during the transition from DBSE to MBSE by providing a better understanding of how roles should be allocated to tasks and what roles should or should not be combined into a single individual. Following the addition of role allocation to tasks, the next step of this research is to list the skills needed to accomplish each task and discover the associated level of proficiency required for the different personnel roles executing these tasks in the different projects. This should leverage and expand upon the DoD's DECF v1.1, with the result that these findings could provide recommendations for organizations transitioning to MBSE on how to structure their teams and provide training for those teams.

CHAPTER 5: DECF MAPPING AND COMPETENCY DECOMPOSITION

5.1 Introduction and Methodology

After mapping which roles execute each task in the SE projects that use MBSE and defining which and how many roles could be assigned to an individual for different team sizes, we can next understand what skills or competencies each role requires to execute their assigned tasks and to what level of proficiency. This chapter answers the question asked in RQ3: *What are the competencies and the level of proficiency required by role for an example SE project that uses MBSE?*

Understanding the training that each individual may need to execute a project successfully means that one must first know which competencies are required and to what level of proficiency. This can vary by role, project, and team size. This RQ takes the data produced in RQ2 and combines it with the KSABs for each competency in DECF v1.1 to create a mapping for the System Requirements Definition and Traceability project, showing what proficiency levels are required for each competency, by role and team size. Determining the competencies and level of proficiency for each role is accomplished through three Research Tasks that are subordinate to RQ3:

- Task 1 (RQ3-T1): Identify the KSABs in DECF v1.1 that map to each task in an example SE project that uses MBSE
- Task 2 (RQ3-T2): For each role and team size, group the KSABs in each competency that are required for the tasks assigned to that role for an example SE project that uses MBSE
- Task 3 (RQ3-T2): Determine the required level of proficiency for each competency for each of the roles in the different team sizes

Figure 14 is a SysML Activity Diagram depicting the process for using the results from Chapter 4 and accomplishing the above agenda. The following sections provide more information on each of the steps shown in the figure.

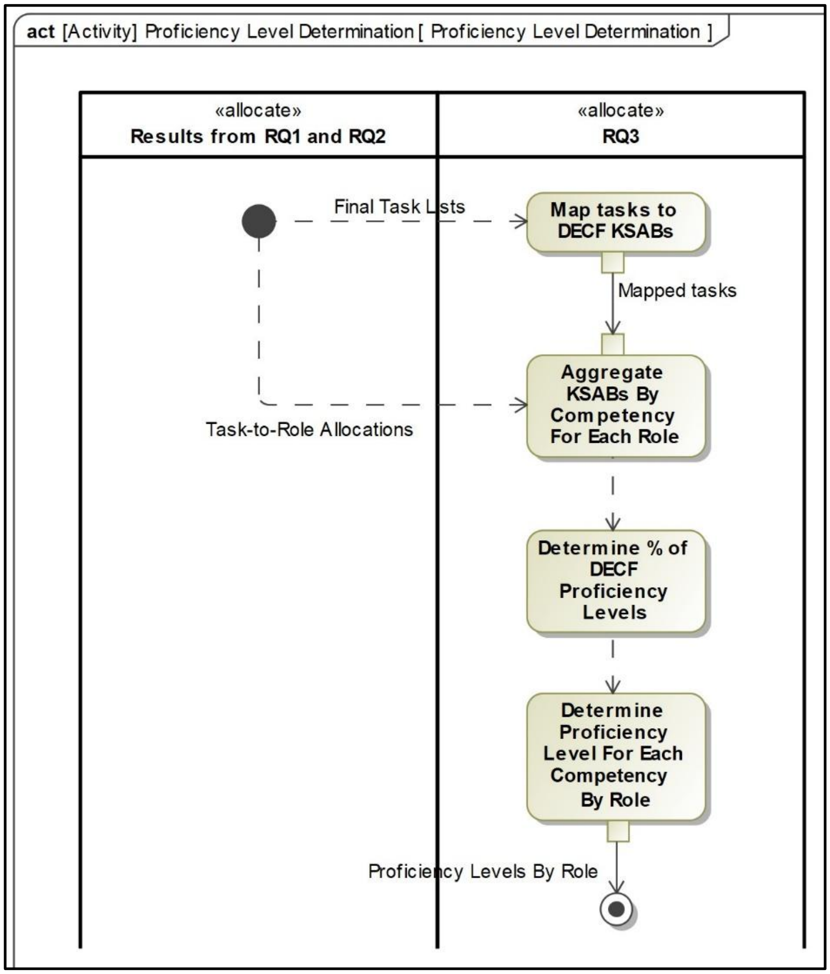

Figure 14. SysML Activity Diagram for Determining Proficiency Level for Each Competency by Role

5.2 Identify the KSABs in DECF v1.1 that map to each task in an example SE project that uses MBSE.

DECF v1.1 lists KSABs for each competency, sorted by proficiency levels. As shown in Table 10, there are five competency groups that each represent a core area of expertise in DE, as well as foundational digital competencies that apply broadly to all roles that are executing DE activities. Including the foundational digital competencies, there are 31 total competencies listed in the DECF. The descriptions for each competency can be found in DECF v1.1. Each competency contains KSABs that are explicitly related to DE. There is a range of 0 to 48 KSABs assigned to each proficiency level in the different competencies. Competencies that are more specific to DE, such as "Model-Based Systems Engineering Processes," typically have KSABs that are increasingly general. Table 10 also shows the distribution of KSABs by proficiency for each competency.[42]

Table 10. Distribution of KSABs in DECF v1.1[42]

Competency Group	Competency	Total KSABs	Proficiency Level				
			Awareness	Basic	Intermediate	Advanced	Expert
G1 Data Governance	C1 Data Governance	48	3	11	7	14	13
	C2 Data Management	30	2	7	1	14	6
G2 Modeling and Simulation	C3 Modeling	122	11	25	36	35	15
	C4 Simulation	56	8	8	16	16	8
	C5 Artificial Intelligence/Machine Learning	32	2	19	8	3	0
	C6 Data Visualization	22	2	4	12	2	2
	C7 Data Analytics	47	2	5	12	17	11
G3 Digital Engineering and Analysis	C8 Digital Architecting	55	3	14	18	18	2
	C9 Digital Requirements Modeling	24	1	3	15	4	1
	C10 Digital Validation and Verification	13	2	2	6	3	0
	C11 Model-Based Systems Engineering Processes	108	11	33	17	35	12
	C12 Digital Model-Based Reviews	15	2	1	6	5	1
	C13 Project and Program Management	42	2	18	12	7	3
	C14 Organizational Development	18	1	2	1	4	10
	C15 Digital Engineering Policy and Guidance	23	1	3	2	7	10
	C16 Configuration Management	19	1	3	5	8	2
G4 Systems Software	C17 Software Construction	18	1	8	3	5	1
	C18 Software Engineering	47	3	5	5	24	10
G5 Digital Enterprise Environment	C19 Digital Environment Development	47	1	15	3	15	13
	C20 Management	23	2	2	1	10	8
	C21 Communications	12	1	2	1	3	5
	C22 Planning	11	1	2	2	3	3
	C23 Digital Environment Operations	26	3	4	8	9	2
	C24 Digital Environment Support	67	3	6	18	25	15
	C25 Digital Environment Security	42	6	2	7	16	11
Foundational Digital Competencies	F1 Digital Literacy	120	4	16	11	41	48
	F2 Digital Engineering Value Proposition	12	2	7	3	0	0
	F3 DoD Policy/Guidance	4	3	0	0	0	1
	F4 Coaching/Mentoring	9	1	1	2	3	2
	F5 Decision Making	29	0	1	5	10	13
	F6 Software Literacy	90	7	10	15	38	20
	Total	1231	92	239	258	394	248

As defined in DECF v1.1, "proficiency is the level to which an individual attains a competency."[42] There are five proficiency levels listed in the DECF and the definitions for each level are shown in Table 11.

Table 11. Proficiency Levels of DECF v1.1[42]

Proficiency Level	0	1	2	3	4	5
	None	**Awareness**	**Basic** General Knowledge (Entry)	**Intermediate** General Knowledge (Junior)	**Advanced** Detailed Knowledge (Senior)	**Expert** In-Depth Knowledge (SME)
Definition	No experience with or knowledge of the competency.	Applies the competency in the simplest situations.	Applies the competency in somewhat difficult situations.	Applies the competency in difficult situations.	Applies the competency in considerably difficult situations.	Applies the competency in exceptionally difficult situations.
		Requires close and extensive guidance.	Requires frequent guidance.	Requires occasional guidance.	Generally requires little or no guidance.	Serves as a key resource and advises others.
		Demonstrates awareness of concepts and processes.	Demonstrates familiarity with concepts and processes.	Demonstrates understanding of concepts and processes.	Demonstrates broad understanding of concepts and processes.	Demonstrates comprehensive, expert understanding of concepts and processes.

For this RQ, only the System Requirements Definition and Traceability project was used. This is because it provided the most complete and well-documented data regarding task-to-role allocations. Using a data-rich example ensured the quality of the mapping, which was a primary concern. To begin identifying the proficiency level that each role needs for each competency, each task listed in RQ1 for the System Requirements Definition and Traceability project was individually reviewed against the KSABs for each competency in DECF v1.1, beginning with "Data Governance". The researcher used professional judgment to map the tasks to the KSABs. Table 12 shows an abbreviated example of the output for mapping task 1.1.1 "Identify stakeholders and manage engagement, expectations, and needs" to the KSABs for the "Data Governance" competency in DECF v1.1. The complete output for all tasks and competencies is shown in Appendix C.

Table 12. Example of System Requirements Definition and Traceability Task 1.1.1 Mapped to the "Data Governance" KSABs in DECF v1.1[42]

1.1.1: Identify stakeholders and manage engagement, expectations, and needs		
Competency	**Level**	**KSABs**
Data Governance	Awareness	• Aware of the data required to inform program and technical decisions • Explain the importance of a data model
	Basic	• Assist in providing accessibility, retrievability, security, and protection of data in an ethical manner • Critically review, analyze, synthesize, compare, and interpret information • Draw conclusions from relevant and/or missing information • Identify data connections between issues • Understand and apply principles of usability and accessibility to published information • Understand the definition of data model
	Intermediate	• Update methods, processes, and tools to enable data and model exchanges while protecting property rights for both vendors and the government
	Advanced	• Devise and implement master data management processes, including classification, security, quality, ethical principles, retrieval, and retention processes • Identify the implications of copyright, data protection, and other legal issues associated with publishing data
	Expert	• Identify and manage resources needed for the planning, development, and delivery of specified information and communications systems services (including storage, modifications, and communication of data, voice, text, audio, and images) • Develop organizational policies, standards, and guidelines for data management, aligned with principles congruent to the ethical use and dissemination of digital artifacts • Establish and communicate the organization's information management strategy

5.3 For each role and team size, group the KSABs in each competency that are required for the tasks assigned to that role for an example SE project that uses MBSE.

After mapping each task for the System Requirements Definition and Traceability project to the competencies and KSABs in DECF v1.1, this output can be combined with the task-to-role results from RQ2 to understand which KSABs are required for each role. This combination was accomplished for the ideal team sizes of 10 and 50 to examine what training is needed for the ideal state. The ideal team size of 100 was not included in these results because, as mentioned in section 4.3.1.4, the task-to-role allocation was nearly identical for the ideal teams of 50 and 100. Figure 6 in section 4.3.1 shows the tasks that are allocated to individual roles for the System Requirements Definition and Traceability project. The team sizes that will be used are shown in light green and light blue in that figure, which are the ideal teams of 10 and 50, respectively. An example of how the KSABs are consolidated for each role is described below.

In this example, the KSABs for the Chief Eng on the ideal team of 10 are consolidated. According to the results from RQ2, the Chief Eng participates in tasks 1.1.2, 1.1.5, 1.1.7, 1.1.9, 1.1.12-1.1.16, 1.2.1-1.2.7, 1.3.1-1.3.7, and 1.4.1-1.4.4, so all of the KSABs for each competency for those tasks should be aggregated. Using the data in Appendix C, which shows the KSABs that are mapped to each task in System Requirements Definition and Traceability, new tables can be created showing all of the KSABs for the "Data Governance" competency (as an example) that are included in the tasks that the Chief Eng is involved in for the ideal team of 10.

It is potentially more intuitive for organizations to focus on Project tasks rather than PM/Admin tasks, especially for non-PM roles. However, it may be interesting to understand what KSABs are required for roles involved in the PM/Admin tasks for SE projects that use MBSE and how those compare to the KSABs required for the Project tasks. As mentioned, the Chief Eng participates in the PM/Admin tasks: 1.1.2, 1.1.5, 1.1.7, 1.1.9, 1.1.12-1.1.16. The following table uses the data in Appendix C to show the mapping for these PM/Admin tasks.

Table 13. "Data Governance" KSABs from DECF v1.1[42] for the Chief Eng on the Ideal Team of 10 in System Requirements Definition and Traceability for PM/Admin Tasks

KSABs for PM/Admin Tasks; Chief Eng; Ideal Team of 10		
Competency	**Level**	**KSABs**
Data Governance	Awareness	• Aware of the data required to inform program and technical decisions • Explain the importance of a data model
	Basic	• Assist in providing accessibility, retrievability, security, and protection of data in an ethical manner • Critically review, analyze, synthesize, compare, and interpret information • Draw conclusions from relevant and/or missing information • Identify data connections between issues • Understand project-specific needs in the digital environment such as database or data warehouse specifications • Understand and apply principles of usability and accessibility to published information • Understand the definition of data model • Understand the definitions of data governance, data storage, data integration, and monitoring
	Intermediate	• Update methods, processes, and tools to enable data and model exchanges while protecting property rights for both vendors and the government • Assess the implications of low-quality data
	Advanced	• Assess issues which might prevent the organization from making maximum use of its information assets • Devise and implement master data management processes, including classification, security, quality, ethical principles, retrieval, and retention processes • Ensure effective controls are in place for internal delegation, audit, and control relating to information and records management • Identify the implications of copyright, data protection, and other legal issues associated with publishing data • Provide expert guidance in the selection, provision, and use of database and data warehouse architectures, software, and facilities • Recommend remediation actions on information and documentation, records management, information assurance, and data protection, as required
	Expert	• Identify and manage resources needed for the planning, development, and delivery of specified information and communications systems services (including storage,

		modifications, and communication of data, voice, text, audio, and images) • Determine the data requirements for the appropriate governance of enterprise digital environment, ensuring clarity of responsibilities and authority, goals, and objectives, within a designated area of accountability • Develop organizational policies, standards, and guidelines for information and records management, ensuring that uniformly recognized and accepted data definitions are developed and applied throughout the organization

In contrast to PM/Admin tasks, Project tasks are the tasks that are more technical in nature. In System Requirements Definition and Traceability, they are tasks 1.2.1-1.2.7, 1.3.1-1.3.7, and 1.4.1-1.4.4. Table 14 shows only the Project tasks for System Requirements Definition and Traceability for the Chief Eng on the ideal team of 10. As mentioned, the Chief Eng participates in tasks 1.2.1-1.2.7, 1.3.1-1.3.7, and 1.4.1-1.4.4, which are all of the Project tasks. The following table uses the data in Appendix C for these tasks.

Table 14. "Data Governance" KSABs from DECF v1.1[42] for the Chief Eng on the Ideal Team of 10 in System Requirements Definition and Traceability for Project Tasks

KSABs for Project Tasks; Chief Eng; Ideal Team of 10		
Competency	**Level**	**KSABs**
Data Governance	Awareness	• Aware of the data required to inform program and technical decisions • Explain the importance of a data model
	Basic	• Assist in providing accessibility, retrievability, security, and protection of data in an ethical manner • Critically review, analyze, synthesize, compare, and interpret information • Draw conclusions from relevant and/or missing information • Identify data connections between issues • Understand the definition of data model
	Intermediate	• Contribute to the development of organizational strategies that address information control requirements • Update methods, processes, and tools to enable data and model exchanges while protecting property rights for both vendors and the government • Assess the implications of low-quality data

	Advanced	• Ensure that operational problems are identified, recorded, monitored, and resolved, using relevant data and data analyses • Devise and implement master data management processes, including classification, security, quality, ethical principles, retrieval, and retention processes • Ensure effective controls are in place for internal delegation, audit, and control relating to information and records management • Identify the implications of copyright, data protection, and other legal issues associated with publishing data • Recommend remediation actions on information and documentation, records management, information assurance, and data protection, as required
	Expert	• Develop organizational policies, standards, and guidelines for data management, aligned with principles congruent to the ethical use and dissemination of digital artifacts

After mapping the PM/Admin tasks and the Project tasks to the KSABs, the results can be aggregated to show all the KSABs for the "Data Governance" competency for the Chief Eng for the ideal team of 10. These results are shown in the following table.

Table 15. "Data Governance" KSABs from DECF v1.1[42] for the Chief Eng on the Ideal Team of 10 in System Requirements Definition and Traceability for All Tasks

KSABs for All Tasks; Chief Eng; Ideal Team of 10		
Competency	**Level**	**KSABs**
Data Governance	Awareness	• Aware of the data required to inform program and technical decisions • Explain the importance of a data model
	Basic	• Assist in providing accessibility, retrievability, security, and protection of data in an ethical manner • Critically review, analyze, synthesize, compare, and interpret information • Draw conclusions from relevant and/or missing information • Identify data connections between issues • Understand project-specific needs in the digital environment such as database or data warehouse specifications • Understand and apply principles of usability and accessibility to published information • Understand the definition of data model

		• Understand the definitions of data governance, data storage, data integration, and monitoring
	Intermediate	• Contribute to the development of organizational strategies that address information control requirements • Update methods, processes, and tools to enable data and model exchanges while protecting property rights for both vendors and the government • Assess the implications of low-quality data
	Advanced	• Ensure that operational problems are identified, recorded, monitored, and resolved, using relevant data and data analyses • Assess issues which might prevent the organization from making maximum use of its information assets • Devise and implement master data management processes, including classification, security, quality, ethical principles, retrieval, and retention processes • Ensure effective controls are in place for internal delegation, audit, and control relating to information and records management • Identify the implications of copyright, data protection, and other legal issues associated with publishing data • Provide expert guidance in the selection, provision, and use of database and data warehouse architectures, software, and facilities • Recommend remediation actions on information and documentation, records management, information assurance, and data protection, as required
	Expert	• Identify and manage resources needed for the planning, development, and delivery of specified information and communications systems services (including storage, modifications, and communication of data, voice, text, audio, and images) • Determine the data requirements for the appropriate governance of enterprise digital environment, ensuring clarity of responsibilities and authority, goals, and objectives, within a designated area of accountability • Develop organizational policies, standards, and guidelines for data management, aligned with principles congruent to the ethical use and dissemination of digital artifacts • Develop organizational policies, standards, and guidelines for information and records management, ensuring that uniformly recognized and accepted data definitions are developed and applied throughout the organization

This exercise was completed similarly for all roles and all competencies in the System Requirements Definition and Traceability project for the ideal teams of 10 and 50 to examine the differences in required competencies and proficiency levels that are related to team size.

5.4 Determine the required level of proficiency for each competency for each of the roles in the different team sizes.

5.4.1 KSAB Aggregation

Now that the set of KSABs required for each competency in each role has been identified, the KSABs can be analyzed to determine the level of proficiency required for each competency as a function of team size. Once the KSABs were compiled for each role, the number of KSABs included for each role was counted for each proficiency level. This provides the total for that role and team size of the number of KSABs required for that competency at that proficiency level.

For example, looking at Table 13, we can see that for the PM/Admin tasks that include KSABs in the "Data Governance" competency on the ideal team of 10, the Chief Eng is required to have:

- 2 KSABs for Awareness
- 8 for Basic
- 2 for Intermediate
- 6 for Advanced
- 3 for Expert

Similarly, in Table 14 for the Project tasks that include KSABs in the "Data Governance" competency on the ideal team of 10, the Chief Eng is required to have:

- 2 KSABs for Awareness
- 5 for Basic

- 3 for Intermediate
- 5 for Advanced
- 1 for Expert

Continuing to Table 15 for All tasks that include KSABs in the "Data Governance" competency on the ideal team of 10, the Chief Eng is required to have:

- 2 KSABs for Awareness
- 8 for Basic
- 3 for Intermediate
- 7 for Advanced
- 4 for Expert

Once the number of KSABs was counted for each proficiency level in each competency, the level of proficiency for that competency and role can be determined using the following method. In DECF v1.1, the "Data Governance" competency includes 3 KSABs for Awareness, 11 for Basic, 7 for Intermediate, 14 for Advanced, and 13 for Expert.[42] To determine the level of proficiency required for that role for that competency, a rule of 50% was applied. For example, the Chief Eng requires 2 out of 3 KSABs for Awareness proficiency level for All tasks, or 67%, for "Data Governance", therefore the Chief Eng on the ideal team of 10 does require an Awareness proficiency level for "Data Governance". However, the Chief Eng only needs 4 out of 13 KSABs, or 31%, for Expert proficiency so it is concluded that the Chief Eng on the ideal team of 10 does not require an Expert proficiency level for "Data Governance".

When assigning the KSABs to tasks, an exception was made for the "Coaching and Mentoring" competency. This competency was judged to be based more on the role an individual is performing, rather than the particular tasks in an SE project that the role participates in.

Therefore, the KSABs in this competency were not assigned to individual tasks, but rather to roles during the step where the KSABs for all tasks and competencies were compiled together.

Table 16 shows a sample for the "Data Governance" competency with the number of KSABs and their percentage of DECF v1.1[42] KSABs for each proficiency level for the Chief Eng for the ideal team of 10. Any percentages that are greater than or equal to 50% are shown in red. Additional tables showing the output for all of the roles and team sizes are shown in Appendix D.

Table 16. KSAB Total and Percentage of DECF v1.1[42] KSABs for the Chief Eng for the System Requirements Definition and Traceability Project Ideal Team of 10 for the "Data Governance" Competency, as an example

		Number of KSABs in the DECF	KSABs Required for Chief Eng – All Tasks		KSABs Required for Chief Eng – PM/Admin Tasks		KSABs Required for Chief Eng – Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	2	67	2	67
	Basic	11	8	73	8	73	5	45
	Intermediate	7	3	43	2	29	3	43
	Advanced	14	7	50	6	43	5	36
	Expert	13	4	31	3	23	1	8

5.4.2 Proficiency Level Determination

Once the exercise was completed for all roles and both team sizes, the proficiency level for each competency was assessed for each role. The final proficiency level for each role is determined by the highest level of proficiency that contains at least 50% of the KSABs in that proficiency level. For example, based on Table 16, the Chief Eng requires an Advanced proficiency level for All tasks, Basic proficiency level for PM/Admin tasks, and Awareness proficiency level for Project tasks on the ideal team of 10.

Figures 15-25 are radar plots showing the resulting required proficiency level in each competency for each role for the System Requirements Definition and Traceability project ideal teams of 10 and 50. The top row of charts across each figure shows the proficiency levels for All tasks, the middle row shows the proficiency levels for PM/Admin tasks, and the bottom row shows the proficiency levels for Project tasks. The numbers labeled on the concentric circles correspond to proficiency levels as follows: 1 = Awareness, 2 = Basic, 3 = Intermediate, 4 = Advanced, and 5 = Expert.

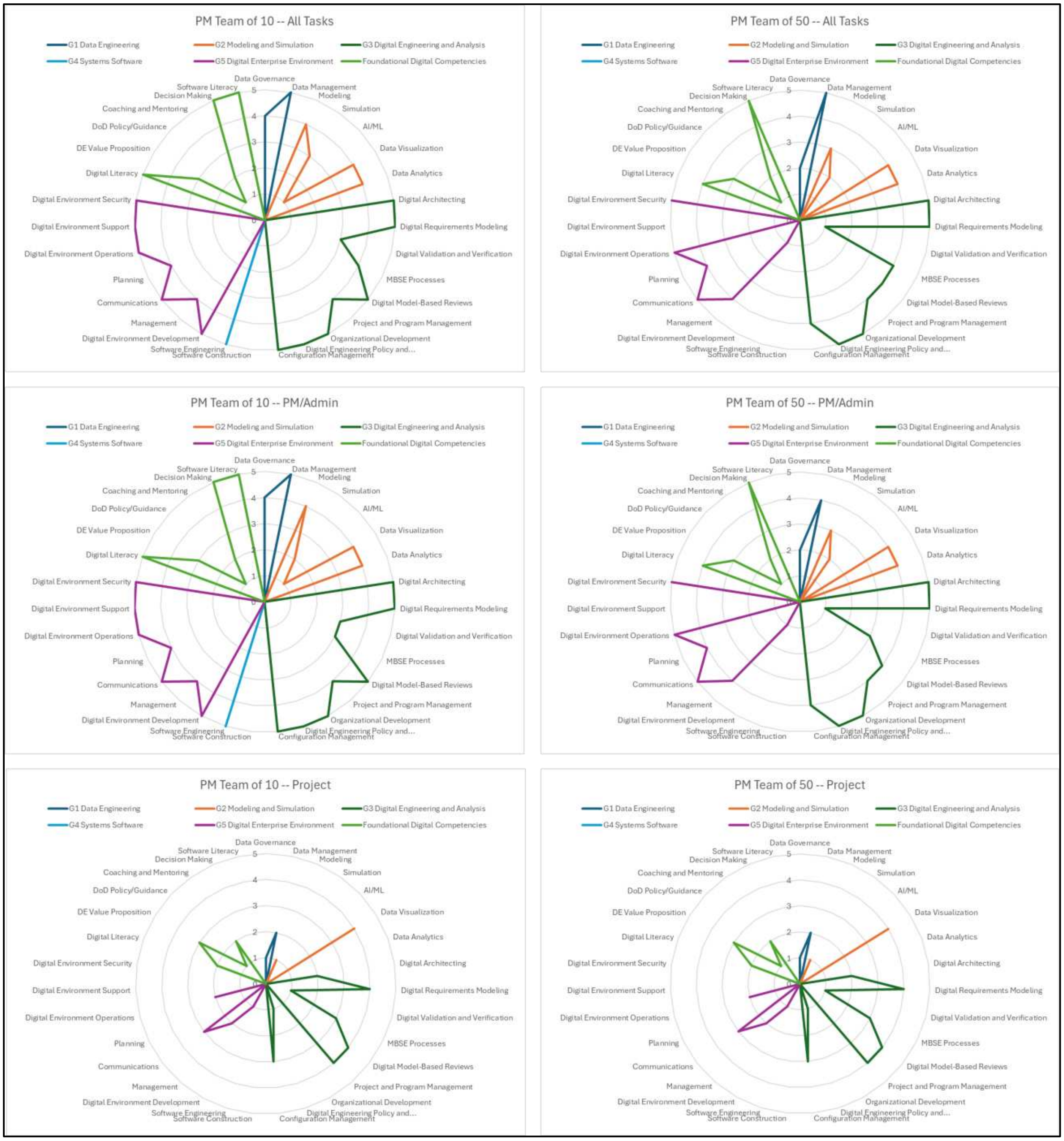

Figure 15. Proficiency Levels for the PM Role in System Requirements Definition and Traceability Project

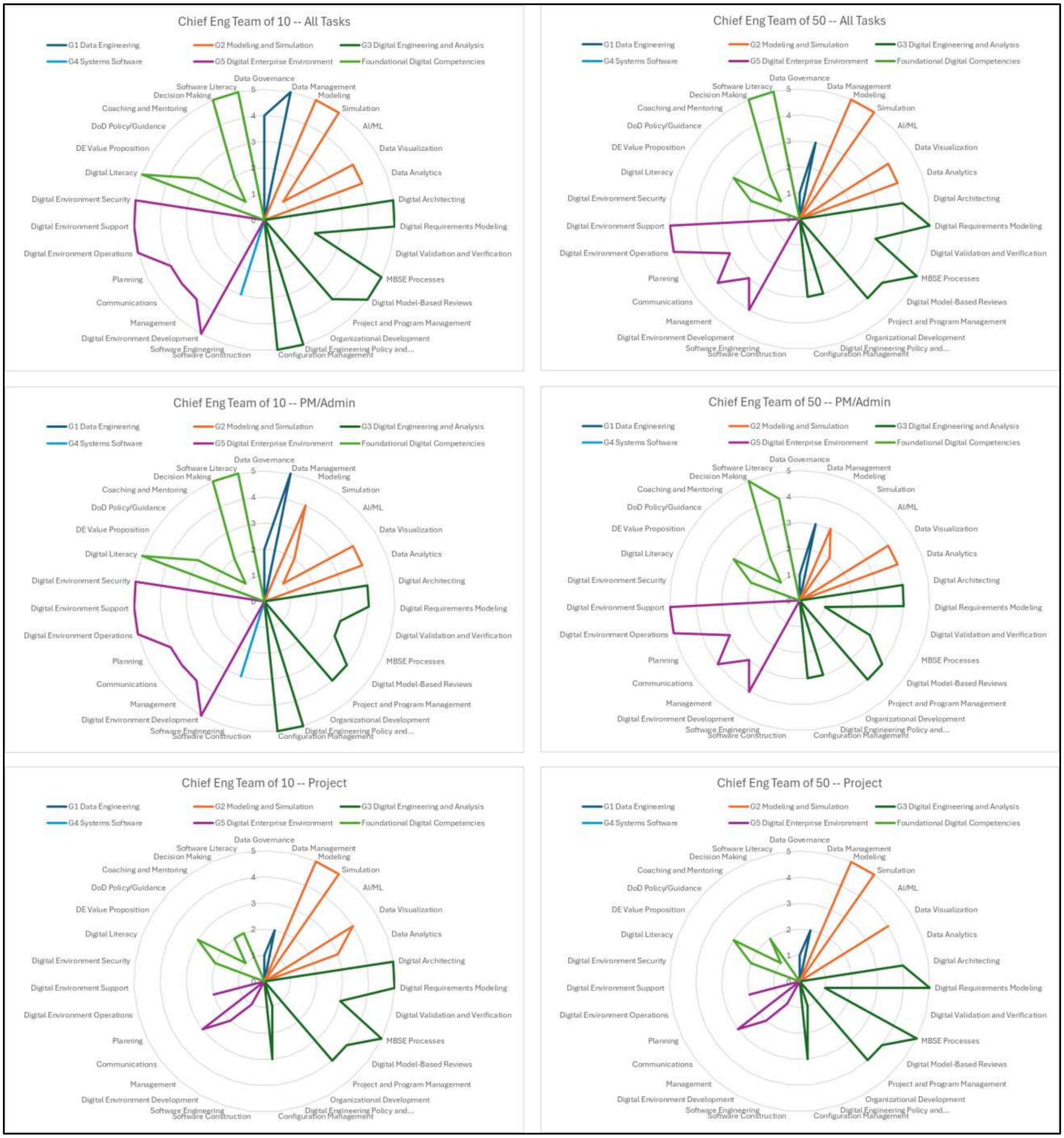

Figure 16. Proficiency Levels for the Chief Eng Role in System Requirements Definition and Traceability Project

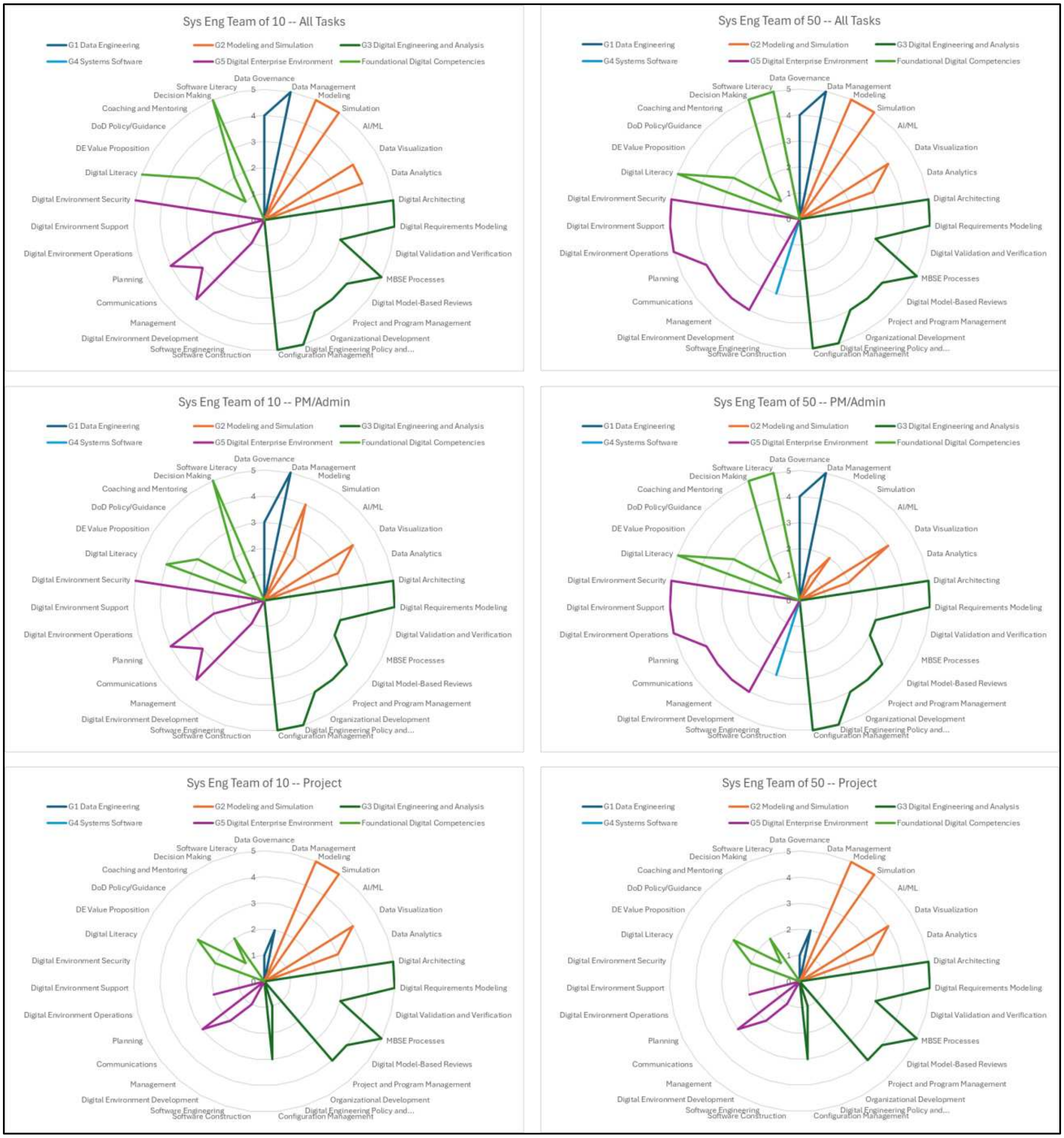

Figure 17. Proficiency Levels for the Sys Eng Role in System Requirements Definition and Traceability Project

There are no PM/Admin tasks assigned to the Tech SME in either team size for System Requirements Definition and Traceability, so those radar plots are not shown in the following figure. Since Project tasks are the only tasks assigned to the Tech SME, the radar plots for the Project tasks are the same as the Tech SME radar plots for All tasks.

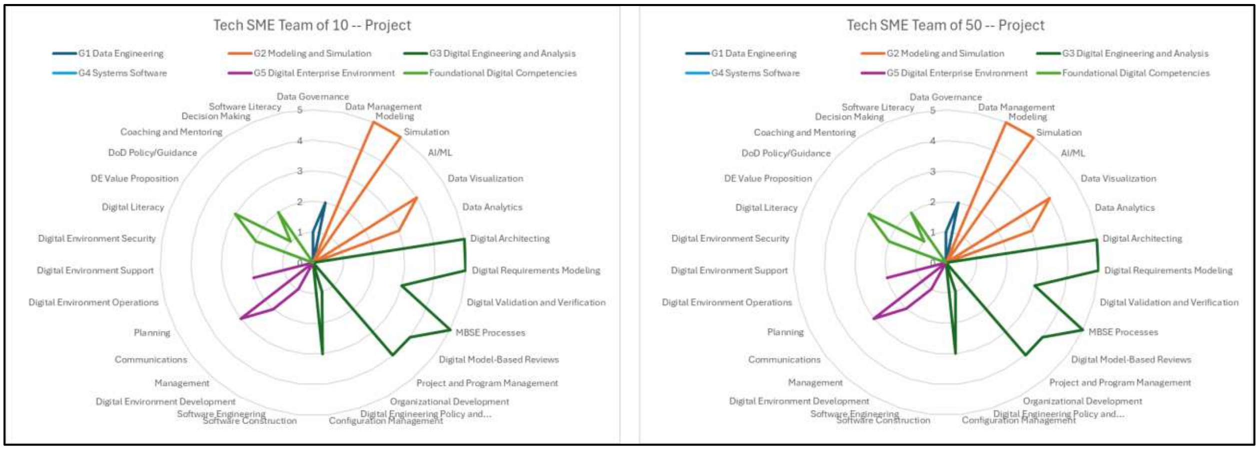

Figure 18. Proficiency Levels for the Tech SME Role in System Requirements Definition and Traceability Project

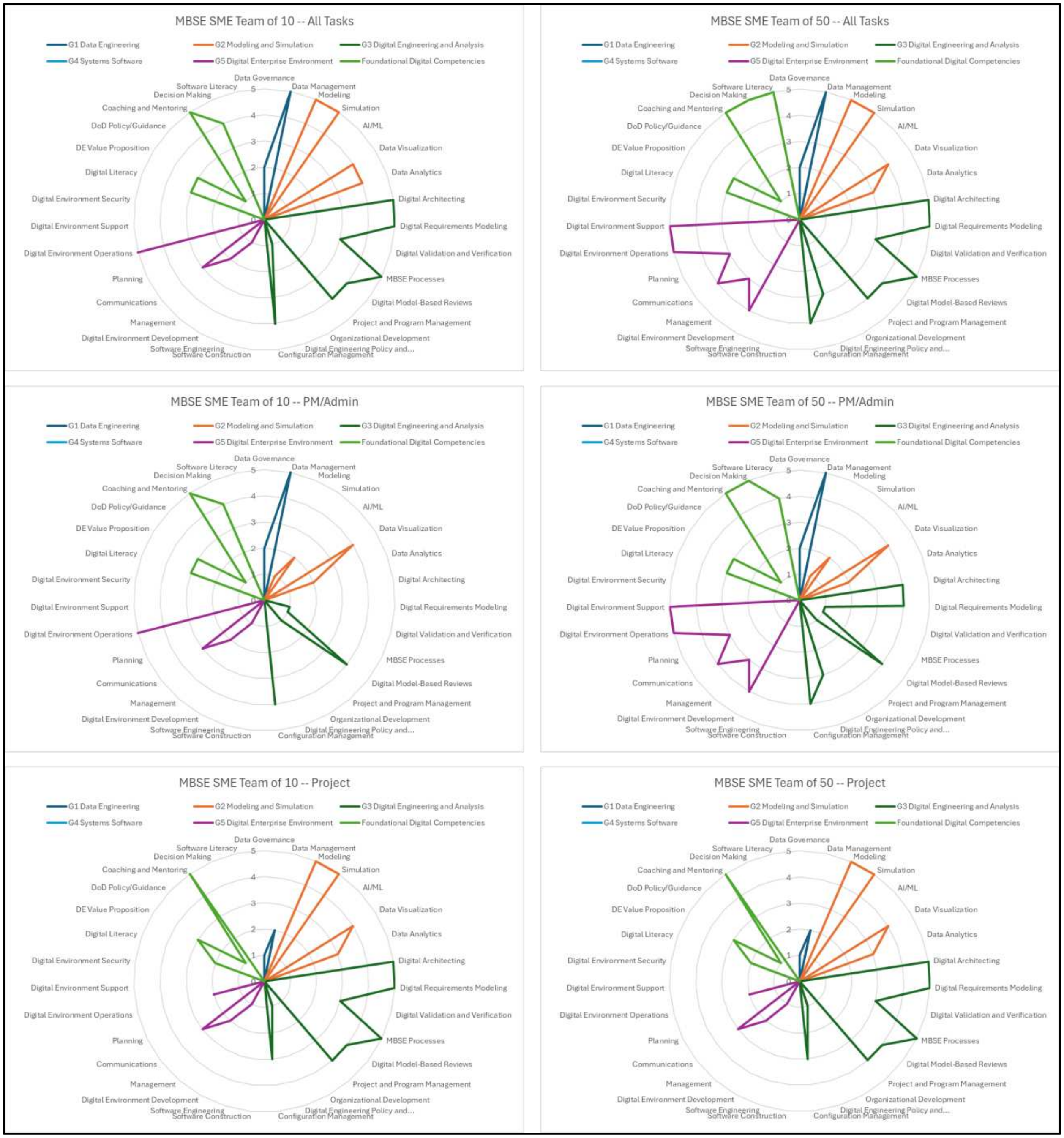

Figure 19. Proficiency Levels for the MBSE SME Role in System Requirements Definition and Traceability Project

There are no Project tasks assigned to the Prog Sec or IT roles in either team size for System Requirements Definition and Traceability, so those radar plots are not shown in the following figures. Since PM/Admin tasks are the only tasks assigned to the Prog Sec and IT roles, those radar plots are the same as their respective radar plots for All tasks.

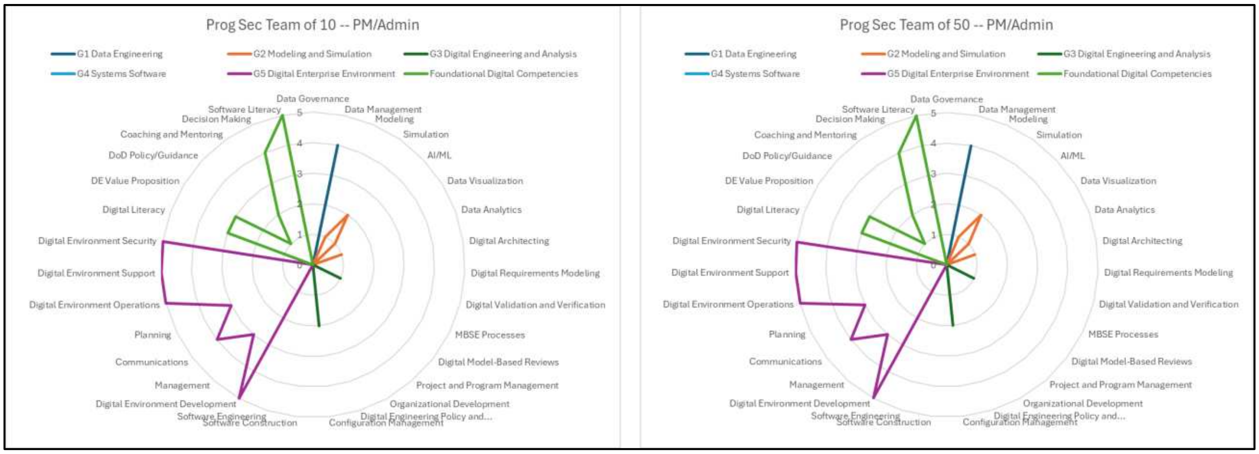

Figure 20. Proficiency Levels for the Prog Sec Role in System Requirements Definition and Traceability Project

Figure 21. Proficiency Levels for the IT Role in System Requirements Definition and Traceability Project

There are no tasks assigned to the Phys Sec role in the ideal team of 10 and only PM/Admin tasks are assigned to the Phys Sec role for the ideal team of 50 for System Requirements Definition and Traceability, so those radar plots are not shown in the following figure. Since PM/Admin tasks are the only tasks assigned to the Phys Sec role for the ideal team of 50, that radar plot is the same as the Phys Sec radar plot for All tasks.

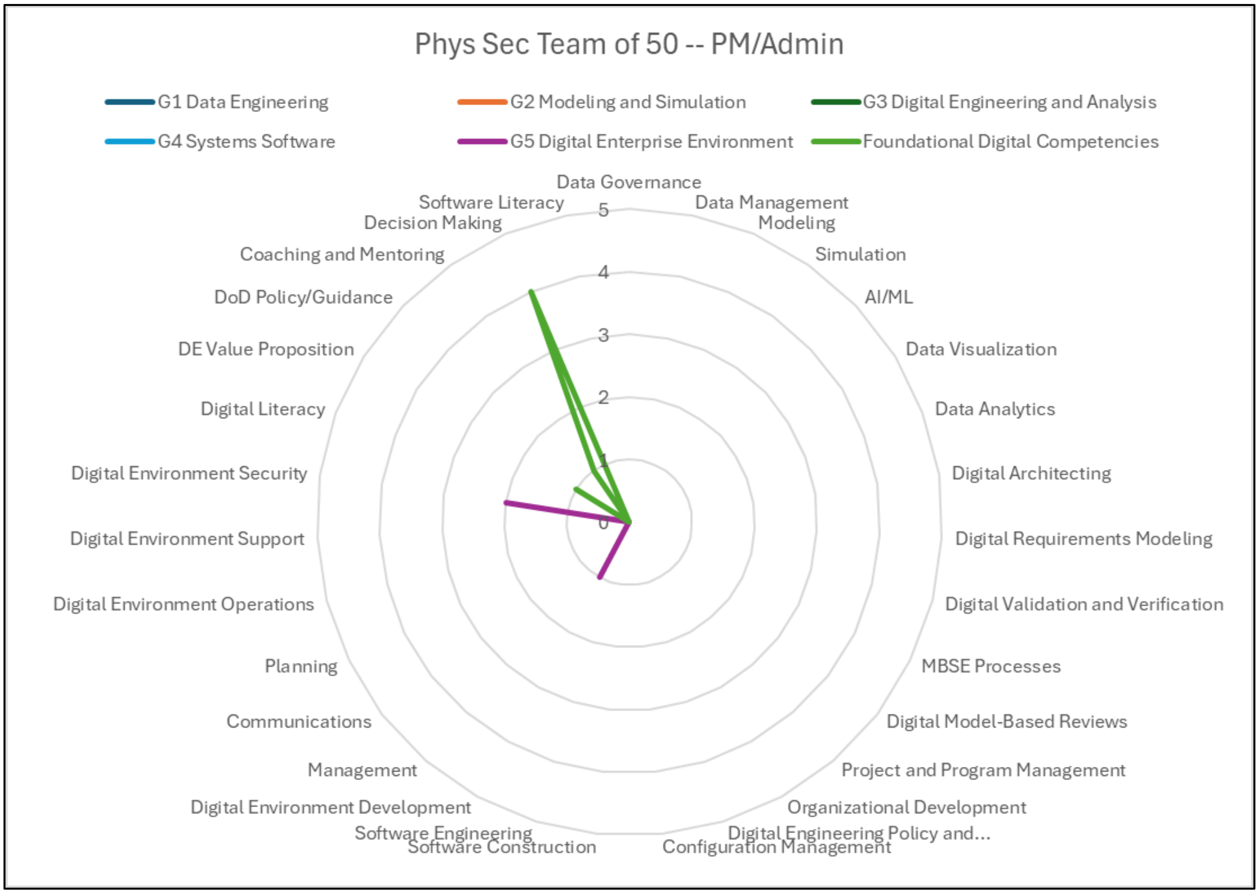

Figure 22. Proficiency Levels for the Phys Sec Role in System Requirements Definition and Traceability Project

There are no Project tasks assigned to the Config Cntrl role in either team size for System Requirements Definition and Traceability, so those radar plots are not shown in the following figure. Since PM/Admin tasks are the only tasks assigned to the Config Cntrl role, those radar plots are the same as the Config Cntrl radar plots for All tasks.

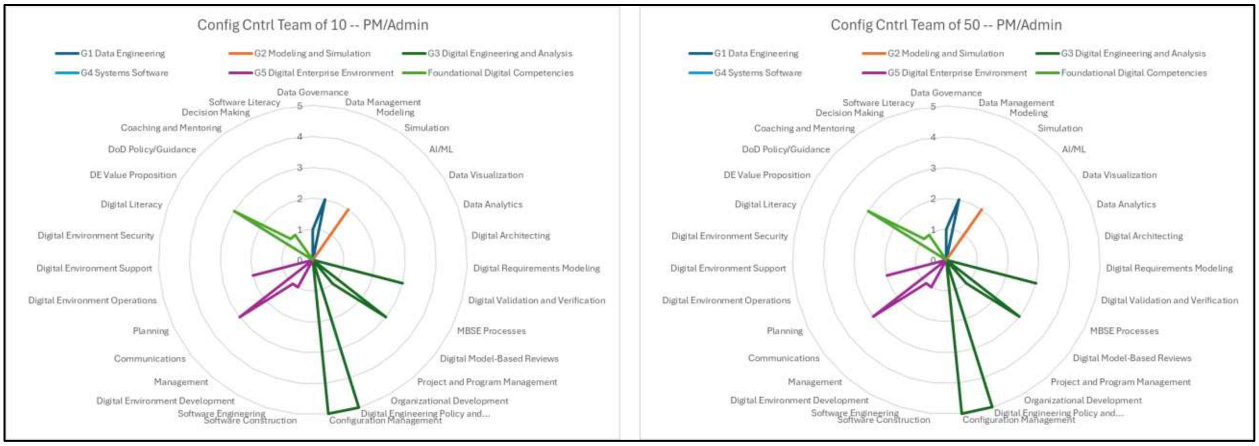

Figure 23. Proficiency Levels for the Config Cntrl Role in System Requirements Definition and Traceability Project

There are no PM/Admin tasks assigned to the T&E SME in either team size for System Requirements Definition and Traceability, so those radar plots are not shown in the following figure. Since Project tasks are the only tasks assigned to the T&E SME, those radar plots are the same as the T&E SME radar plots for All tasks.

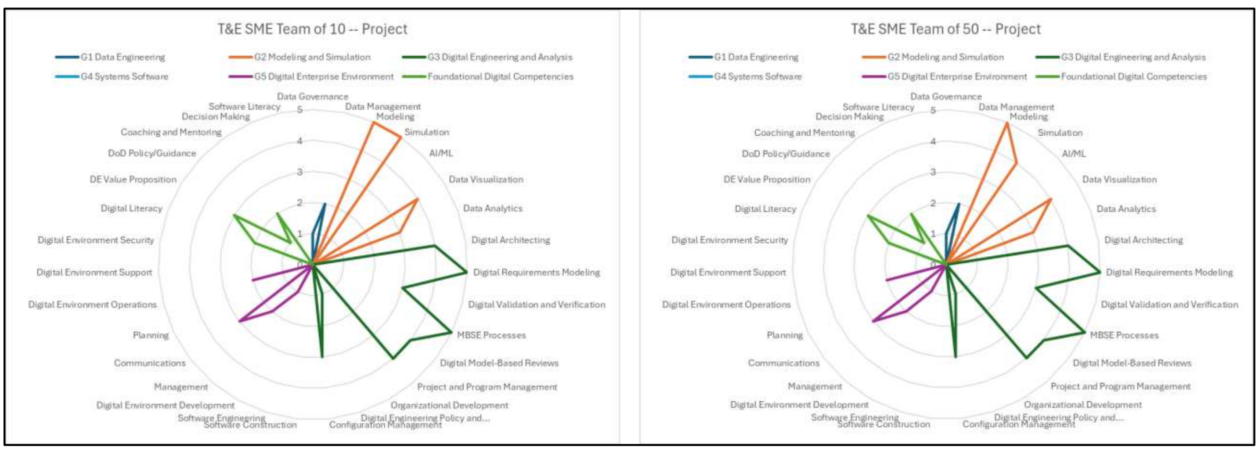

Figure 24. Proficiency Levels for the T&E SME Role in System Requirements Definition and Traceability Project

There are no tasks assigned to the Finance role in either team size for System Requirements Definition and Traceability, so those radar plots are not shown.

There are no Project tasks assigned to the Scheduler role in either team size for System Requirements Definition and Traceability, so those radar plots are not shown in the following figure. Since PM/Admin tasks are the only tasks assigned to the Scheduler, those radar plots are the same as the Scheduler radar plots for All tasks.

Figure 25. Proficiency Levels for the Scheduler Role in System Requirements Definition and Traceability Project

There are no tasks assigned to the Contracts role in either team size for System Requirements Definition and Traceability, so those radar plots are not shown.

The following tables summarize the information in the radar plots for the ideal teams of 10 and 50, showing the proficiency level required for each role for the System Requirements Definition and Traceability Project. The information shown is for All tasks. The numbers correspond to proficiency levels as follows: 1 = Awareness, 2 = Basic, 3 = Intermediate, 4 = Advanced, and 5 = Expert.

Table 17. Final List for Competencies and Proficiency Levels by Role for the System Requirements Definition and Traceability Project Ideal Team of 10

		PM	Chief Eng	Sys Eng	Tech SME	MBSE SME	Prog Sec	IT	Config Cntrl	T&E SME	Scheduler
C1	Data Governance	4	1	1	1	1	0	0	1	1	1
C2	Data Management	5	2	2	2	2	4	4	2	2	2
C3	Modeling	4	5	5	5	5	1	0	0	5	5
C4	Simulation	3	5	5	5	5	2	0	2	5	5
C5	AI/ML	1	0	0	0	0	1	1	0	0	0
C6	Data Visualization	4	4	4	4	4	0	0	0	4	4
C7	Data Analytics	4	3	3	3	3	1	1	0	3	3
C8	Digital Architecting	5	5	5	5	5	0	0	0	4	4
C9	Digital Requirements Modeling	5	5	5	5	5	0	0	0	5	5
C10	Digital Validation and Verification	3	3	3	3	3	0	0	3	3	3
C11	MBSE Processes	4	5	5	5	5	1	0	0	5	5
C12	Digital Model-Based Reviews	5	4	4	4	4	0	0	3	4	4
C13	Project and Program Management	4	4	4	4	4	0	1	1	4	4
C14	Organizational Development	5	0	0	0	0	0	0	0	0	0
C15	Digital Engineering Policy and Guidance	5	1	1	1	1	0	3	5	1	1
C16	Configuration Management	5	3	3	3	3	2	0	5	3	3
C17	Software Construction	0	0	0	0	0	0	0	0	0	0
C18	Software Engineering	5	0	0	0	0	0	3	0	0	0
C19	Digital Environment Development	5	1	1	1	1	5	5	1	1	1
C20	Management	4	2	2	2	2	3	3	1	2	2
C21	Communications	5	3	3	3	3	4	4	3	3	3
C22	Planning	4	0	0	0	0	3	4	0	0	0
C23	Digital Environment Operations	5	2	2	2	2	5	5	2	2	2
C24	Digital Environment Support	5	0	0	0	0	5	5	0	0	0
C25	Digital Environment Security	5	0	0	0	0	5	5	0	0	0
F1	Digital Literacy	5	2	2	2	2	3	1	0	2	2
F2	DE Value Proposition	3	3	3	3	3	3	3	3	3	3
F3	DoD Policy/Guidance	1	1	1	1	1	1	1	1	1	1
F4	Coaching and Mentoring	2	2	2	2	5	2	1	1	2	2
F5	Decision Making	5	2	0	0	0	4	4	0	0	0
F6	Software Literacy	5	0	0	0	0	5	5	0	0	0

Table 18. Final List for Competencies and Proficiency Levels by Role for the System Requirements Definition and Traceability Project Ideal Team of 50

		PM	Chief Eng	Sys Eng	Tech SME	MBSE SME	Prog Sec	IT	Phys Sec	Config Cntrl	T&E SME	Scheduler
C1	Data Governance	2	1	4	1	2	0	0	0	1	1	0
C2	Data Management	5	3	5	2	5	4	4	0	2	2	1
C3	Modeling	3	5	5	5	5	1	0	0	0	5	0
C4	Simulation	2	5	5	5	5	2	0	0	2	4	0
C5	AI/ML	0	0	0	0	0	1	1	0	0	0	0
C6	Data Visualization	4	4	4	4	4	0	0	0	0	4	4
C7	Data Analytics	4	4	3	3	3	1	1	0	0	3	0
C8	Digital Architecting	5	4	5	5	5	0	0	0	0	4	0
C9	Digital Requirements Modeling	5	5	5	5	5	0	0	0	0	5	0
C10	Digital Validation and Verification	1	3	3	3	3	0	0	0	3	3	0
C11	MBSE Processes	4	5	5	5	5	1	0	0	0	5	0
C12	Digital Model-Based Reviews	4	4	4	4	4	0	0	0	3	4	1
C13	Project and Program Management	4	4	4	4	4	0	1	0	1	4	4
C14	Organizational Development	5	0	4	0	0	0	0	0	0	0	0
C15	Digital Engineering Policy and Guidance	5	3	5	1	3	0	3	0	5	1	0
C16	Configuration Management	4	3	5	3	4	2	0	0	5	3	0
C17	Software Construction	0	0	0	0	0	0	0	0	0	0	0
C18	Software Engineering	0	0	3	0	0	0	3	0	0	0	0
C19	Digital Environment Development	1	4	4	1	4	5	5	1	1	1	1
C20	Management	4	3	4	2	3	3	3	0	1	2	1
C21	Communications	5	4	4	3	4	4	4	0	3	3	2
C22	Planning	4	3	4	0	3	3	4	0	0	0	0
C23	Digital Environment Operations	5	5	5	2	5	5	5	0	2	2	2
C24	Digital Environment Support	0	5	5	0	5	5	5	0	0	0	0
C25	Digital Environment Security	5	0	5	0	0	5	5	2	0	0	0
F1	Digital Literacy	4	2	5	2	3	3	1	0	0	2	0
F2	DE Value Proposition	3	3	3	3	3	3	3	1	3	3	3
F3	DoD Policy/Guidance	1	1	1	1	1	1	1	0	1	1	1
F4	Coaching and Mentoring	2	2	2	2	5	2	1	1	1	2	1
F5	Decision Making	5	5	5	0	5	4	4	4	0	0	0
F6	Software Literacy	0	5	5	0	5	5	5	0	0	0	0

The following paragraphs discuss the key results from analyzing the proficiency levels required for each competency by role for the System Requirements Definition and Traceability project, as shown in Figures 15-25.

5.4.2.1 Higher DE proficiency is required for involvement in PM/Admin tasks when compared to Project tasks.

The three engineering roles that are involved in both PM/Admin tasks and Project tasks for System Requirements Definition and Traceability are the Chief Eng, Sys Eng, and MBSE SME. But across all of these roles, a higher level of proficiency is typically required for competencies in the PM/Admin tasks when compared to those same competencies in the Project tasks. For example, Figure 16 shows that for the Chief Eng on a team of 10, there are 29 competencies included for the PM/Admin tasks with 20 of those (69%) requiring a proficiency of Advanced or Expert. In comparison, 23 competencies are included in the Project tasks, with 8 (35%) of those requiring Advanced or Expert proficiency. This comparison is similar for the Chief Eng role on a team of 50. Here, there are 26 competencies included in the PM/Admin tasks, with 12 (46%) requiring Advanced or Expert proficiency, and there are 21 competencies included in the Project tasks, with 8 (38%) requiring Advanced or Expert proficiency. This comparison also holds for the Sys Eng role (as illustrated in Figure 17) and the MBSE SME (in Figure 19).

This result has important implications for the training and skills that must be developed in these engineering roles, suggesting that the PM/Admin tasks for MBSE projects include planning, resource allocation, risk management, policy implementation, and organizational coordination, and they shape the environment in which the more technical Project tasks occur. Traditionally, programmatic roles managed static deliverables, schedules, and budgets. Because of the shift to DE, roles involved in PM/Admin tasks must work actually inside the digital environment, where they previously did not need to.[65] A deep understanding of the tools, technology, and processes required for the project is essential because PM/Admin errors can lead to inefficiencies and cascade throughout the project. Since these engineering roles involved in spanning across the PM/Admin and Project tasks must bridge organizational breadth and technical breadth, they reflect the need for efficiency across many multi-disciplinary competencies.[66]

5.4.2.2 Even within the Project task set, the Sys Eng role needs a wide range of DE competencies outside of the expected competency groups.

As shown in Figure 17, the Sys Eng role is characterized by a high level of proficiency in the "Modeling and Simulation" and the "Digital Engineering and Analysis" Competency Groups, shown in orange and dark green, respectively. However, Figure 17 also illustrates that the Sys Eng requires a high level of proficiency for "Digital Enterprise Environment" competencies (shown in purple) and "Data Engineering" competencies (shown in dark blue). These are competencies that one might not naturally link to the Sys Eng role.

These results illustrate that the Sys Eng will be a key role in MBSE and DE projects, and that this role will concentrate on both the competencies that are usually associated with SE and in other competency groups. These results reinforce previous studies that demand Sys Engs have a wide range of "Recommended Minimum Competency Levels Across Roles" in DE.[67] A broad competency base enables the Sys Eng to understand and coordinate across disciplines like software, hardware, modeling, testing, and lifecycle management. This wider range of competencies that are required for the Sys Eng enables this role to adapt to evolving project needs and maintain system coherence amid change.

5.4.2.3 The roles involved in the Project tasks have the same required competencies and proficiency levels in performing the Project tasks.

For the System Requirements Definition and Traceability project, the PM, Chief Eng, Sys Eng, Tech SME, MBSE SME, and T&E SME are the only roles involved in Project tasks. The number of Project tasks each team member on the team of 10 is involved in is as follows: PM (1), Chief Eng (18), Sys Eng (18), Tech SME (10), MBSE SME (15), and T&E SME (4). For those roles that are involved in more than one Project task, there is little or no difference in their required competencies and the corresponding proficiency levels. There is little or no difference in the proficiencies required between the ideal team size of 10 and the ideal team size of 50, so Table 19 summarizes the ideal team size of 10 for these roles to provide a quick comparison. In Table 19, only one value is different between the roles and it is shown in red font. This is Expert proficiency level (5) for "Coaching and Mentoring" for the MBSE SME, while the other roles involved in Project tasks only require a Basic proficiency level (2) for that competency. The reason for this difference was discussed in section 5.4.1.

Table 19. Comparison of Competencies and Proficiency Levels Across Roles for System Requirements Definition and Traceability Ideal Team of 10 Project Tasks

		Chief Eng	Sys Eng	Tech SME	MBSE SME	T&E SME
C1	Data Governance	1	1	1	1	1
C2	Data Management	2	2	2	2	2
C3	Modeling	5	5	5	5	5
C4	Simulation	5	5	5	5	5
C5	AI/ML	0	0	0	0	0
C6	Data Visualization	4	4	4	4	4
C7	Data Analytics	3	3	3	3	3
C8	Digital Architecting	5	5	5	5	4
C9	Digital Requirements Modeling	5	5	5	5	5
C10	Digital Validation and Verification	3	3	3	3	3
C11	MBSE Processes	5	5	5	5	5
C12	Digital Model-Based Reviews	4	4	4	4	4
C13	Project and Program Management	4	4	4	4	4
C14	Organizational Development	0	0	0	0	0
C15	Digital Engineering Policy and Guidance	1	1	1	1	1
C16	Configuration Management	3	3	3	3	3
C17	Software Construction	0	0	0	0	0
C18	Software Engineering	0	0	0	0	0
C19	Digital Environment Development	1	1	1	1	1
C20	Management	2	2	2	2	2
C21	Communications	3	3	3	3	3
C22	Planning	0	0	0	0	0
C23	Digital Environment Operations	2	2	2	2	2
C24	Digital Environment Support	0	0	0	0	0
C25	Digital Environment Security	0	0	0	0	0
F1	Digital Literacy	2	2	2	2	2
F2	DE Value Proposition	3	3	3	3	3
F3	DoD Policy/Guidance	1	1	1	1	1
F4	Coaching and Mentoring	2	2	2	**5**	2
F5	Decision Making	2	0	0	0	0
F6	Software Literacy	0	0	0	0	0

These results are significant because they imply a shared and universal foundation of knowledge and skills required to operate within the technical sphere of a DE project. This result has implications for workforce development since training programs can emphasize a common baseline of competencies across technical roles to foster more integrated, flexible, and resilient project teams. The required Expert proficiency level in the "Coaching and Mentoring" competency for the MBSE SME is derivable from the idea that this SME would be required to "coach advanced practitioners in systems modeling and analysis"[42] and "mentor advanced practitioners in systems modeling and analysis,"[42] where the other roles in the project tasks are only required to be audience to this coaching and mentoring, mostly perhaps from the MBSE SME. This does not refute information in the literature that shows the MBSE SME has a unique role and knowledge,[24] but instead shows that the team benefits from a common understanding across several key roles.

5.4.2.4 Only the Awareness proficiency level is required for the "Artificial Intelligence/Machine Learning" (AI/ML) competency, as defined in DECF v1.1.

Although AI has been highlighted in recent literature as a key component of technical digital literacy and is included as an important component of DECF v1.1, "Artificial Intelligence/Machine Learning" proficiency was not included as a large component of the required skills for this SE project that includes MBSE. The PM, Chief Eng, Prog Sec, and IT roles only require an Awareness level of proficiency in the "Artificial Intelligence/Machine Learning" competency, while all of the other roles do not need any proficiency level for AI/ML. An example of this is observed in Figure 15 where the "Artificial Intelligence/Machine Learning" competency only extends out to the "1" on the ideal team of 10 for PM/Admin tasks, which corresponds to the Awareness proficiency level. This is similarly seen in Figures 16, 20, and 21 for the Chief Eng, Prog Sec, and IT roles, respectively. Additionally, this Awareness proficiency is only present in these four roles for the PM/Admin tasks and not the Project tasks. Table 47 in Appendix C shows that only one of two KSABs in the "Artificial Intelligence/Machine Learning" competency was mapped to a task. This KSAB is "Ability to describe text classification, information retrieval, information extraction"[42] and that is mapped to task 1.1.16, which is "Manage IT/cyber support and ensure coordination with Security." Task 1.1.16 is only assigned to the PM, Chief Eng, Prog

Sec, and IT roles for the ideal team of 10, and the Prog Sec and IT roles for the ideal team of 50, as reflected in Tables 25 and 26, respectively, in Appendix B.

These results are noteworthy because the lack of proficiency required in the "Artificial Intelligence/Machine Learning" competency suggests that AI/ML is not necessary in this chosen SE project that uses MBSE, in contrast with recent literature showing increased emphasis in AI/ML in DE, SE, and MBSE.[68,69] In this study, the researcher observed that the DECF's "Artificial Intelligence/Machine Learning" competency KSABs did not map well to the project tasks and to the types of activities that are being performed by AI in DE/MBSE projects. In DECF v1.1, the "Artificial Intelligence/Machine Learning" KSABs are technology- and method-specific, not process-specific like SE project tasks. The KSABs describe specialized technical expertise, such as "Design and construct an ontology supporting a semantic web application,"[42] that is not inherent in a typical SE workflow and does not align with the standard SE task structure. The KSABs also emphasize demonstrating a capability, like "Apply a range of machine-learning techniques…,"[42] which is different than producing a standard SE work product. In the SE literature, AI/ML is shown to increase automation and reduce the burden on engineers by augmenting human decision-making[67] and automating administrative and management tasks, making it a valuable inclusion in SE projects that incorporate MBSE. DECF v1.1 was published in 2021, and AI/ML technology and use have evolved considerably since then. A recent study asked more than 600 engineers and engineering managers about the types of tasks they use AI for, and three of the top five were more general tasks that many roles on a team would typically do, like "documentation," "internal communication and collaboration," and "search and discovery."[70] In tailoring the DECF to particular industries or enterprises, we recommend that users add a

Foundational Digital Competency to include more KSABs that apply less to AI/ML specialists, and more to a broad set of roles across the project team.

5.5 Conclusion

This chapter has now answered the question asked in RQ3: *What are the competencies and the level of proficiency required by role for an example SE project that uses MBSE?* The results presented in this chapter highlight the competencies in DECF v1.1 that are required for various roles within a selected SE project that includes MBSE, focusing on the System Requirements Definition and Traceability project. Identifying these competencies along with the necessary levels of proficiency for each role can help organizations understand the training needs essential for effectively executing this project. This information can guide organizations in providing or encouraging appropriate training for various roles for current or possible upcoming SE projects that include MBSE. Additionally, individuals can use this information as a resource to recognize the proficiency levels in different competencies that they may need to attain to perform their roles more effectively. Individuals and organizations can also use the method outlined in RQ3 to determine the competencies and level of proficiency required for other potential SE projects that include MBSE, using DECF v1.1.

The tasks that were defined in Chapter 4 for the System Requirements Definition and Traceability project were mapped to KSABs in DECF v1.1 for each competency. This resulted in a comprehensive table for each competency, detailing all applicable KSABs for each competency, sorted by task in the System Requirements Definition and Traceability project and organized by proficiency level. Leveraging the output from RQ2, the KSABs were then aggregated for each role by competency and proficiency level across all tasks involved in System Requirements Definition and Traceability. This analysis was conducted for both the ideal teams of 10 and 50.

To gain further insight, the competencies and KSABs were further aggregated by PM/Admin tasks (1.1.1-1.1.16) and Project tasks (1.2.1-1.4.4). This breakdown aimed to understand any potential difference in proficiency level required when roles engaged in PM/Admin tasks compared with Project tasks. This was also accomplished for the ideal teams of 10 and 50 for each individual role. The outcome was a series of tables for each role, reflecting all KSABs for each competency necessary for all of the tasks (differentiated by PM/Admin, Project, and All tasks) that the role is involved in for the System Requirements Definition and Traceability project.

Following this decomposition, the KSABs were analyzed to find the required proficiency level for each competency associated with the individual roles. This was determined by:

- Counting the number of KSABs necessary for each proficiency level in each competency
- Comparing this number to the total number of KSABs listed for each competency in DECF v1.1
- Identifying which proficiency levels for each role included 50% or more of the KSABs

If a proficiency level included 50% or more of the KSABs from DECF v1.1, it was concluded that the role required that proficiency level. The highest proficiency level that included 50% or more of the KSABs was determined to be the necessary proficiency level for that role. Using this data, radar plots were constructed for each role, showing the proficiency level for each competency. These plots were produced for both the ideal teams of 10 and 50 for each individual role, with distinctions made between PM/Admin tasks, Project tasks, and All tasks. The radar plots provide a visual comparison of the final results. The results indicate that:

- Higher DE proficiency is required for involvement in PM/Admin tasks when compared to Project tasks

- Even within the Project task set, the Sys Eng role needs a wide range of DE competencies outside of the expected competency groups
- The roles involved in the Project tasks have the same required competencies and proficiency levels in performing the Project tasks
- Only the Awareness proficiency level is required for the "Artificial Intelligence/Machine Learning" (AI/ML) competency, as defined in DECF v1.1

The results of this research provide an improved understanding of the competencies and corresponding proficiency levels needed for each role when participating in small and large teams while executing System Requirements Definition and Traceability or other SE projects that use MBSE. This can help organizations provide efficient training to their teams by grouping individuals with similar competency and proficiency level needs. Furthermore, this can assist individuals in recognizing the competencies and corresponding proficiency levels they may require when participating in small and large teams that are executing or will execute SE projects that include MBSE.

CHAPTER 6: CONCLUSIONS

6.1 Summary

This research defined a series of Research Questions and Tasks to address the primary challenges and organizational factors that may be influencing the aerospace industry's transition from a legacy DBSE approach to MBSE. This transition is driven by the increasing complexity of modern systems and rapidly changing requirements. MBSE can support these needs, but transitioning to this modernized approach is challenging. The industry needs to better understand the steps involved and the organizational factors, like team size and role-specific training, that can affect the successful adoption of MBSE. The DECF is one current competency framework that can be leveraged to determine required competencies and their level of proficiency for different roles involved in executing SE projects that use MBSE. By leveraging this resource and input from a panel of DE and SE experts, this research resulted in an improved, generalizable understanding of the personnel roles and associated skills, competencies, and proficiency levels required for different projects that include MBSE tasks, and how these vary by team size.

Research Question 1 sought to identify and draft task lists for SE projects that use MBSE from a range of aerospace industry sources. WBSs were solicited from both commercial and government organizations to ground the effort in practical program execution. In addition to the WBSs, task lists were also synthesized from systems engineering handbooks and industry guidance, resulting in the definition of four projects. Drafting the task lists was challenging because the SE process is highly tailorable. To ensure they were correct and complete, the task lists were reviewed multiple times by a panel of DE and SE experts. The outcome of this effort clarified the tasks in these specific SE projects that use MBSE and laid the groundwork for analyzing how these tasks are distributed across roles and team sizes.

Research Question 2 examined how tasks are allocated to roles and how roles are allocated to personnel in SE projects that use MBSE. Using input from the panel of experts, this RQ examined task-to-role and role-to-personnel allocations across both current and ideal teams of 10, 50, and 100 members. Responses were grouped into categories based on team size, and results required at least 50% agreement among respondents for a task or role assignment to be included. Finally, correlation matrices were created to analyze role-to-personnel allocations to assess how labor distribution changes with team size. Expert review and feedback validated the findings. The results of this RQ provided an improved and generalizable understanding of the personnel roles, what tasks are allocated to those roles, and how those roles are combined in different personnel as team sizes change.

Across the analyses for RQ2, several patterns emerged regarding task-to-role allocation in SE projects that use MBSE. First, as team sizes decrease, more roles participate in each task, leading to less segmentation and greater collaboration. However, larger teams exhibit greater specialization and the inclusion of non-engineering roles. Experts emphasized the need for broad MBSE familiarity across roles in smaller teams and more specialized expertise in larger ones. The ideal teams showed a notable increase in MBSE SME involvement across all team sizes, indicating a desired cultural and process shift toward greater MBSE competency and leadership commitment as MBSE use matures within organizations. Conversely, Tech SMEs were assigned fewer, more specialized tasks within larger teams, suggesting that as project size increases, technical experts focus more on high-value engineering activities, while the MBSE SME role concentrates on modeling and systems integration. Finally, the nearly identical responses for ideal teams of 50 and

100 show that beyond a certain threshold, experts confirmed that larger teams are often subdivided into smaller teams to execute different aspects of the system lifecycle.

The analysis of role-to-personnel allocations revealed some key insights into how roles are distributed among personnel. A strong positive correlation between the Sys Eng and MBSE SME roles indicates that these roles are often performed by the same individual in smaller teams, and that the roles tend to diverge slightly as team size increases, providing more opportunity for specialization but still showing overlap. In contrast, a strong negative correlation is consistently observed between Sys Eng and Tech SME roles, reflecting their distinct skill sets. Similarly, a negative correlation between the Tech SME and MBSE SME roles suggests that MBSE expertise is typically held by individuals focused on modeling processes and systems integration rather than domain-specific technical work. This aligns with what several experts confirmed during the review and validation process. Finally, comparisons of current and ideal teams of 100 show little difference in role allocation. Experts responded that large teams are already structured in alignment with organizational norms and that personnel can be reallocated on these teams quickly, if needed.

Research Question 3 addressed specific workforce needs in the form of competencies and proficiency levels by role for a specific SE project that uses MBSE. The tasks defined in RQ1 were mapped to KSABs in DECF v1.1, and then the task-to-role mapping from RQ2 was used to aggregate the KSABs by competency based on the tasks each role accomplishes. Finally, the proficiency levels needed for each competency across roles and team configurations were defined. Together, these efforts helped clarify role-specific competency requirements and proficiency expectations, which can help organizations when developing more targeted and effective training plans.

Analysis of the data from RQ3 found that higher levels of DE proficiency are required for PM/Admin tasks than for technical Project tasks, particularly for roles such as Chief Eng, Sys Eng, and MBSE SME. These PM/Admin responsibilities, such as planning, resource allocation, and risk management, now require increased use and understanding of digital tools and environments, highlighting the need for higher proficiency in these DE competencies. Within the Project task set, the Sys Eng role demonstrated a particularly broad range of required DE competencies, extending beyond traditional modeling and analysis to include digital enterprise and data engineering, highlighting their central coordinating role in SE projects that use MBSE. Additionally, all roles involved in Project tasks shared a common foundation of competencies and proficiency levels, supporting workforce strategies that emphasize standardized training across technical roles, with the MBSE SME role standing out for its higher requirement in the "Coaching and Mentoring" competency. Finally, while the "Artificial Intelligence/Machine Learning" competency was included in DECF v1.1, this study found only minimal relevance to the tasks in the selected SE project, as "Artificial Intelligence/Machine Learning"-related KSABs were too specialized and did not align well with typical SE workflows. This suggests a need to refine the DECF to better reflect the evolving integration of AI/ML across general engineering roles rather than limiting it to niche applications.

The resulting mapping between SE projects that use MBSE, workforce needs, competencies, and proficiency levels is a novel contribution to our field's understanding of the transition to DE. This research could ultimately inform recommendations for organizations' team structure and workforce development for executing SE projects that use MBSE, enabling organizations to prepare their workforce for this transition more efficiently and effectively.

6.2 Research Contributions

This dissertation offers several original research contributions. The first is a derivation of an industry-validated list of tasks and the associated personnel roles required to adopt and execute specific SE projects that use MBSE. This provides a foundation for defining clear responsibilities across the system lifecycle. These results provide a new understanding of the roles within DE organizations and how those roles are allocated to personnel.

A second contribution involves an evaluation of how tasks allocated to personnel roles vary by team size, sorted by project. This research provided insights into how roles are actually implemented in practice in DE organizations. An analysis of role allocation patterns identifies trends in how roles shift with team size. These findings represent the first time the correlation between project, team size, and workforce role allocation is defined for SE projects that use MBSE. This could inform workforce planning by supporting managers and organizational leaders in making data-informed staffing choices to optimize training, implementation, and overall project performance.

Finally, this research provides a novel competency-proficiency mapping that establishes a structured relationship between key competencies and proficiency levels required for specific roles in an example SE project that uses MBSE, leveraging the DECF v1.1. This mapping defines the proficiency levels for the competencies required for each role, providing clarity on workforce capability expectations for SE projects that use MBSE. Additionally, the results provide a new workforce development resource. This serves as a practical tool for identifying training needs and assessing role readiness, concisely showing which skills and proficiency levels are necessary to support their organization’s transition to MBSE for an example SE project that uses MBSE. Managers could use this to determine what skills their personnel need, enabling them to invest in tailored training accordingly. Alternatively, individual personnel could use this listing to identify skills they may need if their role will be involved in executing specific projects in the future.

6.3 Future Work

Several concrete opportunities for future research emerged from this work. One limitation of this research was the relatively small number of responses collected. In practice, this meant that some task-to-role and role-to-personnel allocations had fewer data points than expected, which constrained the strength of the conclusions that could be drawn. For each project type and team size, the number of responses ranged from zero to four, making it difficult to establish patterns or derive statistically meaningful results. While the data gathered provides an initial foundation for understanding team and role dynamics of SE projects that use MBSE, the limited sample reduces the confidence in the generalizability of the findings. To strengthen future investigations, researchers could employ the same methodology with a larger pool of participants across a wider range of projects. This would enable more robust comparisons, help identify trends with greater reliability, and ultimately confirm or refine the preliminary insights uncovered in this study.

Additional future research could expand the number of researchers engaged in mapping tasks to KSABs to increase the fidelity and reliability of the results. A broader base of SMEs would help reduce bias, improve consistency, and provide a more comprehensive understanding of the competencies required for SE projects that use MBSE. Also, replicating the same process from this research across a wider set of SE projects that use MBSE would allow for comparative analysis of how competencies and associated proficiency levels vary across projects throughout the SE lifecycle. This work would provide key insights into role-specific training requirements, support the development of more targeted workforce training, and ultimately enhance the effectiveness of MBSE adoption across the aerospace industry. It is important to note that the

DECF v1.1 was released in 2021 and reflects the competencies needed during an early phase of the DE transition. Like other frameworks, it will continue to evolve as practices, tools, and standards mature, so the specific mappings developed here are best viewed as a point-in-time reference. However, the methodology used to connect project tasks, roles, and DECF competencies remains valid across versions. It provides a repeatable structure that can be applied to future DECF updates, extending the lifespan of this research beyond v1.1.

Future research could also include a formal sensitivity analysis to examine how varying the weighting assumptions for task-to-role mapping, role-to-personnel mapping, and proficiency level determination affects the overall outcome. In this study, each of these factors was held constant at 50%. Exploring a wider range of values, individually and in combination, would provide insight into which assumptions most strongly influence role assignments and performance estimates.

Finally, it would be valuable to explore the specific training and developmental pathways required to achieve the different levels of proficiency for each competency. Future research could build on the current findings by mapping the competencies and corresponding proficiency levels to targeted training programs or learning pathways. This approach would help to create a structured framework that links competency needs directly to relevant educational or on-the-job training opportunities. This framework could serve as a practical guide for organizations seeking to strengthen their workforce capabilities, ensuring consistent skill development across roles and facilitating a smoother transition toward more advanced DE and MBSE practices.

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APPENDIX A: DRAFT TASK LISTS FOR EACH SE PROJECT

A.1 System Requirements Definition and Traceability

Table 20. Draft Tasks for System Requirements Definition and Traceability

Project 1: System Requirements Definition and Traceability	
Task 1: Program Management/Admin	
1.1.1	Manage cost
1.1.2	Manage schedule
1.1.3	Manage personnel
1.1.4	Manage required tools and equipment
1.1.5	Manage risk and program compliance
1.1.6	Manage access to spaces and required tools/equipment
1.1.7	Manage project outcome
1.1.8	Manage and execute required reviews
1.1.9	Identify stakeholders and manage engagement
1.1.10	Manage Security and maintain Security Classification Guide
Task 2: Define System Requirements	
1.2.1	Define functional boundary in terms of the behavior and properties the system will provide
1.2.2	Identify stakeholder requirements
1.2.3	Define functions and associated performance
1.2.4	Define constraints on the program/system, interactions with external systems, and required new interfaces
1.2.5	Identify requirements that relate to risk, criticality, critical quality characteristics, and compliance with standards and regulations
1.2.6	Define verification success criteria for each requirement, verification strategy, verification method, verification plan, and responsible organization
1.2.7	Identify and capture system requirements and attributes
Task 3: Analyze System Requirements	
1.3.1	Analyze requirements to ensure they are correct, complete, consistent, understandable, appropriate to level, and feasible
1.3.2	Define critical performance measures
1.3.3	Review analyzed requirements with stakeholders and resolve any issues
Task 4: Manage System Requirements	
1.4.1	Establish and sustain requirements traceability
1.4.2	Establish and manage system requirements change process
1.4.3	Review analyzed requirements with stakeholders and resolve any issues

A.2 Pre-Phase A Architecture Development

Table 21. Draft Tasks for Pre-Phase A Architecture Development

Project 2: Pre-Phase A Architecture Development	
Task 1: Program Management/Admin	
1.1.1	Manage cost
1.1.2	Manage schedule
1.1.3	Manage personnel
1.1.4	Manage required tools and equipment
1.1.5	Manage risk and program compliance
1.1.6	Manage access to spaces and required tools/equipment
1.1.7	Manage project outcome
1.1.8	Manage and execute required reviews
1.1.9	Identify stakeholders and manage engagement
1.1.10	Manage Security and maintain Security Classification Guide
Task 2: Define System-Level Architecture	
2.2.1	Perform system-level trade study to research and generate possible system concepts and make a recommendation
2.2.2	Conduct system architecture peer review to ensure the appropriateness and potential success of recommended system concepts
2.2.3	Define module structural elements, including boundaries, relationships, interfaces, exchanges, and interactions between the proposed subsystems of the module
2.2.4	Define module internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed subsystems of the module
2.2.5	Define module element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
2.2.6	Define module-level data, including the scope, structure, and location of the data and its flow to and from the module
2.2.7	Define module-level behavior within the context of its use
2.2.8	Define module-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Task 3: Define Subsystem-Level Architecture (performed for each subsystem)	
2.3.1	Perform subsystem-level trade study to research and generate possible subsystem concepts and make a recommendation
2.3.2	Conduct subsystem architecture peer review to ensure the appropriateness and potential success of recommended subsystem concepts
2.3.3	Define subsystem structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to each subsystem

2.3.4	Define subsystem internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed assemblies of the subsystem
2.3.5	Define subsystem element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
2.3.6	Define subsystem data, including the scope, structure, and location of the data and its flow to and from each subsystem
2.3.7	Define subsystem behavior within the context of its use
2.3.8	Define subsystem requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Task 4: Define Assembly-Level Architecture (performed for each assembly that makes up the subsystems, e.g., individual actuators, mechanisms, structural elements, and sensors)	
2.4.1	Perform assembly-level trade study to research and generate possible assembly concepts and make a recommendation
2.4.2	Conduct assembly architecture peer review to ensure the appropriateness and potential success of recommended assembly concepts
2.4.3	Define assembly structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to each assembly
2.4.4	Define assembly internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed elements of the assembly
2.4.5	Define assembly element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
2.4.6	Define assembly data, including the scope, structure, and location of the data and its flow to and from each assembly
2.4.7	Define assembly behavior within the context of its use
2.4.8	Define assembly requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria

A.3 Concept Definition

Table 22. Draft Tasks for Concept Definition

Project 3: Concept Definition	
Task 1: Program Management/Admin	
1.1.1	Manage cost
1.1.2	Manage schedule
1.1.3	Manage personnel
1.1.4	Manage required tools and equipment
1.1.5	Manage risk and program compliance
1.1.6	Manage access to spaces and required tools/equipment

1.1.7	Manage project outcome
1.1.8	Manage and execute required reviews
1.1.9	Identify stakeholders and manage engagement
1.1.10	Manage Security and maintain Security Classification Guide
Task 2: System Analysis and Architecture Design	
3.2.1	Analyze stakeholder system requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria; decomposing system requirements into subsystem requirements, as needed
3.2.2	Analyze desired stakeholder system Use Cases, including relationships, interfaces, exchanges, and interactions between the proposed system and its external environment
3.2.3	Define system functional architecture, relating the functions to system requirements
3.2.4	Allocate system functional architecture to structural elements
3.2.5	Parameterize system functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.
Task 3: Subsystem Analysis and Architecture Design	
3.3.1	Analyze stakeholder subsystem requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria; decomposing the subsystem requirements into component requirements, as needed
3.3.2	Define subsystem functional architecture, relating the functions to subsystem requirements
3.3.3	Allocate subsystem functional architecture to structural elements
3.3.4	Parameterize subsystem functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.
Task 4: Component Analysis and First Unit Architecture Design	
3.4.1	Analyze stakeholder component requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
3.4.2	Define component functional architecture, relating the functions to component requirements
3.4.3	Allocate component functional architecture to structural elements
3.4.4	Parameterize component functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.

A.4 Test & Evaluation

Table 23. Draft Tasks for Test & Evaluation

Project 4: Test & Evaluation	
Task 1: Program Management/Admin	
1.1.1	Manage cost
1.1.2	Manage schedule
1.1.3	Manage personnel
1.1.4	Manage required tools and equipment
1.1.5	Manage risk and program compliance
1.1.6	Manage access to spaces and required tools/equipment
1.1.7	Manage project outcome
1.1.8	Manage and execute required reviews
1.1.9	Identify stakeholders and manage engagement
1.1.10	Manage Security and maintain Security Classification Guide
Task 2: Pre-KDP A Concept Studies (Phase 0) Efforts	
4.2.1	Assess the testability of all concept alternatives, validation strategy for ground support and special test equipment, test infrastructure, and test requirements
4.2.2	Define and evaluate Technical Performance Measures and mission requirements validation strategy
4.2.3	Identify and establish test organizational relationships (e.g., OTA, support agreements)
4.2.4	Assess National Environmental Policy Act impacts and/or initiate environmental studies
Task 3: Concept Development (Phase A) Efforts	
4.3.1	Assess mission and system CONOPS and requirements for completeness and to support testability
4.3.2	Develop a Test & Evaluation Master Plan (TEMP)
4.3.3	Assess system internal and external interface definition, completeness, and testability
4.3.4	Examine need for simulations, models, prototypes, and test beds, and evaluate long-lead planning and procurement
4.3.5	Assess testability of the integrated space and ground elements
4.3.6	Determine risk to the flight units/system concept due to the stress of ground testing
4.3.7	Assess the need for any test resources, ground support equipment, and/or special test equipment, either existing or new
4.3.8	Develop the assembly and integration strategy
4.3.9	Connect with any necessary specialty engineering disciplines (e.g., electromagnetic compatibility)
4.3.10	Develop IT&E schedule that supports key decision points, including any margin for rework
4.3.11	Develop certification test strategy

4.3.12	Develop requirements verification architecture model (RVAM)
4.3.13	Collect necessary system operating environments to establish test needs (e.g., SMC-S-016 acoustic, shock, vibration levels)
Task 4: Preliminary Design (Phase B) Efforts	
4.4.1	Decompose and assess T&E certification requirements
4.4.2	Develop any COTS/heritage test requirements
4.4.3	Determine technology development strategy
4.4.4	Develop segment-to-segment verification/validation strategy (e.g., space-to-ground, space-to-launch)
4.4.5	Flow-down test requirements to lower-level assemblies
4.4.6	Develop space vehicle test program, including test conditions, test risks, and space-to-ground interface validation, software, and cyber
4.4.7	Develop plan for payload integration to bus
4.4.8	Assess supply chain test strategies and risks
4.4.9	Conduct space vehicle component testing and evaluate data
4.4.10	Conduct space vehicle subsystem testing and evaluate data
Task 5: Complete Design (Phase C) Efforts	
4.5.1	Develop final system integration and test plan
4.5.2	Develop final verification plan
4.5.3	Reevaluate test risks to flight hardware over the course of the entire planned test sequence
4.5.4	Evaluate any informal test data
4.5.5	Obtain interim Authority to Test (IATT) and/or Authority to Operate (ATO)
Task 6: Fabrication and Integration (Phase D1) Efforts	
4.6.1	Develop launch vehicle/space vehicle integrated test plan
4.6.2	Develop assembly, test, and checkout procedures
4.6.3	Evaluate and document test risk items
4.6.4	Conduct pre-ship test and evaluate data
4.6.5	Conduct space vehicle integrated system test and evaluate data
4.6.6	Conduct acceptance testing and evaluate results
Task 7: Fielding and Checkout (Phase D2) Efforts	
4.7.1	Evaluate launch base checkout and readiness
4.7.2	Evaluate satellite deployment and initialization and establish baseline
4.7.3	Conduct operational testing and evaluate data
4.7.4	Evaluate and resolve any anomalies
Task 8: Operations and Disposal (Phase D3) Efforts	
4.8.1	Evaluate periodic mission performance testing, monitor trends, and assess and update reliability statistics
4.8.2	Evaluate periodic space vehicle subsystem calibration results
4.8.3	Evaluate system baseline changes impacting performance

4.8.4	Maintain ground test infrastructure
4.8.5	Develop software upgrade test strategies (modeling sandbox) for ground support equipment and on-orbit software

APPENDIX B: SYNTHESIZED LISTINGS OF ROLES AND ASSOCIATED TASKS FOR EACH SE PROJECT

B.1 System Requirements Definition and Traceability

The following table shows the roles allocated to tasks for a team size of 10 personnel for a current team.

Table 24. Roles Assigned to Tasks for System Requirements Definition and Traceability for a Current Team of 10 (n=2)

Assigned Roles	Task #	Task
Task 1: Program Management/Admin		
PM	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng Sys Eng Tech SME	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Chief Eng	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM Chief Eng Sys Eng	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM Sys Eng	1.1.6	Define and manage cost/budget
PM	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM Chief Eng	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM Chief Eng Sys Eng T&E SME	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Chief Eng	1.1.10	Define and manage risk and program compliance
PM Prog Sec IT Phys Sec	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure

PM Chief Eng Sys Eng Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM Chief Eng Sys Eng	1.1.13	Define, manage, and execute required reviews
PM Chief Eng Config Cntrl	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Chief Eng Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
PM Chief Eng Tech SME Prog Sec	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Define System Requirements		
Chief Eng Sys Eng T&E SME	1.2.1	Define functional boundary in terms of the behavior and properties the system will provide, including system performance attributes, throughput, and responsiveness needs
Chief Eng Sys Eng T&E SME	1.2.2	Identify/obtain stakeholder key functional/performance requirements and iteratively review
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	1.2.3	Define functions and associated performance, system CONOPs, and Use Cases
Chief Eng Sys Eng T&E SME	1.2.4	Define constraints on the program/system, operating environment, interactions with external systems, externally-driven requirements, and required new interfaces; create required documentation
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	1.2.5	Identify and capture system requirements and attributes and create requirements baseline
Chief Eng Sys Eng T&E SME	1.2.6	Identify requirements that relate to risk, criticality, critical quality characteristics, and compliance with standards and regulations
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	1.2.7	Begin to define verification success criteria for each requirement, verification strategy, verification method, verification plan, and responsible organization, and continue to iterate

Task 3: Analyze System Requirements		
Chief Eng Sys Eng MBSE SME Config Cntrl T&E SME	1.3.1	Analyze requirements to ensure they are correct, complete, consistent, traceable, understandable, appropriate to level, verifiable/measurable, and feasible, adjudicating and refining as necessary
Chief Eng Sys Eng Tech SME T&E SME	1.3.2	Define critical performance measures
PM Chief Eng Sys Eng Tech SME T&E SME	1.3.3	Review analyzed requirements with stakeholders and resolve any issues
PM Chief Eng Sys Eng T&E SME	1.3.4	Analyze requirements for criticality (e.g., impact of non-satisfaction) and sensitivity (e.g., impact of partial satisfaction)
PM Chief Eng Sys Eng T&E SME	1.3.5	Prioritize requirements, if needed
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	1.3.6	Develop performance models and analyses to model and/or test to validate and/or verify requirements
PM Chief Eng Sys Eng T&E SME	1.3.7	Determine system compliance criteria and margin to requirements
Task 4: Manage System Requirements		
Chief Eng Sys Eng MBSE SME Config Cntrl	1.4.1	Establish and sustain requirements traceability
Chief Eng Sys Eng MBSE SME Config Cntrl	1.4.2	Establish, document, and manage system requirements change process, including a means to identify impacts of a proposed requirements change
Chief Eng Sys Eng Config Cntrl	1.4.3	Establish and manage baselines for information items, work products, or other artifacts

PM Chief Eng Sys Eng Tech SME	1.4.4	Manage progress of requirements development, change, and satisfaction

The roles allocated to tasks for a team size of 10 personnel for an ideal team are displayed in the table below.

Table 25. Roles Assigned to Tasks for System Requirements Definition and Traceability for an Ideal Team of 10 (n=4)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng Sys Eng	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Sys Eng	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng Sys Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM	1.1.6	Define and manage cost/budget
PM Chief Eng Scheduler	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM Chief Eng IT	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Sys Eng	1.1.10	Define and manage risk and program compliance
PM Prog Sec IT	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
PM Chief Eng Sys Eng Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM	1.1.13	Define, manage, and execute required reviews

Chief Eng Sys Eng MBSE SME		
PM Chief Eng Sys Eng MBSE SME	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Chief Eng Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
PM Chief Eng Prog Sec IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Define System Requirements		
Chief Eng Sys Eng MBSE SME T&E SME	1.2.1	Define functional boundary in terms of the behavior and properties the system will provide, including system performance attributes, throughput, and responsiveness needs
Chief Eng Sys Eng MBSE SME	1.2.2	Identify/obtain stakeholder key functional/performance requirements and iteratively review
Chief Eng Sys Eng Tech SME MBSE SME	1.2.3	Define functions and associated performance, system CONOPs, and Use Cases
Chief Eng Sys Eng Tech SME MBSE SME	1.2.4	Define constraints on the program/system, operating environment, interactions with external systems, externally-driven requirements, and required new interfaces; create required documentation
Chief Eng Sys Eng Tech SME MBSE SME	1.2.5	Identify and capture system requirements and attributes and create requirements baseline
Chief Eng Sys Eng Tech SME	1.2.6	Identify requirements that relate to risk, criticality, critical quality characteristics, and compliance with standards and regulations
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	1.2.7	Begin to define verification success criteria for each requirement, verification strategy, verification method, verification plan, and responsible organization, and continue to iterate
Task 3: Analyze System Requirements		

Chief Eng Sys Eng MBSE SME T&E SME	1.3.1	Analyze requirements to ensure they are correct, complete, consistent, traceable, understandable, appropriate to level, verifiable/measurable, and feasible, adjudicating and refining as necessary
Chief Eng Sys Eng Tech SME	1.3.2	Define critical performance measures
Chief Eng Sys Eng Tech SME	1.3.3	Review analyzed requirements with stakeholders and resolve any issues
Chief Eng Sys Eng MBSE SME	1.3.4	Analyze requirements for criticality (e.g., impact of non-satisfaction) and sensitivity (e.g., impact of partial satisfaction)
PM Chief Eng Sys Eng	1.3.5	Prioritize requirements, if needed
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	1.3.6	Develop performance models and analyses to model and/or test to validate and/or verify requirements
Chief Eng Sys Eng Tech SME MBSE SME	1.3.7	Determine system compliance criteria and margin to requirements
Task 4: Manage System Requirements		
Chief Eng Sys Eng MBSE SME	1.4.1	Establish and sustain requirements traceability
Chief Eng Sys Eng MBSE SME	1.4.2	Establish, document, and manage system requirements change process, including a means to identify impacts of a proposed requirements change
Chief Eng Sys Eng MBSE SME	1.4.3	Establish and manage baselines for information items, work products, or other artifacts
Chief Eng Sys Eng Tech SME MBSE SME	1.4.4	Manage progress of requirements development, change, and satisfaction

The following table displays the roles allocated to tasks for an ideal team size of 50 personnel.

Table 26. Roles Assigned to Tasks for System Requirements Definition and Traceability for an Ideal Team of 50 (n=3)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Sys Eng	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM	1.1.6	Define and manage cost/budget
PM Chief Eng Scheduler	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
Chief Eng Sys Eng MBSE SME IT	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Sys Eng	1.1.10	Define and manage risk and program compliance
PM IT Phys Sec	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
Sys Eng Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM Chief Eng Sys Eng MBSE SME	1.1.13	Define, manage, and execute required reviews
PM Sys Eng MBSE SME	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
Prog Sec IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Define System Requirements		

Sys Eng MBSE SME	1.2.1	Define functional boundary in terms of the behavior and properties the system will provide, including system performance attributes, throughput, and responsiveness needs
Chief Eng Sys Eng MBSE SME	1.2.2	Identify/obtain stakeholder key functional/performance requirements and iteratively review
Sys Eng MBSE SME	1.2.3	Define functions and associated performance, system CONOPs, and Use Cases
Sys Eng Tech SME MBSE SME	1.2.4	Define constraints on the program/system, operating environment, interactions with external systems, externally-driven requirements, and required new interfaces; create required documentation
Sys Eng MBSE SME	1.2.5	Identify and capture system requirements and attributes and create requirements baseline
Chief Eng Sys Eng Tech SME MBSE SME	1.2.6	Identify requirements that relate to risk, criticality, critical quality characteristics, and compliance with standards and regulations
Sys Eng T&E SME	1.2.7	Begin to define verification success criteria for each requirement, verification strategy, verification method, verification plan, and responsible organization, and continue to iterate
Task 3: Analyze System Requirements		
Sys Eng MBSE SME	1.3.1	Analyze requirements to ensure they are correct, complete, consistent, traceable, understandable, appropriate to level, verifiable/measurable, and feasible, adjudicating and refining as necessary
Chief Eng Sys Eng MBSE SME	1.3.2	Define critical performance measures
Sys Eng MBSE SME	1.3.3	Review analyzed requirements with stakeholders and resolve any issues
Chief Eng Sys Eng MBSE SME	1.3.4	Analyze requirements for criticality (e.g., impact of non-satisfaction) and sensitivity (e.g., impact of partial satisfaction)
PM Chief Eng Sys Eng	1.3.5	Prioritize requirements, if needed
Sys Eng Tech SME MBSE SME T&E SME	1.3.6	Develop performance models and analyses to model and/or test to validate and/or verify requirements
Chief Eng Sys Eng Tech SME MBSE SME	1.3.7	Determine system compliance criteria and margin to requirements
Task 4: Manage System Requirements		

Sys Eng MBSE SME	1.4.1	Establish and sustain requirements traceability
Sys Eng MBSE SME	1.4.2	Establish, document, and manage system requirements change process, including a means to identify impacts of a proposed requirements change
Sys Eng MBSE SME	1.4.3	Establish and manage baselines for information items, work products, or other artifacts
Sys Eng MBSE SME	1.4.4	Manage progress of requirements development, change, and satisfaction

The roles allocated to tasks for a team size of 100 personnel for a current team are displayed in the following table.

Table 27. Roles Assigned to Tasks for System Requirements Definition and Traceability for a Current Team of 100 (n=1)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM Chief Eng	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM Chief Eng Finance	1.1.6	Define and manage cost/budget
PM Chief Eng Scheduler	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM Chief Eng	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
Chief Eng IT	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Chief Eng Sys Eng Config Cntrl	1.1.10	Define and manage risk and program compliance

PM Chief Eng IT Phys Sec	1.1.11	Manage access to facilities/spaces and required tools/equipment, including IT infrastructure
Chief Eng Sys Eng Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
Chief Eng Sys Eng	1.1.13	Define, manage, and execute required reviews
Chief Eng Sys Eng Config Cntrl Contracts	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
Chief Eng Sys Eng Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
Chief Eng Sys Eng Prog Sec IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Define System Requirements		
Sys Eng MBSE SME	1.2.1	Define functional boundary in terms of the behavior and properties the system will provide, including system performance attributes, throughput, and responsiveness needs
Chief Eng Sys Eng MBSE SME	1.2.2	Identify/obtain stakeholder key functional/performance requirements and iteratively review
Sys Eng MBSE SME	1.2.3	Define functions and associated performance, system CONOPs, and Use Cases
Sys Eng MBSE SME Tech SME Prog Sec	1.2.4	Define constraints on the program/system, operating environment, interactions with external systems, externally-driven requirements, and required new interfaces; create required documentation
Sys Eng MBSE SME Prog Sec Config Cntrl	1.2.5	Identify and capture system requirements and attributes and create requirements baseline
Chief Eng Sys Eng Tech SME Prog Sec	1.2.6	Identify requirements that relate to risk, criticality, critical quality characteristics, and compliance with standards and regulations
Sys Eng Prog Sec T&E SME	1.2.7	Begin to define verification success criteria for each requirement, verification strategy, verification method, verification plan, and responsible organization, and continue to iterate

Task 3: Analyze System Requirements		
Sys Eng MBSE SME	1.3.1	Analyze requirements to ensure they are correct, complete, consistent, traceable, understandable, appropriate to level, verifiable/measurable, and feasible, adjudicating and refining as necessary
Chief Eng Sys Eng	1.3.2	Define critical performance measures
Sys Eng	1.3.3	Review analyzed requirements with stakeholders and resolve any issues
Chief Eng Sys Eng MBSE SME	1.3.4	Analyze requirements for criticality (e.g., impact of non-satisfaction) and sensitivity (e.g., impact of partial satisfaction)
PM Chief Eng Sys Eng	1.3.5	Prioritize requirements, if needed
Sys Eng Tech SME T&E SME	1.3.6	Develop performance models and analyses to model and/or test to validate and/or verify requirements
Chief Eng Sys Eng MBSE SME Tech SME	1.3.7	Determine system compliance criteria and margin to requirements
Task 4: Manage System Requirements		
Sys Eng MBSE SME	1.4.1	Establish and sustain requirements traceability
Chief Eng Sys Eng MBSE SME	1.4.2	Establish, document, and manage system requirements change process, including a means to identify impacts of a proposed requirements change
Chief Eng Sys Eng MBSE SME	1.4.3	Establish and manage baselines for information items, work products, or other artifacts
Sys Eng MBSE SME	1.4.4	Manage progress of requirements development, change, and satisfaction

The following table shows the roles allocated to tasks for an ideal team size of 100.

Table 28. Roles Assigned to Tasks for System Requirements Definition and Traceability for an Ideal Team of 100 (n=3)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng	1.1.2	Define program/system scope, including system boundaries and work breakdown structure

PM Sys Eng	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM	1.1.6	Define and manage cost/budget
PM Chief Eng Scheduler	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
Chief Eng Sys Eng MBSE SME IT	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Sys Eng	1.1.10	Define and manage risk and program compliance
PM IT Phys Sec	1.1.11	Manage access to facilities/spaces and required tools/equipment, including IT infrastructure
Sys Eng Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM Chief Eng Sys Eng MBSE SME	1.1.13	Define, manage, and execute required reviews
PM Sys Eng MBSE SME	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
Prog Sec IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Define System Requirements		
Sys Eng MBSE SME	1.2.1	Define functional boundary in terms of the behavior and properties the system will provide, including system performance attributes, throughput, and responsiveness needs
Chief Eng Sys Eng MBSE SME	1.2.2	Identify/obtain stakeholder key functional/performance requirements and iteratively review
Sys Eng MBSE SME	1.2.3	Define functions and associated performance, system CONOPs, and Use Cases

Sys Eng Tech SME MBSE SME	1.2.4	Define constraints on the program/system, operating environment, interactions with external systems, externally-driven requirements, and required new interfaces; create required documentation
Sys Eng MBSE SME	1.2.5	Identify and capture system requirements and attributes and create requirements baseline
Chief Eng Sys Eng Tech SME MBSE SME	1.2.6	Identify requirements that relate to risk, criticality, critical quality characteristics, and compliance with standards and regulations
Sys Eng T&E SME	1.2.7	Begin to define verification success criteria for each requirement, verification strategy, verification method, verification plan, and responsible organization, and continue to iterate
Task 3: Analyze System Requirements		
Sys Eng MBSE SME	1.3.1	Analyze requirements to ensure they are correct, complete, consistent, traceable, understandable, appropriate to level, verifiable/measurable, and feasible, adjudicating and refining as necessary
Chief Eng Sys Eng MBSE SME	1.3.2	Define critical performance measures
Sys Eng MBSE SME	1.3.3	Review analyzed requirements with stakeholders and resolve any issues
Chief Eng Sys Eng MBSE SME	1.3.4	Analyze requirements for criticality (e.g., impact of non-satisfaction) and sensitivity (e.g., impact of partial satisfaction)
PM Chief Eng Sys Eng	1.3.5	Prioritize requirements, if needed
Sys Eng Tech SME MBSE SME	1.3.6	Develop performance models and analyses to model and/or test to validate and/or verify requirements
Chief Eng Sys Eng Tech SME MBSE SME	1.3.7	Determine system compliance criteria and margin to requirements
Task 4: Manage System Requirements		
Sys Eng MBSE SME	1.4.1	Establish and sustain requirements traceability
Sys Eng MBSE SME	1.4.2	Establish, document, and manage system requirements change process, including a means to identify impacts of a proposed requirements change
Sys Eng MBSE SME	1.4.3	Establish and manage baselines for information items, work products, or other artifacts
Sys Eng MBSE SME	1.4.4	Manage progress of requirements development, change, and satisfaction

B.2 Pre-Phase A Architecture Development

The following table shows the roles allocated to tasks for a current team size of 10.

Table 29. Roles Assigned to Tasks for Pre-Phase A Architecture Development for a Current Team of 10 (n=1)

Assigned Roles	Task #	Task
Task 1: Program Management/Admin		
PM Chief Eng	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng Sys Eng	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Chief Eng Sys Eng	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM Chief Eng	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng Sys Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM Chief Eng	1.1.6	Define and manage cost/budget
PM Chief Eng	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM Chief Eng	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM Chief Eng Sys Eng Tech SME T&E SME IT	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Chief Eng Sys Eng	1.1.10	Define and manage risk and program compliance
PM Chief Eng Prog Sec IT Phys Sec	1.1.11	Manage access to facilities/spaces and required tools/equipment, including IT infrastructure
PM Chief Eng Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control

PM Chief Eng	1.1.13	Define, manage, and execute required reviews
PM Chief Eng Sys Eng Config Cntrl	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Chief Eng Sys Eng Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
PM Chief Eng Tech SME IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Define System-Level Architecture		
Chief Eng SE Tech SME	2.2.1	Perform system-level trade study to research and generate possible system architectures and make a recommendation
PM Chief Eng Sys Eng Tech SME	2.2.2	Conduct system architecture peer review to ensure the appropriateness and potential success of recommended system architecture against key functional/performance requirements; iteratively review with appropriate stakeholder(s)
PM Chief Eng Sys Eng Tech SME MBSE SME	2.2.3	Capture final system CONOPs and define architecture ownership roles
Chief Eng Sys Eng Tech SME MBSE SME	2.2.4	Identify and elaborate on system Use Cases
Chief Eng Sys Eng Tech SME MBSE SME	2.2.5	Define system structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to the system
Chief Eng Sys Eng Tech SME MBSE SME	2.2.6	Define system internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed subsystems of the module
Chief Eng Sys Eng Tech SME MBSE SME	2.2.7	Define system element specifications to include relevant information, such as physical characteristics/constraints, environment, test support features, software features, links to drawings and specifications, etc.
Chief Eng Sys Eng	2.2.8	Define system-level data, including the scope, structure, and location of the data, its flow to and from the module, and algorithm needs

Tech SME MBSE SME		
Chief Eng Sys Eng Tech SME MBSE SME	2.2.9	Define system-level behavior within the context of its use
Chief Eng Sys Eng Tech SME MBSE SME	2.2.10	Define, map, and allocate system-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Chief Eng Sys Eng Tech SME MBSE SME	2.2.11	Determine modeling strategy
Task 3: Define Subsystem-Level Architecture		
Chief Eng Sys Eng Tech SME MBSE SME	2.3.1	Perform subsystem-level trade study to research and generate possible subsystem concepts/architectures and make a recommendation based on ability to meet key requirements within cost/schedule
Chief Eng Sys Eng Tech SME MBSE SME	2.3.2	Conduct subsystem architecture peer review to ensure the appropriateness and potential success of recommended subsystem concepts
Chief Eng Sys Eng Tech SME MBSE SME	2.3.3	Define subsystem structural elements, including boundaries, relationships, interfaces, exchanges, and interactions within elements external to each subsystem
Chief Eng Sys Eng Tech SME MBSE SME	2.3.4	Define subsystem internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed assemblies of the subsystem
Chief Eng Sys Eng Tech SME MBSE SME	2.3.5	Define subsystem element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
Chief Eng Sys Eng Tech SME MBSE SME	2.3.6	Define subsystem-level data, including the scope, structure, and location of the data, its flow to and from each subsystem, and algorithm needs
Chief Eng Sys Eng Tech SME MBSE SME	2.3.7	Define subsystem behavior within the context of its use

Chief Eng Sys Eng Tech SME MBSE SME	2.3.8	Define, map, and allocate subsystem-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Task 4: Define Assembly-Level Architecture		
PM Chief Eng Sys Eng Tech SME MBSE SME	2.4.1	Perform assembly-level trade study to research and generate possible assembly concepts and make a recommendation
Chief Eng Sys Eng Tech SME	2.4.2	Conduct assembly architecture peer review to ensure the appropriateness and potential success of recommended assembly concepts
Chief Eng Sys Eng Tech SME MBSE SME	2.4.3	Define assembly structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to each assembly
Chief Eng Sys Eng Tech SME MBSE SME	2.4.4	Define assembly internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed elements of the assembly
Chief Eng Sys Eng Tech SME MBSE SME	2.4.5	Define assembly element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
Chief Eng Sys Eng Tech SME MBSE SME	2.4.6	Define assembly-level data, including the scope, structure, and location of the data, its flow to and from the assembly, and algorithm needs
Chief Eng Sys Eng Tech SME MBSE SME	2.4.7	Define assembly behavior within the context of its use
Chief Eng Sys Eng Tech SME MBSE SME	2.4.8	Define, map, and allocate assembly-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria

The roles allocated to tasks for an ideal team size of 10 personnel are displayed in the following table.

Table 30. Roles Assigned to Tasks for Pre-Phase A Architecture Development for an Ideal Team of 10 (n=3)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng Sys Eng	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Sys Eng	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM Chief Eng	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM Chief Eng	1.1.6	Define and manage cost/budget
PM Chief Eng	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM Chief Eng	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM Chief Eng Sys Eng IT	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Chief Eng Sys Eng	1.1.10	Define and manage risk and program compliance
PM Chief Eng IT	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
PM Chief Eng Sys Eng Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM Chief Eng Sys Eng	1.1.13	Define, manage, and execute required reviews
PM Chief Eng Sys Eng	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Chief Eng	1.1.15	Manage Security and maintain Security Classification Guide

Prog Sec		
PM Chief Eng IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Define System-Level Architecture		
Chief Eng Sys Eng	2.2.1	Perform system-level trade study to research and generate possible system architectures and make a recommendation
Chief Eng Sys Eng Tech SME MBSE SME	2.2.2	Conduct system architecture peer review to ensure the appropriateness and potential success of recommended system architecture against key functional/performance requirements; iteratively review with appropriate stakeholder(s)
Sys Eng MBSE SME	2.2.3	Capture final system CONOPs and define architecture ownership roles
Sys Eng MBSE SME	2.2.4	Identify and elaborate on system Use Cases
Sys Eng MBSE SME	2.2.5	Define system structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to the system
Sys Eng MBSE SME	2.2.6	Define system internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed subsystems of the module
Sys Eng MBSE SME	2.2.7	Define system element specifications to include relevant information, such as physical characteristics/constraints, environment, test support features, software features, links to drawings and specifications, etc.
Sys Eng MBSE SME	2.2.8	Define system-level data, including the scope, structure, and location of the data, its flow to and from the module, and algorithm needs
Sys Eng MBSE SME	2.2.9	Define system-level behavior within the context of its use
Sys Eng MBSE SME	2.2.10	Define, map, and allocate system-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Sys Eng MBSE SME	2.2.11	Determine modeling strategy
Task 3: Define Subsystem-Level Architecture		
Sys Eng MBSE SME	2.3.1	Perform subsystem-level trade study to research and generate possible subsystem concepts/architectures and make a recommendation based on ability to meet key requirements within cost/schedule
Sys Eng Tech SME MBSE SME	2.3.2	Conduct subsystem architecture peer review to ensure the appropriateness and potential success of recommended subsystem concepts
Sys Eng MBSE SME	2.3.3	Define subsystem structural elements, including boundaries, relationships, interfaces, exchanges, and interactions within elements external to each subsystem

Sys Eng MBSE SME	2.3.4	Define subsystem internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed assemblies of the subsystem
Sys Eng MBSE SME	2.3.5	Define subsystem element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
Sys Eng MBSE SME	2.3.6	Define subsystem-level data, including the scope, structure, and location of the data, its flow to and from each subsystem, and algorithm needs
Sys Eng MBSE SME	2.3.7	Define subsystem behavior within the context of its use
Sys Eng MBSE SME	2.3.8	Define, map, and allocate subsystem-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Task 4: Define Assembly-Level Architecture		
Sys Eng	2.4.1	Perform assembly-level trade study to research and generate possible assembly concepts and make a recommendation
Sys Eng	2.4.2	Conduct assembly architecture peer review to ensure the appropriateness and potential success of recommended assembly concepts
Sys Eng MBSE SME	2.4.3	Define assembly structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to each assembly
Sys Eng MBSE SME	2.4.4	Define assembly internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed elements of the assembly
Sys Eng MBSE SME	2.4.5	Define assembly element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
Sys Eng MBSE SME	2.4.6	Define assembly-level data, including the scope, structure, and location of the data, its flow to and from the assembly, and algorithm needs
Sys Eng MBSE SME	2.4.7	Define assembly behavior within the context of its use
Sys Eng MBSE SME	2.4.8	Define, map, and allocate assembly-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria

The following table shows the roles assigned to tasks for an ideal team of 50 personnel.

Table 31. Roles Assigned to Tasks for Pre-Phase A Architecture Development for an Ideal Team of 50 (n=2)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM Sys Eng MBSE SME	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng Sys Eng MBSE SME	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Sys Eng MBSE SME	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM Chief Eng	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM Chief Eng Finance	1.1.6	Define and manage cost/budget
PM Chief Eng Scheduler	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM Chief Eng	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM Chief Eng Sys Eng MBSE SME IT	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Chief Eng Sys Eng MBSE SME Config Cntrl	1.1.10	Define and manage risk and program compliance
PM Chief Eng Sys Eng MBSE SME IT Phys Sec	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure

PM Chief Eng Sys Eng MBSE SME Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM Chief Eng Sys Eng MBSE SME	1.1.13	Define, manage, and execute required reviews
PM Chief Eng Sys Eng MBSE SME Config Cntrl Contracts	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Chief Eng Sys Eng Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
PM Chief Eng Sys Eng Prog Sec IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Define System-Level Architecture		
Chief Eng Sys Eng MBSE SME	2.2.1	Perform system-level trade study to research and generate possible system architectures and make a recommendation
Chief Eng Sys Eng Tech SME MBSE SME Prog Sec	2.2.2	Conduct system architecture peer review to ensure the appropriateness and potential success of recommended system architecture against key functional/performance requirements; iteratively review with appropriate stakeholder(s)
Sys Eng MBSE SME	2.2.3	Capture final system CONOPs and define architecture ownership roles
Sys Eng MBSE SME	2.2.4	Identify and elaborate on system Use Cases
Sys Eng MBSE SME	2.2.5	Define system structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to the system
Sys Eng MBSE SME	2.2.6	Define system internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed subsystems of the module

Sys Eng MBSE SME	2.2.7	Define system element specifications to include relevant information, such as physical characteristics/constraints, environment, test support features, software features, links to drawings and specifications, etc.
Sys Eng MBSE SME	2.2.8	Define system-level data, including the scope, structure, and location of the data, its flow to and from the module, and algorithm needs
Sys Eng MBSE SME	2.2.9	Define system-level behavior within the context of its use
Sys Eng MBSE SME	2.2.10	Define, map, and allocate system-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Sys Eng MBSE SME	2.2.11	Determine modeling strategy
Task 3: Define Subsystem-Level Architecture		
Sys Eng MBSE SME	2.3.1	Perform subsystem-level trade study to research and generate possible subsystem concepts/architectures and make a recommendation based on ability to meet key requirements within cost/schedule
Sys Eng Tech SME MBSE SME	2.3.2	Conduct subsystem architecture peer review to ensure the appropriateness and potential success of recommended subsystem concepts
Sys Eng MBSE SME	2.3.3	Define subsystem structural elements, including boundaries, relationships, interfaces, exchanges, and interactions within elements external to each subsystem
Sys Eng MBSE SME	2.3.4	Define subsystem internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed assemblies of the subsystem
Sys Eng MBSE SME	2.3.5	Define subsystem element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
Sys Eng MBSE SME	2.3.6	Define subsystem-level data, including the scope, structure, and location of the data, its flow to and from each subsystem, and algorithm needs
Sys Eng MBSE SME	2.3.7	Define subsystem behavior within the context of its use
Sys Eng MBSE SME	2.3.8	Define, map, and allocate subsystem-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Task 4: Define Assembly-Level Architecture		
Sys Eng MBSE SME	2.4.1	Perform assembly-level trade study to research and generate possible assembly concepts and make a recommendation
Sys Eng MBSE SME	2.4.2	Conduct assembly architecture peer review to ensure the appropriateness and potential success of recommended assembly concepts

Sys Eng MBSE SME	2.4.3	Define assembly structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to each assembly
Sys Eng MBSE SME	2.4.4	Define assembly internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed elements of the assembly
Sys Eng MBSE SME	2.4.5	Define assembly element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
Sys Eng MBSE SME	2.4.6	Define assembly-level data, including the scope, structure, and location of the data, its flow to and from the assembly, and algorithm needs
Sys Eng MBSE SME	2.4.7	Define assembly behavior within the context of its use
Sys Eng MBSE SME	2.4.8	Define, map, and allocate assembly-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria

The following table shows the roles allocated to tasks for a current team size of 100.

Table 32. Roles Assigned to Tasks for Pre-Phase A Architecture Development for a Current Team of 100 (n=1)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng Sys Eng	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM Chief Eng	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/technical/cost/schedule decisions
PM Chief Eng Finance	1.1.6	Define and manage cost/budget
PM Chief Eng Scheduler	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM Chief Eng	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training

Chief Eng IT	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Chief Eng Sys Eng Config Cntrl	1.1.10	Define and manage risk and program compliance
PM Chief Eng IT Phys Sec	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
Chief Eng Sys Eng Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
Chief Eng Sys Eng	1.1.13	Define, manage, and execute required reviews
Chief Eng Sys Eng Config Cntrl Contracts	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
Chief Eng Sys Eng Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
Chief Eng Sys Eng Prog Sec IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Define System-Level Architecture		
Chief Eng Sys Eng	2.2.1	Perform system-level trade study to research and generate possible system architectures and make a recommendation
Chief Eng Sys Eng Tech SME MBSE SME Prog Sec	2.2.2	Conduct system architecture peer review to ensure the appropriateness and potential success of recommended system architecture against key functional/performance requirements; iteratively review with appropriate stakeholder(s)
Sys Eng MBSE SME	2.2.3	Capture final system CONOPs and define architecture ownership roles
Sys Eng MBSE SME	2.2.4	Identify and elaborate on system Use Cases
Sys Eng MBSE SME	2.2.5	Define system structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to the system
Sys Eng MBSE SME	2.2.6	Define system internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed subsystems of the module

Sys Eng MBSE SME	2.2.7	Define system element specifications to include relevant information, such as physical characteristics/constraints, environment, test support features, software features, links to drawings and specifications, etc.
Sys Eng MBSE SME	2.2.8	Define system-level data, including the scope, structure, and location of the data, its flow to and from the module, and algorithm needs
Sys Eng MBSE SME	2.2.9	Define system-level behavior within the context of its use
Sys Eng MBSE SME	2.2.10	Define, map, and allocate system-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Chief Eng Sys Eng MBSE SME	2.2.11	Determine modeling strategy
Task 3: Define Subsystem-Level Architecture		
Sys Eng	2.3.1	Perform subsystem-level trade study to research and generate possible subsystem concepts/architectures and make a recommendation based on ability to meet key requirements within cost/schedule
Sys Eng Tech SME	2.3.2	Conduct subsystem architecture peer review to ensure the appropriateness and potential success of recommended subsystem concepts
Sys Eng	2.3.3	Define subsystem structural elements, including boundaries, relationships, interfaces, exchanges, and interactions within elements external to each subsystem
Sys Eng	2.3.4	Define subsystem internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed assemblies of the subsystem
Sys Eng	2.3.5	Define subsystem element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
Sys Eng	2.3.6	Define subsystem-level data, including the scope, structure, and location of the data, its flow to and from each subsystem, and algorithm needs
Sys Eng	2.3.7	Define subsystem behavior within the context of its use
Sys Eng	2.3.8	Define, map, and allocate subsystem-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Task 4: Define Assembly-Level Architecture		
	2.4.1	Perform assembly-level trade study to research and generate possible assembly concepts and make a recommendation
	2.4.2	Conduct assembly architecture peer review to ensure the appropriateness and potential success of recommended assembly concepts

	2.4.3	Define assembly structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to each assembly
	2.4.4	Define assembly internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed elements of the assembly
	2.4.5	Define assembly element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
	2.4.6	Define assembly-level data, including the scope, structure, and location of the data, its flow to and from the assembly, and algorithm needs
	2.4.7	Define assembly behavior within the context of its use
	2.4.8	Define, map, and allocate assembly-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria

The following table shows the roles allocated to tasks for an ideal team size of 100 personnel.

Table 33. Roles Assigned to Tasks for Pre-Phase A Architecture Development for an Ideal Team of 100 (n=2)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM Sys Eng MBSE SME	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng Sys Eng MBSE SME	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Sys Eng MBSE SME	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM Chief Eng	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM Chief Eng Finance	1.1.6	Define and manage cost/budget
PM Chief Eng	1.1.7	Define and manage schedule, ensuring focus on major milestones

Scheduler		
PM Chief Eng	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM Chief Eng Sys Eng MBSE SME IT	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Chief Eng Sys Eng MBSE SME Config Cntrl	1.1.10	Define and manage risk and program compliance
PM Chief Eng Sys Eng MBSE SME IT Phys Sec	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
PM Chief Eng Sys Eng MBSE SME Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM Chief Eng Sys Eng MBSE SME	1.1.13	Define, manage, and execute required reviews
PM Chief Eng Sys Eng MBSE SME Config Cntrl Contracts	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Chief Eng Sys Eng Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
PM Chief Eng Sys Eng Prog Sec IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Define System-Level Architecture		

Chief Eng Sys Eng MBSE SME	2.2.1	Perform system-level trade study to research and generate possible system architectures and make a recommendation
Chief Eng Sys Eng Tech SME MBSE SME Prog Sec	2.2.2	Conduct system architecture peer review to ensure the appropriateness and potential success of recommended system architecture against key functional/performance requirements; iteratively review with appropriate stakeholder(s)
Sys Eng MBSE SME	2.2.3	Capture final system CONOPs and define architecture ownership roles
Sys Eng MBSE SME	2.2.4	Identify and elaborate on system Use Cases
Sys Eng MBSE SME	2.2.5	Define system structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to the system
Sys Eng MBSE SME	2.2.6	Define system internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed subsystems of the module
Sys Eng MBSE SME	2.2.7	Define system element specifications to include relevant information, such as physical characteristics/constraints, environment, test support features, software features, links to drawings and specifications, etc.
Sys Eng MBSE SME	2.2.8	Define system-level data, including the scope, structure, and location of the data, its flow to and from the module, and algorithm needs
Sys Eng MBSE SME	2.2.9	Define system-level behavior within the context of its use
Sys Eng MBSE SME	2.2.10	Define, map, and allocate system-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Sys Eng MBSE SME	2.2.11	Determine modeling strategy
Task 3: Define Subsystem-Level Architecture		
Sys Eng MBSE SME	2.3.1	Perform subsystem-level trade study to research and generate possible subsystem concepts/architectures and make a recommendation based on ability to meet key requirements within cost/schedule
Sys Eng Tech SME MBSE SME	2.3.2	Conduct subsystem architecture peer review to ensure the appropriateness and potential success of recommended subsystem concepts
Sys Eng MBSE SME	2.3.3	Define subsystem structural elements, including boundaries, relationships, interfaces, exchanges, and interactions within elements external to each subsystem
Sys Eng MBSE SME	2.3.4	Define subsystem internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed assemblies of the subsystem

Sys Eng MBSE SME	2.3.5	Define subsystem element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
Sys Eng MBSE SME	2.3.6	Define subsystem-level data, including the scope, structure, and location of the data, its flow to and from each subsystem, and algorithm needs
Sys Eng MBSE SME	2.3.7	Define subsystem behavior within the context of its use
Sys Eng MBSE SME	2.3.8	Define, map, and allocate subsystem-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria
Task 4: Define Assembly-Level Architecture		
Sys Eng MBSE SME	2.4.1	Perform assembly-level trade study to research and generate possible assembly concepts and make a recommendation
Sys Eng MBSE SME	2.4.2	Conduct assembly architecture peer review to ensure the appropriateness and potential success of recommended assembly concepts
Sys Eng MBSE SME	2.4.3	Define assembly structural elements, including boundaries, relationships, interfaces, exchanges, and interactions with elements external to each assembly
Sys Eng MBSE SME	2.4.4	Define assembly internal structure, including the functions of and relationships, interfaces, exchanges, and interactions between the proposed elements of the assembly
Sys Eng MBSE SME	2.4.5	Define assembly element specifications to include relevant information, such as physical characteristics/constraints, environment, links to drawings and specifications, etc.
Sys Eng MBSE SME	2.4.6	Define assembly-level data, including the scope, structure, and location of the data, its flow to and from the assembly, and algorithm needs
Sys Eng MBSE SME	2.4.7	Define assembly behavior within the context of its use
Sys Eng MBSE SME	2.4.8	Define, map, and allocate assembly-level requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria

B.3 Concept Definition

The following table shows the roles allocated to tasks for a current team size of 10 personnel.

Table 34. Roles Assigned to Tasks for Concept Definition for a Current Team of 10 (n=2)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM Chief Eng Sys Eng	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng Sys Eng	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Chief Eng Sys Eng	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM Chief Eng	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng Sys Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/technical/cost/schedule decisions
PM Chief Eng	1.1.6	Define and manage cost/budget
PM Chief Eng	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM Chief Eng	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM Chief Eng Sys Eng Tech SME MBSE SME IT T&E SME	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Chief Eng Sys Eng	1.1.10	Define and manage risk and program compliance
PM Chief Eng Prog Sec IT Phys Sec	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
PM Chief Eng Sys Eng Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM Chief Eng	1.1.13	Define, manage, and execute required reviews

PM Chief Eng Sys Eng Config Cntrl	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Chief Eng Sys Eng Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
PM Chief Eng Tech SME Prog Sec IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: System Analysis and Architecture Design		
Chief Eng Sys Eng Tech SME	3.2.1	Identify and analyze stakeholder system requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; key performance requirements; and success criteria; decomposing the system requirements into subsystem requirements, as needed. Iteratively review with appropriate stakeholders.
Chief Eng Sys Eng Tech SME MBSE SME	3.2.2	Analyze desired stakeholder system Use Cases, including relationships, interfaces, exchanges, and interactions between the proposed system and its external environment
Chief Eng Sys Eng Tech SME	3.2.3	Perform system-level trade study to research and generate possible system concepts and make a recommendation
Chief Eng Sys Eng Tech SME MBSE SME	3.2.4	Define system functional architecture, relating the functions to system requirements
Chief Eng Sys Eng Tech SME MBSE SME	3.2.5	Allocate system functional architecture to structural elements
Chief Eng Sys Eng Tech SME MBSE SME	3.2.6	Parameterize system functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.
Chief Eng Sys Eng Tech SME MBSE SME	3.2.7	Develop modeling strategy and model/simulate system behavior
Task 3: Subsystem Analysis and Architecture Design		

Chief Eng Sys Eng Tech SME MBSE SME	3.3.1	Analyze stakeholder subsystem requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria; decomposing the subsystem requirements into component requirements, as needed. Iteratively review with appropriate stakeholders.
Chief Eng Sys Eng Tech SME MBSE SME	3.3.2	Perform subsystem-level trade study to research and generate possible subsystem concepts and make a recommendation
Chief Eng Sys Eng Tech SME MBSE SME	3.3.3	Define subsystem functional architecture, relating the functions to subsystem requirements
Chief Eng Sys Eng Tech SME MBSE SME	3.3.4	Allocate subsystem functional architecture to structural elements
Chief Eng Sys Eng Tech SME MBSE SME	3.3.5	Parameterize subsystem functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.
Chief Eng Sys Eng Tech SME MBSE SME	3.3.6	Revisit/assess modeling strategy and perform end-to-end modeling, simulation, and analysis through subsystems to ensure both CONOPs closure and likelihood of meeting key performance requirements
Task 4: Component Analysis and First Unit Architecture Design		
Chief Eng Sys Eng Tech SME	3.4.1	Analyze stakeholder component requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria. Iteratively review with appropriate stakeholders.
Chief Eng Sys Eng Tech SME	3.4.2	Perform component-level trade study to research and generate possible component concepts and make a recommendation
Chief Eng Sys Eng Tech SME MBSE SME	3.4.3	Define component functional architecture, relating the functions to component requirements
Chief Eng Sys Eng Tech SME MBSE SME	3.4.4	Allocate component functional architecture to structural elements
Chief Eng Sys Eng Tech SME MBSE SME	3.4.5	Parameterize component functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.

The following table shows the roles allocated to tasks for an ideal team size of 10 personnel.

Table 35. Roles Assigned to Tasks for Concept Definition for an Ideal Team of 10 (n=4)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM Chief Eng	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng Sys Eng MBSE SME	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Chief Eng Sys Eng	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM Chief Eng	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM Chief Eng	1.1.6	Define and manage cost/budget
PM Chief Eng	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM Chief Eng	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM Chief Eng	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Chief Eng Sys Eng	1.1.10	Define and manage risk and program compliance
PM Chief Eng IT	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
PM Chief Eng Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM Chief Eng	1.1.13	Define, manage, and execute required reviews
PM Chief Eng Sys Eng	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Chief Eng	1.1.15	Manage Security and maintain Security Classification Guide

Prog Sec		
PM IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: System Analysis and Architecture Design		
Chief Eng Sys Eng Tech SME	3.2.1	Identify and analyze stakeholder system requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; key performance requirements; and success criteria; decomposing the system requirements into subsystem requirements, as needed. Iteratively review with appropriate stakeholders.
Chief Eng Sys Eng MBSE SME	3.2.2	Analyze desired stakeholder system Use Cases, including relationships, interfaces, exchanges, and interactions between the proposed system and its external environment
Chief Eng Sys Eng	3.2.3	Perform system-level trade study to research and generate possible system concepts and make a recommendation
Chief Eng Sys Eng Tech SME MBSE SME	3.2.4	Define system functional architecture, relating the functions to system requirements
Chief Eng Sys Eng MBSE SME	3.2.5	Allocate system functional architecture to structural elements
Chief Eng Sys Eng MBSE SME	3.2.6	Parameterize system functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.
Chief Eng Sys Eng MBSE SME	3.2.7	Develop modeling strategy and model/simulate system behavior
Task 3: Subsystem Analysis and Architecture Design		
Chief Eng Sys Eng Tech SME MBSE SME	3.3.1	Analyze stakeholder subsystem requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria; decomposing the subsystem requirements into component requirements, as needed. Iteratively review with appropriate stakeholders.
Chief Eng Sys Eng Tech SME MBSE SME	3.3.2	Perform subsystem-level trade study to research and generate possible subsystem concepts and make a recommendation
Chief Eng Sys Eng Tech SME MBSE SME	3.3.3	Define subsystem functional architecture, relating the functions to subsystem requirements
Chief Eng Sys Eng	3.3.4	Allocate subsystem functional architecture to structural elements

Tech SME MBSE SME		
Chief Eng Sys Eng Tech SME MBSE SME	3.3.5	Parameterize subsystem functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.
Chief Eng Sys Eng Tech SME MBSE SME	3.3.6	Revisit/assess modeling strategy and perform end-to-end modeling, simulation, and analysis through subsystems to ensure both CONOPs closure and likelihood of meeting key performance requirements
Task 4: Component Analysis and First Unit Architecture Design		
Chief Eng Sys Eng Tech SME	3.4.1	Analyze stakeholder component requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria. Iteratively review with appropriate stakeholders.
Chief Eng Sys Eng Tech SME	3.4.2	Perform component-level trade study to research and generate possible component concepts and make a recommendation
Chief Eng Sys Eng Tech SME	3.4.3	Define component functional architecture, relating the functions to component requirements
Chief Eng Tech SME MBSE SME	3.4.4	Allocate component functional architecture to structural elements
Chief Eng Tech SME MBSE SME	3.4.5	Parameterize component functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.

The following table shows the roles allocated to tasks for an ideal team size of 50 personnel.

Table 36. Roles Assigned to Tasks for Concept Definition for an Ideal Team of 50 (n=3)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM Sys Eng	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Sys Eng MBSE SME	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Sys Eng	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM	1.1.4	Define and drive vision and way-ahead for the team
PM	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions

PM	1.1.6	Define and manage cost/budget
PM	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Sys Eng	1.1.10	Define and manage risk and program compliance
PM	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
PM	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM	1.1.13	Define, manage, and execute required reviews
PM Sys Eng	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
PM IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: System Analysis and Architecture Design		
Sys Eng	3.2.1	Identify and analyze stakeholder system requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; key performance requirements; and success criteria; decomposing the system requirements into subsystem requirements, as needed. Iteratively review with appropriate stakeholders.
Sys Eng MBSE SME	3.2.2	Analyze desired stakeholder system Use Cases, including relationships, interfaces, exchanges, and interactions between the proposed system and its external environment
Sys Eng	3.2.3	Perform system-level trade study to research and generate possible system concepts and make a recommendation
Chief Eng Sys Eng MBSE SME	3.2.4	Define system functional architecture, relating the functions to system requirements
Sys Eng MBSE SME	3.2.5	Allocate system functional architecture to structural elements
Sys Eng MBSE SME	3.2.6	Parameterize system functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.
Sys Eng MBSE SME	3.2.7	Develop modeling strategy and model/simulate system behavior

Task 3: Subsystem Analysis and Architecture Design		
Sys Eng Tech SME MBSE SME T&E SME	3.3.1	Analyze stakeholder subsystem requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria; decomposing the subsystem requirements into component requirements, as needed. Iteratively review with appropriate stakeholders.
Sys Eng Tech SME	3.3.2	Perform subsystem-level trade study to research and generate possible subsystem concepts and make a recommendation
Chief Eng Sys Eng Tech SME MBSE SME	3.3.3	Define subsystem functional architecture, relating the functions to subsystem requirements
Sys Eng MBSE SME	3.3.4	Allocate subsystem functional architecture to structural elements
Sys Eng MBSE SME	3.3.5	Parameterize subsystem functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.
Sys Eng MBSE SME T&E SME	3.3.6	Revisit/assess modeling strategy and perform end-to-end modeling, simulation, and analysis through subsystems to ensure both CONOPs closure and likelihood of meeting key performance requirements
Task 4: Component Analysis and First Unit Architecture Design		
Sys Eng MBSE SME T&E SME	3.4.1	Analyze stakeholder component requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria. Iteratively review with appropriate stakeholders.
Sys Eng Tech SME	3.4.2	Perform component-level trade study to research and generate possible component concepts and make a recommendation
Sys Eng MBSE SME	3.4.3	Define component functional architecture, relating the functions to component requirements
Sys Eng Tech SME MBSE SME	3.4.4	Allocate component functional architecture to structural elements
Sys Eng Tech SME MBSE SME	3.4.5	Parameterize component functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.

There were no responses for the current team of 100 personnel, so there is no table included for that category for this project.

The following table shows the roles allocated to tasks for an ideal team size of 100 personnel.

Table 37. Roles Assigned to Tasks for Concept Definition for an Ideal Team of 100 (n=3)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM Sys Eng	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Sys Eng MBSE SME	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Sys Eng	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM	1.1.4	Define and drive vision and way-ahead for the team
PM	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM	1.1.6	Define and manage cost/budget
PM	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Sys Eng	1.1.10	Define and manage risk and program compliance
PM	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
PM	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM	1.1.13	Define, manage, and execute required reviews
PM Sys Eng	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
PM IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: System Analysis and Architecture Design		
Sys Eng	3.2.1	Identify and analyze stakeholder system requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; key performance requirements; and success criteria; decomposing the system requirements into subsystem requirements, as needed. Iteratively review with appropriate stakeholders.

Sys Eng MBSE SME	3.2.2	Analyze desired stakeholder system Use Cases, including relationships, interfaces, exchanges, and interactions between the proposed system and its external environment
Sys Eng	3.2.3	Perform system-level trade study to research and generate possible system concepts and make a recommendation
Chief Eng Sys Eng MBSE SME	3.2.4	Define system functional architecture, relating the functions to system requirements
Sys Eng MBSE SME	3.2.5	Allocate system functional architecture to structural elements
Sys Eng MBSE SME	3.2.6	Parameterize system functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.
Sys Eng MBSE SME	3.2.7	Develop modeling strategy and model/simulate system behavior
Task 3: Subsystem Analysis and Architecture Design		
Sys Eng Tech SME MBSE SME T&E SME	3.3.1	Analyze stakeholder subsystem requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria; decomposing the subsystem requirements into component requirements, as needed. Iteratively review with appropriate stakeholders.
Sys Eng Tech SME	3.3.2	Perform subsystem-level trade study to research and generate possible subsystem concepts and make a recommendation
Chief Eng Sys Eng Tech SME MBSE SME	3.3.3	Define subsystem functional architecture, relating the functions to subsystem requirements
Sys Eng MBSE SME	3.3.4	Allocate subsystem functional architecture to structural elements
Sys Eng MBSE SME	3.3.5	Parameterize subsystem functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.
Sys Eng MBSE SME T&E SME	3.3.6	Revisit/assess modeling strategy and perform end-to-end modeling, simulation, and analysis through subsystems to ensure both CONOPs closure and likelihood of meeting key performance requirements
Task 4: Component Analysis and First Unit Architecture Design		
Sys Eng MBSE SME T&E SME	3.4.1	Analyze stakeholder component requirements, including constraints and interactions; requirements that relate to risk, critical quality characteristics, and compliance; and success criteria. Iteratively review with appropriate stakeholders.
Sys Eng Tech SME	3.4.2	Perform component-level trade study to research and generate possible component concepts and make a recommendation
Sys Eng Tech SME	3.4.3	Define component functional architecture, relating the functions to component requirements

MBSE SME		
Sys Eng Tech SME MBSE SME	3.4.4	Allocate component functional architecture to structural elements
Sys Eng MBSE SME	3.4.5	Parameterize component functional architecture to include relevant information, such as physical characteristics/constraints, environment, etc.

B.4 Test & Evaluation

The following table shows the roles allocated to tasks for a current team size of 10 personnel.

Table 38. Roles Assigned to Tasks for Test & Evaluation for a Current Team of 10 (n=1)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM Chief Eng T&E SME	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng Sys Eng	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Chief Eng	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM Chief Eng	1.1.4	Define and drive vision and way-ahead for the team
PM Chief Eng Sys Eng	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM	1.1.6	Define and manage cost/budget
PM	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM Chief Eng	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM Chief Eng T&E SME	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Prog Sec	1.1.10	Define and manage risk and program compliance
PM Prog Sec IT Phys Sec	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure

PM Chief Eng Sys Eng Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM Chief Eng Sys Eng Config Cntrl	1.1.13	Define, manage, and execute required reviews
PM Chief Eng Config Cntrl	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Chief Eng Sys Eng Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
PM Chief Eng Prog Sec IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Pre-KDP A Concept Studies (Phase 0) Efforts		
Chief Eng Sys Eng Tech SME T&E SME	4.2.1	Assess the testability of all concept alternatives (including T&E risks), validation strategy for ground support and special test equipment, test infrastructure, and test requirements
Chief Eng Sys Eng Tech SME T&E SME	4.2.2	Define and evaluate Technical Performance Measures and mission requirements validation strategy
Chief Eng Sys Eng Tech SME T&E SME	4.2.3	Identify and establish test organizational relationships (e.g., support agreements, Contractor Test teams, Developmental Test teams, required outside agencies)
Chief Eng Sys Eng Tech SME T&E SME	4.2.4	Define certification requirements
Chief Eng Sys Eng Tech SME T&E SME	4.2.5	Develop a Test & Evaluation Master Plan (TEMP); include specific organizational responsibilities for preparing for or executing test activities
Task 3: Concept Development (Phase A) Efforts		
Chief Eng Sys Eng Tech SME	4.3.1	Assess mission and system CONOPs and requirements for completeness and to support testability

MBSE SME T&E SME		
Chief Eng Sys Eng Tech SME T&E SME	4.3.2	Update TEMP
Chief Eng Sys Eng Tech SME T&E SME	4.3.3	Assess system internal and external interface definition, completeness, and testability (including any test support features)
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.3.4	Examine the need for simulations, models, prototypes, and test beds, and evaluate long-lead planning and procurement
Chief Eng Sys Eng Tech SME T&E SME	4.3.5	Assess testability of the integrated space and ground elements
Chief Eng Sys Eng Tech SME T&E SME	4.3.6	Determine risk to the flight units/system concept due to the stress of ground testing
Chief Eng Sys Eng Tech SME T&E SME	4.3.7	Assess the need for any test resources, ground support equipment, test operations procedures, test execution procedures and software, test parameter databases, and/or special test equipment, either existing or new
Chief Eng Sys Eng Tech SME T&E SME	4.3.8	Develop the assembly and integration strategy
Chief Eng Sys Eng Tech SME T&E SME	4.3.9	Connect with any necessary specialty engineering (e.g., electromagnetic capability, cybersecurity)
Chief Eng Sys Eng Tech SME T&E SME	4.3.10	Develop IT&E schedule that supports key decision points, including any margin for rework
Chief Eng Sys Eng Tech SME T&E SME	4.3.11	Develop certification test strategy
Chief Eng Sys Eng Tech SME	4.3.12	Develop requirements verification architecture model (RVAM) and determine specific conditions and methods for testing and verification of each requirement

T&E SME		
Chief Eng Sys Eng Tech SME T&E SME	4.3.13	Collect necessary system operating environments to establish test needs (e.g., SMC-S-016 acoustic, shock, vibration levels)
Task 4: Preliminary Design (Phase B) Efforts		
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.1	Decompose and assess T&E certification requirements
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.2	Develop any COTS/heritage test requirements
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.3	Determine technology development strategy
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.4	Develop segment-to-segment verification/validation strategy (e.g., space-to-ground, space-to-launch)
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.5	Flow-down test requirements to lower-level assemblies
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.6	Develop space vehicle test program, including test conditions, test risks, test procedures, crypto handling, clean room/electro-static/radiation sensitivities for personnel and hardware, and validation for space-to-ground interface, software, and cyber
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.7	Develop plan for payload integration to bus
Chief Eng Sys Eng Tech SME MBSE SME	4.4.8	Assess supply chain test strategies and risks

T&E SME		
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.9	Conduct space vehicle component testing and evaluate data
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.10	Conduct space vehicle subsystem testing and evaluate data
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.11	Conduct initial activation, fielding, and operations planning
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.12	Participate in Preliminary Design Review (PDR)
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.13	Define and manage external program hardware, software, units, personnel, and test-unique equipment
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.14	Update TEMP
Task 5: Complete Design (Phase C) Efforts		
Chief Eng Sys Eng Tech SME T&E SME	4.5.1	Develop final system integration and test plan(s)
Chief Eng Sys Eng Tech SME T&E SME	4.5.2	Develop final verification plan and schedule
Chief Eng Sys Eng Tech SME T&E SME	4.5.3	Reevaluate test risks to flight hardware over the course of the entire planned test sequence
Chief Eng	4.5.4	Evaluate any informal test data

Sys Eng Tech SME T&E SME		
Chief Eng Sys Eng Tech SME T&E SME	4.5.5	Obtain Interim Authority to Test (IATT) and/or Authority to Operate (ATO)
Chief Eng Sys Eng Tech SME T&E SME	4.5.6	Update activation, fielding, and operations planning
Chief Eng Sys Eng Tech SME T&E SME	4.5.7	Participate in Critical Design Review (CDR)
Chief Eng Sys Eng Tech SME T&E SME	4.5.8	Conduct risk reduction testing (early integration tests, simulator tests, etc.)
Chief Eng Sys Eng Tech SME T&E SME	4.5.9	Develop and test any test unique equipment
Task 6: Fabrication and Integration (Phase D1) Efforts		
Chief Eng Sys Eng Tech SME T&E SME	4.6.1	Develop launch vehicle/space vehicle integrated test plan
Chief Eng Sys Eng Tech SME T&E SME	4.6.2	Develop assembly, test, and checkout procedures
Chief Eng Sys Eng Tech SME T&E SME	4.6.3	Evaluate and document test risk items
Chief Eng Sys Eng Tech SME T&E SME	4.6.4	Conduct pre-ship test and evaluate data
Chief Eng Sys Eng Tech SME T&E SME	4.6.5	Conduct space vehicle integrated system test and evaluate data
Chief Eng	4.6.6	Conduct validation and acceptance testing and evaluate results

Sys Eng Tech SME T&E SME		
Chief Eng Sys Eng Tech SME T&E SME	4.6.7	Conduct Test Readiness Review (TRR)
Chief Eng Sys Eng Tech SME T&E SME	4.6.8	Participate in Manufacturing Readiness Review (MRR)/Production Readiness Review (PRR)
Chief Eng Sys Eng Tech SME T&E SME	4.6.9	Develop and validate operational procedures; conduct operator training and mission rehearsals
Task 7: Fielding and Checkout (Phase D2) Efforts		
Chief Eng Sys Eng Tech SME T&E SME	4.7.1	Evaluate launch base checkout and readiness
Chief Eng Sys Eng Tech SME T&E SME	4.7.2	Evaluate satellite deployment and initialization and establish baseline
Chief Eng Sys Eng Tech SME T&E SME	4.7.3	Plan and conduct operational testing and evaluate data
Chief Eng Sys Eng Tech SME T&E SME	4.7.4	Evaluate and resolve any anomalies
Chief Eng Sys Eng Tech SME T&E SME	4.7.5	Participate in Mission Readiness Review (MRR)/Flight Readiness Review (FRR)
Chief Eng Sys Eng Tech SME T&E SME	4.7.6	Plan and conduct Operational Readiness Review (ORR) prior to turning system over to operations
Task 8: Operations and Disposal (Phase D3) Efforts		
Chief Eng Sys Eng Tech SME	4.8.1	Evaluate periodic mission performance testing, monitor trends, and assess and update reliability statistics

T&E SME		
Chief Eng Sys Eng Tech SME T&E SME	4.8.2	Evaluate periodic space vehicle subsystem calibration results
Chief Eng Sys Eng Tech SME T&E SME	4.8.3	Evaluate system baseline changes impacting performance
Chief Eng Sys Eng Tech SME T&E SME	4.8.4	Maintain ground test infrastructure
Chief Eng Sys Eng Tech SME T&E SME	4.8.5	Develop software upgrade test strategies for ground support equipment and on-orbit software and test following upgrades

The following table shows the roles allocated to tasks for an ideal team size of 10 personnel.

Table 39. Roles Assigned to Tasks for Test & Evaluation for an Ideal Team of 10 (n=2)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM Sys Eng MBSE SME	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Chief Eng Sys Eng MBSE SME	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Sys Eng MBSE SME	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM	1.1.4	Define and drive vision and way-ahead for the team
PM	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM	1.1.6	Define and manage cost/budget
PM	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training

PM	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Sys Eng MBSE SME	1.1.10	Define and manage risk and program compliance
PM Sys Eng MBSE SME Prog Sec IT	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
PM Chief Eng Sys Eng MBSE SME Config Cntrl	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM Chief Eng Sys Eng MBSE SME	1.1.13	Define, manage, and execute required reviews
PM Chief Eng Sys Eng MBSE SME	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Chief Eng Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
PM Chief Eng Prog Sec IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Pre-KDP A Concept Studies (Phase 0) Efforts		
Chief Eng Sys Eng Tech SME T&E SME	4.2.1	Assess the testability of all concept alternatives (including T&E risks), validation strategy for ground support and special test equipment, test infrastructure, and test requirements
Chief Eng Sys Eng Tech SME T&E SME	4.2.2	Define and evaluate Technical Performance Measures and mission requirements validation strategy
Chief Eng Sys Eng Tech SME T&E SME	4.2.3	Identify and establish test organizational relationships (e.g., support agreements, Contractor Test teams, Developmental Test teams, required outside agencies)
Chief Eng	4.2.4	Define certification requirements

Sys Eng Tech SME T&E SME		
Chief Eng Sys Eng Tech SME T&E SME	4.2.5	Develop a Test & Evaluation Master Plan (TEMP); include specific organizational responsibilities for preparing for or executing test activities
Task 3: Concept Development (Phase A) Efforts		
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.3.1	Assess mission and system CONOPs and requirements for completeness and to support testability
Chief Eng Sys Eng Tech SME T&E SME	4.3.2	Update TEMP
Chief Eng Sys Eng Tech SME T&E SME	4.3.3	Assess system internal and external interface definition, completeness, and testability (including any test support features)
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.3.4	Examine the need for simulations, models, prototypes, and test beds, and evaluate long-lead planning and procurement
Chief Eng Sys Eng Tech SME T&E SME	4.3.5	Assess testability of the integrated space and ground elements
Chief Eng Sys Eng Tech SME T&E SME	4.3.6	Determine risk to the flight units/system concept due to the stress of ground testing
Chief Eng Sys Eng Tech SME T&E SME	4.3.7	Assess the need for any test resources, ground support equipment, test operations procedures, test execution procedures and software, test parameter databases, and/or special test equipment, either existing or new
Chief Eng Sys Eng Tech SME T&E SME	4.3.8	Develop the assembly and integration strategy
Chief Eng Sys Eng Tech SME	4.3.9	Connect with any necessary specialty engineering (e.g., electromagnetic capability, cybersecurity)

T&E SME		
Chief Eng Sys Eng Tech SME T&E SME	4.3.10	Develop IT&E schedule that supports key decision points, including any margin for rework
Chief Eng Sys Eng Tech SME T&E SME	4.3.11	Develop certification test strategy
Chief Eng Sys Eng Tech SME T&E SME	4.3.12	Develop requirements verification architecture model (RVAM) and determine specific conditions and methods for testing and verification of each requirement
Chief Eng Sys Eng Tech SME T&E SME	4.3.13	Collect necessary system operating environments to establish test needs (e.g., SMC-S-016 acoustic, shock, vibration levels)
Task 4: Preliminary Design (Phase B) Efforts		
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.1	Decompose and assess T&E certification requirements
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.2	Develop any COTS/heritage test requirements
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.3	Determine technology development strategy
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.4	Develop segment-to-segment verification/validation strategy (e.g., space-to-ground, space-to-launch)
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.5	Flow-down test requirements to lower-level assemblies
Chief Eng Sys Eng	4.4.6	Develop space vehicle test program, including test conditions, test risks, test procedures, crypto handling, clean room/electro-

Tech SME MBSE SME T&E SME		static/radiation sensitivities for personnel and hardware, and validation for space-to-ground interface, software, and cyber
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.7	Develop plan for payload integration to bus
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.8	Assess supply chain test strategies and risks
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.9	Conduct space vehicle component testing and evaluate data
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.10	Conduct space vehicle subsystem testing and evaluate data
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.11	Conduct initial activation, fielding, and operations planning
PM Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.12	Participate in Preliminary Design Review (PDR)
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.13	Define and manage external program hardware, software, units, personnel, and test-unique equipment
Chief Eng Sys Eng Tech SME MBSE SME T&E SME	4.4.14	Update TEMP
Task 5: Complete Design (Phase C) Efforts		

Chief Eng Sys Eng Tech SME T&E SME	4.5.1	Develop final system integration and test plan(s)
Chief Eng Sys Eng Tech SME T&E SME	4.5.2	Develop final verification plan and schedule
Chief Eng Sys Eng Tech SME T&E SME	4.5.3	Reevaluate test risks to flight hardware over the course of the entire planned test sequence
Chief Eng Sys Eng Tech SME T&E SME	4.5.4	Evaluate any informal test data
Chief Eng Sys Eng Tech SME T&E SME	4.5.5	Obtain Interim Authority to Test (IATT) and/or Authority to Operate (ATO)
Chief Eng Sys Eng Tech SME T&E SME	4.5.6	Update activation, fielding, and operations planning
Chief Eng Sys Eng Tech SME T&E SME	4.5.7	Participate in Critical Design Review (CDR)
Chief Eng Sys Eng Tech SME T&E SME	4.5.8	Conduct risk reduction testing (early integration tests, simulator tests, etc.)
Chief Eng Sys Eng Tech SME T&E SME	4.5.9	Develop and test any test unique equipment
Task 6: Fabrication and Integration (Phase D1) Efforts		
Chief Eng Sys Eng Tech SME T&E SME	4.6.1	Develop launch vehicle/space vehicle integrated test plan
Chief Eng Sys Eng Tech SME T&E SME	4.6.2	Develop assembly, test, and checkout procedures

Chief Eng Sys Eng Tech SME T&E SME	4.6.3	Evaluate and document test risk items
Chief Eng Sys Eng Tech SME T&E SME	4.6.4	Conduct pre-ship test and evaluate data
Chief Eng Sys Eng Tech SME T&E SME	4.6.5	Conduct space vehicle integrated system test and evaluate data
Chief Eng Sys Eng Tech SME T&E SME	4.6.6	Conduct validation and acceptance testing and evaluate results
Chief Eng Sys Eng Tech SME T&E SME	4.6.7	Conduct Test Readiness Review (TRR)
Chief Eng Sys Eng Tech SME T&E SME	4.6.8	Participate in Manufacturing Readiness Review (MRR)/Production Readiness Review (PRR)
Chief Eng Sys Eng Tech SME T&E SME	4.6.9	Develop and validate operational procedures; conduct operator training and mission rehearsals
Task 7: Fielding and Checkout (Phase D2) Efforts		
Chief Eng Sys Eng Tech SME T&E SME	4.7.1	Evaluate launch base checkout and readiness
Chief Eng Sys Eng Tech SME T&E SME	4.7.2	Evaluate satellite deployment and initialization and establish baseline
Chief Eng Sys Eng Tech SME T&E SME	4.7.3	Plan and conduct operational testing and evaluate data
Chief Eng Sys Eng Tech SME T&E SME	4.7.4	Evaluate and resolve any anomalies

Chief Eng Sys Eng Tech SME T&E SME	4.7.5	Participate in Mission Readiness Review (MRR)/Flight Readiness Review (FRR)
Chief Eng Sys Eng Tech SME T&E SME	4.7.6	Plan and conduct Operational Readiness Review (ORR) prior to turning system over to operations
Task 8: Operations and Disposal (Phase D3) Efforts		
Chief Eng Sys Eng Tech SME T&E SME	4.8.1	Evaluate periodic mission performance testing, monitor trends, and assess and update reliability statistics
Chief Eng Sys Eng Tech SME T&E SME	4.8.2	Evaluate periodic space vehicle subsystem calibration results
Chief Eng Sys Eng Tech SME T&E SME	4.8.3	Evaluate system baseline changes impacting performance
Chief Eng Sys Eng Tech SME T&E SME	4.8.4	Maintain ground test infrastructure
Chief Eng Sys Eng Tech SME T&E SME	4.8.5	Develop software upgrade test strategies for ground support equipment and on-orbit software and test following upgrades

The following table shows the roles allocated to tasks for an ideal team size of 50 personnel.

Table 40. Roles Assigned to Tasks for Test & Evaluation for an Ideal Team Size of 50 (n=1)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM Sys Eng MBSE SME	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Sys Eng MBSE SME	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Sys Eng	1.1.3	Define and manage program/acquisition strategy and implement business rules

MBSE SME		
PM	1.1.4	Define and drive vision and way-ahead for the team
PM	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/technical/cost/schedule decisions
PM	1.1.6	Define and manage cost/budget
PM	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM Sys Eng MBSE SME	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Sys Eng MBSE SME	1.1.10	Define and manage risk and program compliance
PM Sys Eng MBSE SME	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
PM Sys Eng MBSE SME	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM Sys Eng MBSE SME	1.1.13	Define, manage, and execute required reviews
PM Sys Eng MBSE SME	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide
PM IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Pre-KDP A Concept Studies (Phase 0) Efforts		
SE T&E SME	4.2.1	Assess the testability of all concept alternatives (including T&E risks), validation strategy for ground support and special test equipment, test infrastructure, and test requirements
SE T&E SME	4.2.2	Define and evaluate Technical Performance Measures and mission requirements validation strategy
SE T&E SME	4.2.3	Identify and establish test organizational relationships (e.g., support agreements, Contractor Test teams, Developmental Test teams, required outside agencies)
SE T&E SME	4.2.4	Define certification requirements

SE T&E SME	4.2.5	Develop a Test & Evaluation Master Plan (TEMP); include specific organizational responsibilities for preparing for or executing test activities
Task 3: Concept Development (Phase A) Efforts		
SE T&E SME	4.3.1	Assess mission and system CONOPs and requirements for completeness and to support testability
SE T&E SME	4.3.2	Update TEMP
SE T&E SME	4.3.3	Assess system internal and external interface definition, completeness, and testability (including any test support features)
SE T&E SME	4.3.4	Examine the need for simulations, models, prototypes, and test beds, and evaluate long-lead planning and procurement
SE T&E SME	4.3.5	Assess testability of the integrated space and ground elements
SE T&E SME	4.3.6	Determine risk to the flight units/system concept due to the stress of ground testing
SE T&E SME	4.3.7	Assess the need for any test resources, ground support equipment, test operations procedures, test execution procedures and software, test parameter databases, and/or special test equipment, either existing or new
SE T&E SME	4.3.8	Develop the assembly and integration strategy
SE T&E SME	4.3.9	Connect with any necessary specialty engineering (e.g., electromagnetic capability, cybersecurity)
SE T&E SME	4.3.10	Develop IT&E schedule that supports key decision points, including any margin for rework
SE T&E SME	4.3.11	Develop certification test strategy
SE T&E SME	4.3.12	Develop requirements verification architecture model (RVAM) and determine specific conditions and methods for testing and verification of each requirement
SE T&E SME	4.3.13	Collect necessary system operating environments to establish test needs (e.g., SMC-S-016 acoustic, shock, vibration levels)
Task 4: Preliminary Design (Phase B) Efforts		
SE T&E SME	4.4.1	Decompose and assess T&E certification requirements
SE T&E SME	4.4.2	Develop any COTS/heritage test requirements
SE T&E SME	4.4.3	Determine technology development strategy
SE T&E SME	4.4.4	Develop segment-to-segment verification/validation strategy (e.g., space-to-ground, space-to-launch)
SE T&E SME	4.4.5	Flow-down test requirements to lower-level assemblies

SE T&E SME	4.4.6	Develop space vehicle test program, including test conditions, test risks, test procedures, crypto handling, clean room/electro-static/radiation sensitivities for personnel and hardware, and validation for space-to-ground interface, software, and cyber
SE T&E SME	4.4.7	Develop plan for payload integration to bus
T&E SME	4.4.8	Assess supply chain test strategies and risks
T&E SME	4.4.9	Conduct space vehicle component testing and evaluate data
T&E SME	4.4.10	Conduct space vehicle subsystem testing and evaluate data
T&E SME	4.4.11	Conduct initial activation, fielding, and operations planning
PM Chief Eng Sys Eng T&E SME	4.4.12	Participate in Preliminary Design Review (PDR)
SE T&E SME	4.4.13	Define and manage external program hardware, software, units, personnel, and test-unique equipment
SE T&E SME	4.4.14	Update TEMP
Task 5: Complete Design (Phase C) Efforts		
SE T&E SME	4.5.1	Develop final system integration and test plan(s)
SE T&E SME	4.5.2	Develop final verification plan and schedule
SE T&E SME	4.5.3	Reevaluate test risks to flight hardware over the course of the entire planned test sequence
T&E SME	4.5.4	Evaluate any informal test data
SE T&E SME	4.5.5	Obtain Interim Authority to Test (IATT) and/or Authority to Operate (ATO)
SE T&E SME	4.5.6	Update activation, fielding, and operations planning
PM Chief Eng Sys Eng T&E SME	4.5.7	Participate in Critical Design Review (CDR)
T&E SME	4.5.8	Conduct risk reduction testing (early integration tests, simulator tests, etc.)
T&E SME	4.5.9	Develop and test any test unique equipment
Task 6: Fabrication and Integration (Phase D1) Efforts		
SE T&E SME	4.6.1	Develop launch vehicle/space vehicle integrated test plan
SE T&E SME	4.6.2	Develop assembly, test, and checkout procedures
T&E SME	4.6.3	Evaluate and document test risk items

T&E SME	4.6.4	Conduct pre-ship test and evaluate data
T&E SME	4.6.5	Conduct space vehicle integrated system test and evaluate data
T&E SME	4.6.6	Conduct validation and acceptance testing and evaluate results
SE T&E SME	4.6.7	Conduct Test Readiness Review (TRR)
Chief Eng Sys Eng T&E SME	4.6.8	Participate in Manufacturing Readiness Review (MRR)/Production Readiness Review (PRR)
T&E SME	4.6.9	Develop and validate operational procedures; conduct operator training and mission rehearsals
Task 7: Fielding and Checkout (Phase D2) Efforts		
Chief Eng Sys Eng T&E SME	4.7.1	Evaluate launch base checkout and readiness
Chief Eng Sys Eng T&E SME	4.7.2	Evaluate satellite deployment and initialization and establish baseline
Chief Eng Sys Eng T&E SME	4.7.3	Plan and conduct operational testing and evaluate data
Chief Eng Sys Eng T&E SME	4.7.4	Evaluate and resolve any anomalies
Chief Eng Sys Eng T&E SME	4.7.5	Participate in Mission Readiness Review (MRR)/Flight Readiness Review (FRR)
Chief Eng Sys Eng T&E SME	4.7.6	Plan and conduct Operational Readiness Review (ORR) prior to turning system over to operations
Task 8: Operations and Disposal (Phase D3) Efforts		
Sys Eng T&E SME	4.8.1	Evaluate periodic mission performance testing, monitor trends, and assess and update reliability statistics
Sys Eng T&E SME	4.8.2	Evaluate periodic space vehicle subsystem calibration results
Sys Eng T&E SME	4.8.3	Evaluate system baseline changes impacting performance
Sys Eng T&E SME	4.8.4	Maintain ground test infrastructure
Sys Eng T&E SME	4.8.5	Develop software upgrade test strategies for ground support equipment and on-orbit software and test following upgrades

There were no responses for the current team of 100 personnel, so there is no table included for that category for this project.

The following table shows the roles allocated to tasks for an ideal team size of 100 personnel.

Table 41. Roles Assigned to Tasks for Test & Evaluation for an Ideal Team Size of 100 (n=1)

Assigned Roles	**Task #**	**Task**
Task 1: Program Management/Admin		
PM Sys Eng MBSE SME	1.1.1	Identify stakeholders and manage engagement, expectations, and needs
PM Sys Eng MBSE SME	1.1.2	Define program/system scope, including system boundaries and work breakdown structure
PM Sys Eng MBSE SME	1.1.3	Define and manage program/acquisition strategy and implement business rules
PM	1.1.4	Define and drive vision and way-ahead for the team
PM	1.1.5	Manage project progress and outcome, including understanding the programmatic/technical/cost/schedule implications of programmatic/ technical/cost/schedule decisions
PM	1.1.6	Define and manage cost/budget
PM	1.1.7	Define and manage schedule, ensuring focus on major milestones
PM	1.1.8	Define and manage personnel, roles, teams, and organizational structure to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
PM Sys Eng MBSE SME	1.1.9	Define and manage required tools and equipment, including IT infrastructure, prototypes, simulators, testbeds, engineering models, etc.
PM Sys Eng MBSE SME	1.1.10	Define and manage risk and program compliance
PM Sys Eng MBSE SME	1.1.11	Manage access to facilities/spaces and tools/equipment, including IT infrastructure
PM Sys Eng MBSE SME	1.1.12	Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
PM Sys Eng MBSE SME	1.1.13	Define, manage, and execute required reviews
PM Sys Eng MBSE SME	1.1.14	Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
PM Prog Sec	1.1.15	Manage Security and maintain Security Classification Guide

PM IT	1.1.16	Manage IT/cyber support and ensure coordination with Security
Task 2: Pre-KDP A Concept Studies (Phase 0) Efforts		
Sys Eng T&E SME	4.2.1	Assess the testability of all concept alternatives (including T&E risks), validation strategy for ground support and special test equipment, test infrastructure, and test requirements
Sys Eng T&E SME	4.2.2	Define and evaluate Technical Performance Measures and mission requirements validation strategy
Sys Eng T&E SME	4.2.3	Identify and establish test organizational relationships (e.g., support agreements, Contractor Test teams, Developmental Test teams, required outside agencies)
Sys Eng T&E SME	4.2.4	Define certification requirements
Sys Eng T&E SME	4.2.5	Develop a Test & Evaluation Master Plan (TEMP); include specific organizational responsibilities for preparing for or executing test activities
Task 3: Concept Development (Phase A) Efforts		
Sys Eng T&E SME	4.3.1	Assess mission and system CONOPs and requirements for completeness and to support testability
Sys Eng T&E SME	4.3.2	Update TEMP
Sys Eng T&E SME	4.3.3	Assess system internal and external interface definition, completeness, and testability (including any test support features)
Sys Eng T&E SME	4.3.4	Examine the need for simulations, models, prototypes, and test beds, and evaluate long-lead planning and procurement
Sys Eng T&E SME	4.3.5	Assess testability of the integrated space and ground elements
Sys Eng T&E SME	4.3.6	Determine risk to the flight units/system concept due to the stress of ground testing
Sys Eng T&E SME	4.3.7	Assess the need for any test resources, ground support equipment, test operations procedures, test execution procedures and software, test parameter databases, and/or special test equipment, either existing or new
Sys Eng T&E SME	4.3.8	Develop the assembly and integration strategy
Sys Eng T&E SME	4.3.9	Connect with any necessary specialty engineering (e.g., electromagnetic capability, cybersecurity)
Sys Eng T&E SME	4.3.10	Develop IT&E schedule that supports key decision points, including any margin for rework
Sys Eng T&E SME	4.3.11	Develop certification test strategy
Sys Eng T&E SME	4.3.12	Develop requirements verification architecture model (RVAM) and determine specific conditions and methods for testing and verification of each requirement

Sys Eng T&E SME	4.3.13	Collect necessary system operating environments to establish test needs (e.g., SMC-S-016 acoustic, shock, vibration levels)
Task 4: Preliminary Design (Phase B) Efforts		
Sys Eng T&E SME	4.4.1	Decompose and assess T&E certification requirements
Sys Eng T&E SME	4.4.2	Develop any COTS/heritage test requirements
Sys Eng T&E SME	4.4.3	Determine technology development strategy
Sys Eng T&E SME	4.4.4	Develop segment-to-segment verification/validation strategy (e.g., space-to-ground, space-to-launch)
Sys Eng T&E SME	4.4.5	Flow-down test requirements to lower-level assemblies
Sys Eng T&E SME	4.4.6	Develop space vehicle test program, including test conditions, test risks, test procedures, crypto handling, clean room/electro-static/radiation sensitivities for personnel and hardware, and validation for space-to-ground interface, software, and cyber
Sys Eng T&E SME	4.4.7	Develop plan for payload integration to bus
T&E SME	4.4.8	Assess supply chain test strategies and risks
T&E SME	4.4.9	Conduct space vehicle component testing and evaluate data
T&E SME	4.4.10	Conduct space vehicle subsystem testing and evaluate data
T&E SME	4.4.11	Conduct initial activation, fielding, and operations planning
PM Chief Eng Sys Eng T&E SME	4.4.12	Participate in Preliminary Design Review (PDR)
Sys Eng T&E SME	4.4.13	Define and manage external program hardware, software, units, personnel, and test-unique equipment
Sys Eng T&E SME	4.4.14	Update TEMP
Task 5: Complete Design (Phase C) Efforts		
Sys Eng T&E SME	4.5.1	Develop final system integration and test plan(s)
Sys Eng T&E SME	4.5.2	Develop final verification plan and schedule
Sys Eng T&E SME	4.5.3	Reevaluate test risks to flight hardware over the course of the entire planned test sequence
T&E SME	4.5.4	Evaluate any informal test data
Sys Eng T&E SME	4.5.5	Obtain Interim Authority to Test (IATT) and/or Authority to Operate (ATO)
Sys Eng T&E SME	4.5.6	Update activation, fielding, and operations planning

PM Chief Eng Sys Eng T&E SME	4.5.7	Participate in Critical Design Review (CDR)
T&E SME	4.5.8	Conduct risk reduction testing (early integration tests, simulator tests, etc.)
T&E SME	4.5.9	Develop and test any test unique equipment
Task 6: Fabrication and Integration (Phase D1) Efforts		
Sys Eng T&E SME	4.6.1	Develop launch vehicle/space vehicle integrated test plan
Sys Eng T&E SME	4.6.2	Develop assembly, test, and checkout procedures
T&E SME	4.6.3	Evaluate and document test risk items
T&E SME	4.6.4	Conduct pre-ship test and evaluate data
T&E SME	4.6.5	Conduct space vehicle integrated system test and evaluate data
T&E SME	4.6.6	Conduct validation and acceptance testing and evaluate results
Sys Eng T&E SME	4.6.7	Conduct Test Readiness Review (TRR)
Chief Eng Sys Eng T&E SME	4.6.8	Participate in Manufacturing Readiness Review (MRR)/Production Readiness Review (PRR)
T&E SME	4.6.9	Develop and validate operational procedures; conduct operator training and mission rehearsals
Task 7: Fielding and Checkout (Phase D2) Efforts		
Chief Eng Sys Eng T&E SME	4.7.1	Evaluate launch base checkout and readiness
Chief Eng Sys Eng T&E SME	4.7.2	Evaluate satellite deployment and initialization and establish baseline
Chief Eng Sys Eng T&E SME	4.7.3	Plan and conduct operational testing and evaluate data
Chief Eng Sys Eng T&E SME	4.7.4	Evaluate and resolve any anomalies
Chief Eng Sys Eng T&E SME	4.7.5	Participate in Mission Readiness Review (MRR)/Flight Readiness Review (FRR)
Chief Eng Sys Eng T&E SME	4.7.6	Plan and conduct Operational Readiness Review (ORR) prior to turning system over to operations
Task 8: Operations and Disposal (Phase D3) Efforts		

Sys Eng T&E SME	4.8.1	Evaluate periodic mission performance testing, monitor trends, and assess and update reliability statistics
Sys Eng T&E SME	4.8.2	Evaluate periodic space vehicle subsystem calibration results
Sys Eng T&E SME	4.8.3	Evaluate system baseline changes impacting performance
Sys Eng T&E SME	4.8.4	Maintain ground test infrastructure
Sys Eng T&E SME	4.8.5	Develop software upgrade test strategies for ground support equipment and on-orbit software and test following upgrades

APPENDIX C: TASK MAPPING TO DECF KSABS

The following tables show the mapping of KSABs in DECF v1.1 to tasks in the System Requirements Definition and Traceability project. Each KSAB listed is followed by numbers in brackets that correspond to tasks in System Requirements Definition and Traceability. For brevity, only the KSABs that were mapped to a task are listed in the following tables.

Table 42. System Requirements Definition and Traceability Task Numbers Mapping to KSABs

Number in KSAB Mapping Tables	Task in System Requirements Definition and Traceability
1	1.1.1: Identify stakeholders and manage engagement, expectations, and needs
2	1.1.2: Define program/system scope, including system boundaries and work breakdown structure
3	1.1.3: Define and manage program/acquisition strategy and implement business rules
4	1.1.4: Define and drive vision and way-ahead for the team
5	1.1.5: Manage project progress and outcome, including understanding the programmatic/technical/cost/ schedule implications of programmatic/technical/cost/schedule decisions
6	1.1.6: Define and manage cost/budget
7	1.1.7: Define and manage schedule, ensuring focus on major milestones
8	1.1.8: Define and manage personnel, roles, teams, and organizational structure, to include internal teaming agreements/needs, meeting cadence, reporting/deliverables requirements, and training
9	1.1.9: Define and manage required tools and equipment, including prototypes, simulators, testbeds, engineering models, etc.
10	1.1.10: Define and manage risk and program compliance
11	1.1.11: Manage access to facilities/spaces and required tools/equipment, including IT infrastructure
12	1.1.12: Define process for and manage Change Management, Configuration Control (requirements, project documentation, etc.), and Quality Control
13	1.1.13: Define, manage, and execute required reviews
14	1.1.14: Manage project documentation/technical document library and compile and deliver relevant contract deliverables and documents
15	1.1.15: Manage Security and maintain Security Classification Guide

16	1.1.16: Manage IT/cyber support and ensure coordination with Security
17	1.2.1: Define functional boundary in terms of the behavior and properties the system will provide, including system performance attributes, throughput, and responsiveness needs
18	1.2.2: Identify/obtain stakeholder key functional/performance requirements and iteratively review
19	1.2.3: Define functions and associated performance, system CONOPs, and Use Cases
20	1.2.4: Define constraints on the program/system, operating environment, interactions with external systems, externally-driven requirements, and required new interfaces; create required documentation
21	1.2.5: Identify and capture system requirements and attributes and create requirements baseline
22	1.2.6: Identify requirements that relate to risk, criticality, critical quality characteristics, and compliance with standards and regulations
23	1.2.7: Begin to define verification success criteria for each requirement, verification strategy, verification method, verification plan, and responsible organization, and continue to iterate
24	1.3.1: Analyze requirements to ensure they are correct, complete, consistent, traceable, understandable, appropriate to level, verifiable/measurable, and feasible, adjudicating and refining as necessary
25	1.3.2: Define critical performance measures
26	1.3.3: Review analyzed requirements with stakeholders and resolve any issues
27	1.3.4: Analyze requirements for criticality (e.g., impact of non-satisfaction) and sensitivity (e.g., impact of partial satisfaction)
28	1.3.5: Prioritize requirements, if needed
29	1.3.6: Develop performance models and analyses to model and/or test to validate and/or verify requirements
30	1.3.7: Determine system compliance criteria and margin to requirements
31	1.4.1: Establish and sustain requirements traceability
32	1.4.2: Establish, document, and manage system requirements change process, including a means to identify impacts of a proposed requirements change
33	1.4.3: Establish and manage baselines for information items, work products, or other artifacts
34	1.4.4: Manage progress of requirements development, change, and satisfaction

Table 43. Tasks Mapped to the "Data Governance" Competency

Proficiency Level	KSABs
Awareness	• Aware of the data required to inform program and technical decisions [1- 7, 10, 12-14, 17-34] • Explain the importance of a data model [1, 2, 4, 5, 10, 12-14, 17-34]
Basic	• Assist in providing accessibility, retrievability, security, and protection of data in an ethical manner [1, 11, 14-16, 33] • Critically review, analyze, synthesize, compare, and interpret information [1-7, 10, 12-14, 17-34] • Draw conclusions from relevant and/or missing information [1-7, 10, 12-14, 17-34] • Identify data connections between issues [1-7, 10, 12-14, 17-34] • Understand project-specific needs in the digital environment such as database or data warehouse specifications [9, 16] • Understand and apply principles of usability and accessibility to published information [1, 14] • Understand the definition of data model [1-5, 10, 12-14, 17-34] • Understand the definitions of data governance, data storage, data integration, and monitoring [14, 16]
Intermediate	• Contribute to the development of organizational strategies that address information control requirements [33] • Update methods, processes, and tools to enable data and model exchanges while protecting property rights for both vendors and the government [1, 2, 10, 12-32, 34] • Assess the implications of low-quality data [2, 10, 12-14, 17-32, 34]
Advanced	• Ensure that operational problems are identified, monitored, and resolved, using relevant data and data analyses [20, 22-24, 26, 27, 29, 30, 32, 34] • Assess and manage risks around the use of information [10] • Assess issues which might prevent the organization from making maximum use of its information assets [16] • Devise and implement master data management processes, including classification, security, quality, ethical principles, retrieval, and retention processes [1, 14, 15, 16, 33] • Ensure effective controls are in place for internal delegation, audit, and control relating to information and records management [12, 14, 33] • Identify the implications of copyright, data protection, and other legal issues associated with publishing data [1, 10, 15, 33] • Provide expert guidance in the selection, provision, and use of database and data warehouse architectures, software, and facilities [9, 16]

	• Provide specialist advice to those accountable for information governance to correct digital media-related compliance issues [10] • Recommend remediation actions on information and documentation, records management, information assurance, and data protection, as required [12, 14, 16, 33]
Expert	• Identify and manage resources needed for the planning, development, and delivery of specified information and communications systems services (including storage, modifications, and communication of data, voice, text, audio, and images) [1, 9, 14, 16] • Determine the data requirements for the appropriate governance of enterprise digital environment, ensuring clarity of responsibilities and authority, goals and objectives, within a designated area of accountability [16] • Develop organizational policies, standards, and guidelines for data management, aligned with principles congruent to the ethical use and dissemination of digital artifacts [1, 14, 33] • Establish and communicate the organization's information management strategy [1] • Identify the impact of any relevant statutory, internal, or external regulations on the organization's use of information and develop strategies for compliance [10]

Table 44. Tasks Mapped to the "Data Management" Competency

Proficiency Level	**KSABs**
Awareness	• Understand the benefits of data management [1-7, 9, 10, 12-34] • Understand the definition of data management [1-7, 9, 10, 12-34]
Basic	• Understand, orient to, and integrate new information [1-7, 9, 10, 12-34] • Understand how data from the Digital System Model (DSM) is stored, shared, protected, and used [1-5, 10-34] • Understand the benefits of data centralization [2-7, 9, 10, 12-34] • Understand the definition of library filing construct [2-7, 9, 10, 12-34]
Intermediate	• Develop appropriate physical database or data warehouse design elements, within set policies, to meet business change or development project data requirements [9, 16]
Advanced	• Derive data management structures and metadata to support consistency of information retrieval, combination, analysis, pattern recognition and interpretation, throughout the organization [16] • Develop and maintain specialist knowledge of database and data warehouse concepts, design principles, architectures, software, and facilities [16]

	• Ensure implementation of information and records management policies and standard practice [12, 14, 21, 32, 33] • Ensure that formal information access requests and complaints are dealt with according to approved procedures [11, 16] • Ensure that physical database design policy supports transactional data requirements for performance and availability [16] • Implement physical database designs to support transactional data requirements for performance and availability [9, 16] • Maintain and implement information handling procedures [15, 16] • Manage the iteration, review, and maintenance of data requirements and data models [17-34] • Take responsibility for the accessibility, retrievability, security, quality, retention, and ethical handling of specific subsets of data [11, 12, 15, 16, 32] • Enable the availability, integrity, and searchability of information through the application of formal data and metadata structures and protection measures [14, 16, 21, 33] • Assess the integrity of data from multiple sources [10, 12, 16-20, 22-31, 34]
Expert	• Derive an overall strategy of master data management, within an established information architecture, that supports the development and secure operation of information and digital services [12, 14, 15] • Protect the integrity, availability, authenticity, non-repudiation, and confidentiality of information and data in storage and in transit [14-16] • Review new change proposals and provide specialist advice on information and records management, including advice on and promotion of collaborative working and assessment and management of information-related risk [10, 12, 14]

Table 45. Tasks Mapped to the "Modeling" Competency

Proficiency Level	**KSABs**
Awareness	• Capture and maintain model provenance and pedigree in order to establish trust, credibility, accuracy, and a basis for judging model reuse [12-14, 17-27, 29-34] • Describe a variety of system analysis techniques which can be used to derive information about a system [2, 17-34] • Describe different types of modeling and provide examples [1, 2, 17-27, 29-34]

	• Explain why system representations are required and the benefits they can bring to developments [1-5, 14, 15, 17-34] • Understand that system models are created for system development efforts in accordance with applicable standards and policies [1-5, 10, 12-15, 17-34] • Understand the various modeling toolsets [17-27, 29-34] • Describe the scope and limitations of models, including definition, implementation, and analysis [1-5, 10, 15, 17-34] • Explain how the purpose of modeling affects the approach taken [1-5, 17-27, 29-34] • Re-state terms and definitions about models and Digital Engineering in Systems Engineering [1-5, 13-15, 17-34] • Understand "model" in the context of Digital Engineering [1-5, 13, 15, 17-34] • Understand the basic modeling concepts, diagrams, data attributes, and the relationship(s) between the modeling language diagrams [1, 2, 5, 13-15, 17-34]
Basic	• Construct models to be traceable from concept to disposal, so that they can become the authoritative source of truth [2, 17-27, 29-34] • Know where to find model descriptions [1, 2, 5, 13-15, 17-34] • Understand the purpose and benefits of modeling [1-5, 13-15, 17-34] • Use appropriate system analysis techniques to derive information about the real system [5, 17-34] • Use models to communicate, collaborate, and perform model-driven lifecycle activities by exchanging information between technical disciplines or organizations [1, 2, 4, 5, 13, 14, 17-34] • Use models to support analysis [5, 17-34] • Use various modeling toolsets [17-27, 29-34] • Apply concepts to start creating system models and architecture products (less complex architecture with fewer coordinating activities) with direct supervision [2, 17-27, 29-34] • Apply modeling techniques to establish, modify, or maintain a data structure and its associated components (entity descriptions, relationship descriptions, attribute definitions) [17-27, 29-34] • Apply published modeling methodologies, i.e., OOSEM, JPL-SA, RUP-SE, etc. [17-27, 29-34] • Assist in creating the system model and required architectural products for a system or system-of-systems in accordance with applicable standards and policies under direct supervision [17-27, 29-34] • Assist in maintaining the system model and required architectural products for a system or system-of-systems in accordance with applicable standards and policies under direct supervision [17-27, 29-34] • Assist in more complex modeling activities [17-27, 29-34] • Build models in a collaborative modeling environment [17-27, 29-34]

	• Comply with style guides to properly develop system models [10, 17-27, 29-34] • Define governing modeling plans, processes, and appropriate tools for a project, and use these to monitor and control systems modeling activities for a system or system element [2, 4, 9, 17-27, 29-34] • Develop plans to digitally represent the system of interest, using an approach that uses models to enable the orchestration of activities, the efficient management of work products and multidisciplinary teams to results in the digital representation in the SOI [2, 4, 17-34] • Explain policy and guidance about models, simulations, and Digital Engineering [1-4, 10, 12, 14, 15, 17-34] • Explain the use of models in Digital Engineering (DE) [1, 3-5, 13-15, 17-34] • Utilize modeling language tools to create or maintain architectural products based on data provided [17-27, 29-34] • Utilize Unified Modeling Language (UML) based tools to create or maintain architectural products based on data provided [17-27, 29-34] • Understand the types of data models (conceptual, logical, physical) [1, 2, 14, 15, 17-34] • Identify key considerations for implementing a digital system model successfully [1, 17-34] • Understand the steps of the model-test-model approach: long-term planning, pre-test modeling, field test, post-test modeling, model validation/accreditation [23, 27, 29, 30, 32] • Understand the benefits and potential risks in the model-test-model approach [10, 23, 27, 29, 30, 32]
Intermediate	• Create system models for system development efforts in accordance with applicable standards and policies [17-27, 29-34] • Define the interrelationships among model elements and diagrams [5, 13, 15, 17-34] • Explain why models are developed for a specific purpose or use and provide examples [1, 2, 4, 5, 13, 15, 17-34] • Have a well-developed understanding of modeling tools and how to implement them in both classified and unclassified environments [9, 15, 17-27, 29-34] • Model current and desired scenarios, as directed [17-27, 29-34] • Review the system model created by others [5, 13, 15, 17-34] • Select appropriate tools and techniques for system modeling and analysis [2, 9, 17-27, 29-34] • Use model formalisms to aid in the development, integration, and curation of models, [17-34] • Use modeling language, concepts, diagrams, data attributes [2, 17-34] • Ability to design models based on data [2, 17-27, 29-34] • Analyze the system model [5, 15, 17-27, 29-34] • Apply design, modeling, and quality assurance techniques, based upon a detailed understanding of business processes, to establish, modify, or maintain data structures and associated components (entity descriptions, relationship descriptions, attribute definitions) [12, 17-27, 29-34]

	• Assess aspects of model quality to ensure conformance to language and method constraints [12, 17-27, 29-34] • Contribute to model development and interpretation activities [2, 5, 15, 17-27, 29-34] • Conversant with techniques covering full range of modeling situations [17-27, 29-34] • Develop accurate, complete, trusted, and reusable models [2, 17-27, 29-34] • Develop Digital Artifacts, according to intent [2, 17-27, 29-34] • Develop models with input from subject matter experts and communicate the results back to them for review and confirmation [2, 17-27, 29-34] • Explain why models have a limit of valid use, and the risks of using models outside those limits [1, 2, 4, 5, 10, 15, 17-34] • Gain agreement from subject matter experts to models produced [17-34] • Generate system models [17-27, 29-34] • Implement system model and architecture [17-27, 29-34] • Implement the strategy and approach to be adopted for the modeling on a system or system element [3, 17-27, 29-34] • Integrate and curate models across disciplines to support cohesive model-driven lifecycle activities [5, 17-27, 29-34] • Interpret and use outcomes of modeling, with guidance [1, 2, 5, 15, 17-34] • Lead and determine appropriate representation of a system or system element [17-27, 29-34] • Maintain the system model for a system or system-of-systems in accordance with applicable standards and policies with minimal or no supervision [17-27, 29-34] • Manage framework for system model [17-27, 29-34] • Organize complex models [17-27, 29-34] • Review how the system model is aligned with the framework [17-27, 29-34] • Review system model to identify system components or capabilities based on the application [17-34] • Review the creation of system models (e.g., Interface Control Document, SysML diagrams) produced by other systems engineers to ensure proper format and content [10, 12, 13, 15, 17-27, 29-34] • Select appropriate modeling techniques for meeting assigned objectives [2, 17-27, 29-34] • Use modeling and simulation tools and techniques to represent a system or system element [2, 17-27, 29-34] • Use system models for collaboration of design and technical reviews to execute trade-off and design analyses, prototype, manufacture, test, and sustainment of the developed system [1, 5, 13, 15, 17-34]
Advanced	• Advise on selection of appropriate modeling or analysis approach, based on understanding the strengths and weaknesses of various modeling techniques [17-27, 29-34]

	• Develop approaches to integrating modeling tools with other types of engineering tools such as requirements management tools and configuration management tools [3, 12, 17-27, 29-34] • Prepare instructions in support of collaboration of model development, to ensure accurate use and operation between technical disciplines and organizations [3, 17-27, 29-34] • Adapt approach to accommodate the specifics of a given situation or system of interest being modeled [17-27, 29-34] • Analyze system models [5, 13, 15, 17-34] • Apply a range of mathematical, statistical, or predictive modeling techniques in consultation with experts if appropriate, and with sensitivity to the limitations of the techniques [5, 17-27, 29-34] • Coach new and experienced practitioners in systems modeling and analysis [17-27, 29-34] • Conduct advanced modeling activities for significant change programs and across multiple business functions [17-27, 29-34] • Conduct analyses (e.g., gap, impact, interoperability) of the system model and architectural products [5, 17-34] • Contribute to discussions about the choice of the modeling approach to be used [2, 4, 17-27, 29-34] • Define and document enterprise-level policies, procedures, guidance, and best practice for systems modeling and analysis, including associated tools [3, 4, 9, 10, 12, 17-27, 29-34] • Determine how to integrate or federate models [17-27, 29-34] • Develop framework for system model [17-27, 29-34] • Ensure that DE activities and digital artifacts development are performed according to intent [1-4, 17-34] • Evaluate system models created and maintained by others [13, 17-34] • Identify and maintain an approach that integrates models generated by all stakeholders to digitally represent the SOI throughout the lifecycle [2-4, 17-27, 29-34] • Investigate corporate data requirements, and apply data analysis, modeling, and quality assurance techniques, to establish, modify, or maintain data structures and their associated components (entity descriptions, relationship descriptions, attribute definitions) [12] • Manage complex system model development and analysis efforts [2, 4, 17-27, 29-34] • Plan own modeling activities, selecting appropriate techniques and the correct level of detail for meeting assigned objectives [17-27, 29-34] • Prioritize the creation of system models to meet larger program milestones and events [2, 4, 13, 17-34] • Prioritize the maintenance of system models to meet larger program milestones and Systems Engineering Technical Review (SETR) events [2, 4, 13, 17-34]

	• Responsible for planning and coordinating team modeling activities and for ensuring the quality of their work [12, 17-27, 29-34] • Review and judge the outputs of systems modeling ensuring the results can be used for the intended purpose [12, 13, 15, 17-27, 29-34] • Review complex modeling work [13, 15, 17-27, 29-34] • Set standards for data modeling and design tools and techniques, advise on their application, and ensure compliance [3, 4, 10, 12, 17-27, 29-34] • Verify the creation of system models and architectural products (e.g., Interface Control Document, DoDAF viewpoints, SysML diagrams) produced by other systems engineers to ensure proper format and content [12, 13, 15, 17-27, 29-34]
Expert	• Review and judge the suitability of systems modeling and analysis approaches and results [13, 17-27, 29-34] • Advise and arbitrate on complex or sensitive issues relating to systems modeling [17-27, 29-34] • Apply a wide-ranging knowledge of the strengths and weaknesses of available modeling techniques, to advise on the appropriateness of selected approaches in any given level of complexity and novelty [17-27, 29-34] • Contribute to system modeling best practices [10, 17-27, 29-34] • Defines strategy and approach to be used for modeling and analysis of complex or novel system or system elements [2, 4, 17-27, 29-34] • Has continuing responsibility for the maintenance of models for a designated function [17-27, 29-34] • Influence key stakeholders within and beyond the enterprise boundary in systems modeling and analysis [1, 4, 17-34] • Lead the development of architectures for complex solutions, ensuring consistency with specified requirements agreed with both external, and internal customers [2-4, 17-27, 29-34] • Within a business change program, manage the target design, policies, and standards, working proactively to maintain a stable, viable architecture and ensure consistency of design across projects within the program [10]

Table 46. Tasks Mapped to the "Simulation" Competency

Proficiency Level	KSABs
Awareness	• Describe the scope and limitations of model simulations, including definition, implementation, and analysis [27, 29, 30, 34] • Explain how the purpose of modeling and simulation affects the approach taken [1-4] • Explain the relevance of outputs from systems modeling analysis, and how these relate to overall system development [1-5, 12-15, 17-30, 34] • Describe different types of simulation and provide examples [29, 30, 34] • Describe the scope and limitations of simulations, including definition, implementation, and analysis [29, 30, 34] • Explain how the purpose of simulation affects the approach taken [4, 29, 30, 34] • Re-state terms and definitions about simulations in Systems Engineering [29, 34] • Understand the various simulation toolsets [29, 34]
Basic	• Explain the use of models and simulations within a digital engineering environment [3-5, 12, 13, 15, 17-30, 34] • Explain why models and simulations have a limit of valid use, and the risks of using models and simulations outside those limits [10, 27, 29, 30, 34] • Use established techniques as directed, to model simple subject areas with clearly-defined boundaries [2, 17-27, 29-31, 34] • Understand the definitions of modeling and simulation [2-5, 12, 13, 15, 29, 30, 34] • Understand the definition of models and simulation [2-5, 12, 13, 15, 29, 30, 34] • Explain the use of simulations in Digital Engineering (DE) [1-5, 12, 13, 15, 27-30, 34] • Use various simulation toolsets [29, 30, 34]
Intermediate	• Assist in complex modeling activities [17-22, 25, 27, 29-31, 34] • Applies modeling and simulation applications and tools, to cover a full range of modeling simulations [29, 30, 34] • Integrate modeling capabilities with other product and analytical models including physics-based models [29, 30, 34] • Use system analysis techniques to derive information about the real system, with guidance [17-31, 34] • Use tools and techniques to conduct analysis of models, with guidance [17-31, 34] • Understand different types of models (mathematical, process, text vs graphics-based, low- vs high-level models, flat vs hierarchical [17-31, 34] • Understand considerations for implementing a Digital System Model (DSM) [2-5, 17-31, 34]

	• Understand how models and digital artifacts can be used to represent technical coherency using DE concepts [17-31, 34] • Understand the process for peer review of models, simulations, and digital artifacts [12, 17-27, 29-32, 34] • Understand the spectrum of peer review approaches for modeling and simulation and the implications of each (desk checking, pair programming, team review, walkthrough, formal inspection) [12, 29, 30, 32, 34] • Explain why simulations have a limit of valid use, and the risks of using simulations outside those limits [10, 27, 29, 30, 34] • Interpret and use outcomes of simulation with guidance [29, 30, 34] • Select appropriate tools and techniques for system modeling simulation [9, 29, 30, 34] • Use simulation tools and techniques to represent a system or system element [29, 30, 34]
Advanced	• Apply modeling and simulation techniques to forecast the demand upon a particular resource or service [17-22, 24, 25, 27-30, 34] • Advise on the choice of modeling techniques and approach, to communicate with customers accordingly [17-27, 29, 30, 34] • Analyze system designs (including system elements and enabling system elements), to provide a greater understanding of the reasons for defects and failures at all levels [23, 25, 27, 29, 30, 34] • Apply a range of mathematical, statistical, predictive modeling, or machine-learning techniques in consultation with experts if appropriate, and with sensitivity to the limitations of the techniques [29, 30, 34] • Understand that various modeling and simulation applications and tools are required to cover a full range of modeling and simulation situations [29, 34] • Coordinate complex modeling work [17-22, 25, 27, 30] • Develop and implement clearly defined digital modeling plans and method statements [17-22, 24, 25, 27, 29, 30, 34] • Ensure staff use the model to support their analysis [17-30, 34] • Ensure that appropriate modeling and simulation tools and methods are available, understood, and employed in architecture development [29, 34] • Use models to identify and evaluate alternative architectures and the trade-offs in cost, performance, and scalability [5, 29, 30, 34] • Implement the strategy and approach to be adopted for the modeling and analysis on a system or system element [17-28, 30, 34] • Understand the need to include modeling, simulation, and Digital Engineering tasks in the request for proposal (RFP) [3, 4]

	• Understand the need to obtain the appropriate model, simulation, and digital engineering artifact deliverables using the proper contractual mechanism [3, 4, 14] • Advise on selection of appropriate modeling or analysis approach, based on understanding the strengths and weaknesses of various simulation techniques [17-22, 25, 27] • Review and judge the outputs of systems simulations, ensuring the results can be used for the intended purpose [27, 29, 30, 34]
Expert	• Advise on the suitability and limitations of models and analysis techniques used [17-22, 24, 25, 27] • Apply a wide-ranging knowledge of the strengths and weaknesses of available modeling and analysis techniques, to advise on the appropriateness of selected approaches in any given level of complexity and novelty [17-25, 27] • Develop the capabilities and the requirement sets within digital modeling and simulation environment [17-22, 24, 25, 27, 29, 30, 34] • Ensure the maintenance of models for a designated function [17-22, 24, 25, 27-30, 34]

Table 47. Tasks Mapped to the "Artificial Intelligence/Machine Learning" Competency

Proficiency Level	**KSABs**
Awareness	• Ability to describe text classification, information retrieval, information extraction [16]
Basic	•
Intermediate	•
Advanced	•
Expert	•

Table 48. Tasks Mapped to the "Data Visualization" Competency

Proficiency Level	**KSABs**
Awareness	• Understand the benefits of data visualization [1-7, 10, 12, 13, 17-32, 34] • Understand the definition of data visualization [1, 2, 4-7, 10, 12, 13, 17-32, 34]

Basic	• Describe the benefits of data visualization across a variety of stakeholders [1, 2, 4-7, 10, 12, 13, 17-32, 34]
Intermediate	• Ability to determine the most appropriate visual representation for the specific need [1, 2, 4-7, 10, 12, 13, 17-32, 34] • Ability to do information retrieval on a corpus of documents [1, 2, 5-7, 10, 12-14, 17-25, 27-32, 34] • Ability to implement methods and tools to represent patterns of what happened in the past providing predictive behaviors [5-7] • Ability to implement processes to explore data [5-7, 14] • Ability to implement the most appropriate visual representation for the specific need [1, 2, 4-7, 10, 12, 13, 17-32, 34] • Ability to represent what patterns of what happened in the past [5-7] • Identify, evaluate, select, and apply hardware or software tools or technological solutions appropriate to support data visualization [9]
Advanced	• Ability to determine the most representative metrics for the specific need [1, 2, 5-7, 10, 12, 13, 17-30, 32, 34] • Ability to evaluate results of knowledge representation and extraction [5-7]
Expert	•

Table 49. Tasks Mapped to the "Data Analytics" Competency

Proficiency Level	**KSABs**
Awareness	• Explain the difference between structured and unstructured data [14, 16] • Understand the difference between SQL and NoSQL databases [14, 16]
Basic	• Apply data analysis, design, and modeling techniques to establish, modify, or maintain a data structure and its associated components (entity descriptions, relationship descriptions, attribute definitions) [14, 17-21, 23-25, 27-34] • Leverage data and analytics to enable insights and achieve faster and better data-driven decisions [3-7, 10, 13, 17-30, 32, 34] • Understand definition of data, metadata, telecommunication, databases [14, 16] • Ability to determine the elements required to describe what happened in the past [5-7] • Ability to interact with data engineering procedures and methods [14]

Intermediate	• Apply data analysis, design, modeling, and quality assurance techniques, based upon a detailed understanding of business processes, to establish, modify, or maintain data structures and associated components (entity descriptions, relationship descriptions, attribute definitions) [3, 14] • Identify, evaluate, select, and apply hardware or software tools or technological solutions appropriate to the task at hand (e.g., use statistical tools to show reliability of data) [9, 29, 34] • Interpret and use outcomes of data analysis, with guidance [4-7, 10, 13, 17-32, 34] • Undertake data analysis activities and deliver analysis outputs, in accordance with customer needs and conforming to agreed standards [5-7, 10, 13, 17, 19, 20, 23-25, 27, 29, 30, 32, 34] • Ability to determine patterns in what happened in the past [5-7] • Ability to implement methods and tools to understand what happened in the past [5-7] • Ability to implement methods and tools to understand why something happened in the past [5-7] • Ability to represent what happened in the past and why it happened [5] • Define governing modeling and analysis plans, processes, and appropriate tools for a project, and use these to monitor and control systems modeling and analysis activities for a system or system element [29, 34] • Implement the strategy and approach to be adopted for analysis on a system or system element [3, 29, 34] • Lead and determine appropriate analysis of a system or system element [17, 19, 20, 23-25, 27, 29, 30, 32, 34]
Advanced	• Contribute to the data engineering of digital information systems with the creation of reports, technology road mapping, and the sharing of knowledge and insights [13, 29, 30, 34] • Develop data hypotheses and methods, evaluate analytics models, share insights and findings, and continue to iterate with additional data [5, 17, 19, 20, 23-25, 27, 29, 30, 32, 34] • Establish and manage methods, techniques, and capabilities to enable the organization to analyze data, to generate insights, create value, and drive decision-making [5] • Evaluate the need for analytics, assess the problems to be solved and what internal or external data sources to use or acquire [5-7, 17-20, 23-25, 27-29, 32, 34] • Know the data required to information program and technical decisions [4-7, 10, 12-15, 17-34] • Manipulate specific data from information services, to satisfy defined information needs [5-7] • Specify and apply appropriate mathematical, statistical, predictive modeling, or machine-learning techniques to analyze data, generate insights, create value, and support decision-making [5-7, 17, 19, 20, 23-25, 27, 29, 30, 32, 34] • Adapt approach to accommodate the specifics of a given situation or system of interest being analyzed [6, 7, 29, 30, 34]

	• Lead and determine appropriate analysis of a complex system or system elements [17, 19, 20, 23-25, 27, 29, 30, 32, 34] • Review and judge the outputs of systems analysis, ensuring the results can be used for the intended purpose [13, 17, 19-21, 23-25, 27, 29, 32, 34]
Expert	•

Table 50. Tasks Mapped to the "Digital Architecting" Competency

Proficiency Level	**KSABs**
Awareness	• Understand how a model-based systems engineering approach can enable architectural design [1-5, 17-34] • Understand system model and architectural concepts, including the DoDAF framework [1-5, 17-34] • Understand how architecture enables a model-based systems engineering approach [1-5, 17-34]
Basic	• Create system digital models and basic architecture products, under direct supervision [17-27, 29-34] • Assist in creating the system digital model and required architectural products for a system or system-of-systems in accordance with applicable standards and policies under direct supervision [17-27, 29-34] • Describe what it means for a digital model to be accurate, complete, trusted, and reusable [1-5, 10, 12, 17-34] • Identify and locate data necessary to create system model and architectural products when using architecting tools [2, 17-34] • Identify the relationship(s) between defense architecture frameworks and system models [3, 4] • Interact with relevant stakeholders to create digital engineering-oriented architecture for a system's design [1, 2, 17-34] • Utilize modeling languages to create or maintain system architectural products based on data provided [2, 17-27, 29-34] • Comply with style guides to properly develop architectural products [10, 12, 17-27, 29-34] • Understand the concept of digital thread [3-5, 18-34] • Understand how digital threads work in the acquisition lifecycle [3-5, 18-34] • Understand how digital artifacts support system of systems approaches, program interoperability, and modularity [1-5, 17-34] • Understand how the use of digital artifacts can be used to effectively support interoperability [2-5, 17-34]

	• Understand how the use of digital artifacts can be used to effectively support Modular Open System Approach (MOSA) [2-5, 17-34]
Intermediate	• Provide architecture assessment to make decisions based on the architecture to ensure requirements are met for the system development throughout the lifecycle [4, 5, 10, 13, 17-34] • Apply system model and architectural concepts based on different stakeholder views and how they relate [1, 4, 17-34] • Collaborate with disciplinary subject matter experts to create system models and architectural products [17-27, 29-34] • Collaborate with disciplinary subject matter experts to maintain system models and architectural products [17-27, 29-34] • Create required architectural products for a system or system-of-systems in accordance with applicable standards and policies with minimal or no supervision [17-27, 29-34] • Demonstrate a full understanding of system model and architectural techniques [17-27, 29-34] • Review architecture diagrams [1, 5, 10, 13, 15, 17-34] • Review how the system model and architecture are aligned with the framework [13, 17-34] • Review system architectural products (e.g., structural diagram, behavior diagram, requirements diagram, parametric diagram) to identify system components or capabilities based on the application [5, 17-34] • Review the architectural products created by others, including digital twins and digital assets [13, 17-34] • Understand the ways digital artifacts can be used to support a MOSA [2-5, 17-27, 29-34] • Analyze architectural products using system models [17-34] • Contribute to the system model for a system-of-systems architecture effort to establish the framework by which systems are designed [17-27, 29-34] • Maintain the required architectural products for a system or system-of-systems in accordance with applicable standards and policies with minimal or no supervision [17-27, 29-34] • Manage framework for the architecture [17-27, 29-34] • Review how the architecture is aligned with the framework [13, 17-27, 29-34] • Review the creation of architectural products (e.g., DoDAF viewpoints) produced by other systems engineers to ensure proper format and content [12, 13, 15, 17-27, 29-34] • Identify digital interfaces and integration approaches with the contractor [2, 4, 17-34]
Advanced	• Contribute to the development of solution architectures in specific business, infrastructure, or functional areas, using model-based engineering methods and digital artifacts [2, 17-27, 29-34]

	• Utilize architecture products to assist with analysis of alternatives to make a recommendation for the best solution [5, 10, 17-34] • Analyze system architecture models [5, 10, 17-34] • Apply architecture to the remaining system disciplines and specification development [17-27, 29-34] • Develop framework for the system architecture [17-27, 29-34] • Ensure that appropriate tools and methods are available, understood, and employed in architecture development [1-4, 9, 16-27, 29-34] • Evaluate digital architectural products created and maintained by others [13, 15, 17-34] • Identify and evaluate alternative architectures and the trade-offs in cost, performance, and scalability [5, 10, 17-34] • Lead the development of solution architectures in specific business, infrastructure or functional areas [18-27, 29-34] • Manage complex system architectural development and analysis efforts [3, 4, 17-27, 29-34] • Prioritize the creation of architectural products to meet larger program milestones and events [3, 4, 13, 17-34] • Prioritize the maintenance of architectural products to meet Systems Engineering Technical Review (SETR) events [3, 4, 13, 17-34] • Review program integrated architectures for release outside of the system command [13, 15, 17-27, 29-34] • Support the technical authority expert in approving architectural products and submitting waivers and deviations for approval [18-27, 29-34] • Utilize architectural products to assist with analysis of alternatives to provide a set of technically acceptable solutions [5, 10, 17-34] • Verify architecture products for the technical authority [12, 13, 17-27, 29-34] • Verify the creation of architectural products (e.g., DoDAF viewpoints) produced by other systems engineers to ensure proper format and content [12, 13, 17-27, 29-34] • Verify the maintenance of architectural products (e.g., DoDAF viewpoints) produced by other systems engineers to ensure proper format and content [12, 13, 17-27, 29-34]
Expert	• Lead and oversee the framework for system digital model and architecture [3, 4]

Table 51. Tasks Mapped to the "Digital Requirements Modeling" Competency

Proficiency Level	KSABs
Awareness	• Explain the importance of digital requirements modeling [2-4, 17-34]
Basic	• Use requirements traceability when modeling a system-of-interest [2, 17-34] • Contribute to requirements management using digital modeling [2, 17-34] • Use requirements traceability matrix [17-34]
Intermediate	• Capture stakeholder high-level requirements by documenting stated needs in the form of a model, to assist in the clarification and translation of need statements into a more digital engineering-oriented language for proper architecture definition [1, 2, 17-34] • Create requirements traceability in the digital model architecture [2, 17-27, 29-34] • Ensure traceability between requirements and specifications [2, 17-34] • Generate a system specification in a digital enterprise environment model where all requirements and RDs are generated from the modeled system [2, 17-27, 29-34] • Generate models using requirements and use case diagrams to include requirements elicitation, generation, analysis, verification, and validation [18-34] • Generate system models with functional allocation to operational requirements to determine system functions to include capability, operational, functional, and physical architecture to etablish the allocated, functional, and product baselines based on sound, proven standards [17-19, 21-34] • Perform requirements engineering using digital techniques, deriving lower-level requirements & traceability of parent-child relationships to establish, validate, and maintain a set of system requirements at all system and subsystem levels [17-34] • Query the model for how reliability requirements are addressed [20-32, 34] • Translate requirements into system specifications using digital modeling products [2, 17-34] • Understand relationships between system requirements and the system being developed [2, 4, 17-34] • Create requirements traceability building on architectural products [18-34] • Generate a system specification in a model where all requirements and RDs are generated from the modeled system behavior, performance, structure, qualities, and interfaces to form the baseline of the system performance traced to the CDD requirements to include verification methods which can also be used for source selection [2, 17-34] • Perform requirements engineering deriving lower-level requirements & traceability of parent-child relationships to establish, validate, and maintain a set of system requirements for all system and subsystem levels [17-32, 34]

	• Provide system model to make decisions based on the architecture to ensure requirements are met for the system development throughout the lifecycle [2, 5, 10, 12-14, 17-34] • Translate requirements into system specifications using architecture products [2, 17-27, 29-34]
Advanced	• Ascertain needs requirements of project to ensure proper modeling tools and technology are selected for the current project [1-4, 9, 17-27, 29, 30, 32-34] • Examine engineering artifacts and trace designs to requirements [17-34] • Develop the capabilities and the requirement sets within the digital enterprise environment [1, 2, 17-27, 29-34] • Ensure staff are involved with configuration or requirements management [3, 4, 12, 13, 17-34]
Expert	• Lead the modeling development of digital models for complex solutions, ensuring consistency with specified requirements agreed with both external, and internal customers [3, 4, 17-27, 29-31, 33, 34]

Table 52. Tasks Mapped to the "Digital Validation and Verification" Competency

Proficiency Level	**KSABs**
Awareness	• Develop an understanding of the role of testing within system development, as a tool for design improvement as well as a verification process [3-5, 10, 12, 13, 23-25, 27-30, 32, 34]
Basic	• Explain the validation and verification process of the digital model [12] • Understand how digital twins can be used for T&E/V&V [23, 29, 34]
Intermediate	• Create test cases using own in-depth technical analysis from model-based engineering methods, of both functional and non-functional specifications (such as reliability, efficiency, usability, maintainability, and portability) [24, 25, 27, 29, 30, 34] • Analyze and report test activities and results using model-based engineering methods and tools [13, 24-30, 34] • Understand the specific definition of verification with regards to DE [12, 23, 29] • Understand the specific definition of validation with regards to DE [12, 23, 29] • Understand the use of a digital ecosystem for VV&A of the system [29] • Verify that products are aligned with the review and/or analysis [12, 13, 23]
Advanced	• Verify system model for the technical authority [12]
Expert	•

Table 53. Tasks Mapped to the "Model-Based Systems Engineering Processes" Competency

Proficiency Level	KSABs
Awareness	• Knowledgeable about digital model project lifecycle [1-5, 13, 15, 17-34] • Understand the use of models in the context of digital engineering [1-5, 13, 15, 17-34] • Understand need to assess aspects of model quality including conformance to modeling language and application method constraints [12, 17-34] • Understand published modeling methodologies, i.e., OOSEM, JPL-SA, RUP-SE, etc. [3, 17-34] • Understand the basic fundamentals of Model-Based Systems Engineering (MBSE), Model-Based Engineering (MBE), and the broader Model-Centric Engineering (MCE) concepts [1-5, 13, 15, 17-34] • Understand the uses of system models for system development efforts in accordance with applicable standards and policies [1-5, 10, 13, 15, 17-34] • Understand the value that modeling concepts bring to complex system development efforts throughout the system lifecycle [1-5, 13, 15, 17-34] • Understand the importance of model traceability from concept to disposal in maintaining an authoritative source of truth [1-3, 13, 15, 17-34] • Understand the workforce needs for the development and use of digital artifacts during the acquisition lifecycle [2-4, 17-34] • Understand the definition of digital artifact [1-5, 13, 15, 17-34] • Understand how digital artifacts can be used across the acquisition lifecycle (DoD 5000.02) [1-5, 13, 15, 17-34]
Basic	• Assist with the evaluation of system-of-interest change requests using MBSE processes [12, 32, 34] • Contribute to modeling tasks employing a model-based systems engineering approach [2, 17-27, 29-34] • Describe digital artifacts contribution to the following engineering concepts: Systems of Systems (SoS), program interoperability, and modularity [1-5, 13, 15, 17-34] • Describe how digital system model artifacts advance the state-of-the-practice of digital engineering [1-5, 13, 15, 17-34] • Develop digital model artifacts, according to intent [2, 17-34] • Analyze and interpret the results obtained using model-based engineering methods and tools [17-34] • Understand model-based engineering methods, tools, and technologies that may assist in streamlining work and improving productivity [17-34] • Evaluate the system model and architectural products created and maintained by others [13, 15, 17-34] • Explain the difference in digital enterprise environment stakeholder views [1, 2, 13, 17-34]

	• Use appropriate representations of a system or system element in order to derive information about the real system [2, 5, 17-34] • Use model formalisms to aid in the development, integration, and curation of models [2, 17-34] • Use modeling toolsets to generate diagrams, to establish system model data attributes [2, 17-34] • Use models as the basis for defining, evaluating, comparing, and optimizing alternatives and making decisions [1, 2, 5, 13, 15, 17-34] • Use system models for design analysis [1, 2, 13, 15, 17-34] • Contribute to the system model development and interpretation activities [1, 2, 17-34] • Apply digital modeling tools to the solution of an engineering problem [17-34] • Understand digital artifacts and their use [1-4, 13, 15, 17-34] • Understand how to represent systems and systems of systems (SoS) technical data in the digital engineering environment [1-4, 15, 17-34] • Understand the concept of digital twin and how it can be used in an acquisition environment [1-4, 23, 27, 30] • Understand elements that can make up the digital twin [1-4, 23, 27, 29, 30] • Understand how digital twin can be used for understanding operation and maintenance [1-4, 23, 27, 29, 30] • Understand how the use of models and digital artifacts contributes to technical coherency [1-5, 17-34] • Understand the definitions of models, digital artifacts, and information sharing and how these are related [1-5, 13, 17-34] • Understand why digital artifacts are used and common examples of digital artifacts [1-5, 13, 15, 17-34] • Understand the characteristics of digital artifacts, as well as potential benefits, including: accessibility, alignment, consistency, comprehensiveness, precision, data limitations, relevancy, accuracy, and ownership [1-5, 17-34] • Identify key stakeholder groups that will produce and consume digital artifacts [1-5, 13, 17-34] • Understand how strategic leadership may create or consume digital artifacts [1-5, 13, 15] • Understand how program managers may create or consume digital artifacts [5, 13, 15, 17-34] • Understand how systems engineers may create or consume digital artifacts [1-5, 13, 15, 17-34] • Understand the risk of using digital artifacts with respect to workforce, change, data accuracy, the DE ecosystem, and data consistency [1-5, 10, 15, 17-34] • Understand how digital artifacts can be used to effectively support SoS [1-5, 13, 15, 17-34] • Understand how Digital Artifacts can be used to support interoperability [1-5, 13, 15, 17-34]
Intermediate	• Analyze the system model and architecture products [1, 2, 5, 13, 15, 17-34] • Build models in a digital enterprise environment collaborative modeling environment [2, 17-27, 29-34]

	• Ensure digital artifacts are up-to-date, consistent, interoperable, accessible, uncorrupted, and properly and safely stored [1, 2, 5, 12, 14, 15, 17-34] • Generate digital enterprise environment system models [2, 17-34] • Integrate all other model domains and physics-based models with the system model [23, 27, 29, 30] • Maintain system models for system development efforts in accordance with applicable standards and policies to reduce acquisition lifecycle timeline [17-27, 29-34] • Review system models to identify system components or capabilities based on the application [1, 2, 15, 17-34] • Select and define appropriate representations of a system or system element [2, 17-34] • Understand need to organize complex models, define the interrelationships among model elements and diagrams [1-5, 17-34] • Understand the capabilities and the requirement sets within the digital enterprise environment [2-5, 17-34] • Use digital enterprise environment tools and techniques to represent a system or system element [2, 17-34] • Use models to support engineering activities and decision making across the lifecycle [1-5, 13, 15, 17-34] • Use system models for system development efforts in accordance with applicable standards and policies to reduce acquisition lifecycle timeline [1-4, 10, 17-34] • Conduct operational, architectural, and requirements research, analysis, and documentation of assigned programs [2-5, 15, 17-34] • Understand the definition of model-based systems engineering (MBSE) and the differences/similarities between this and DE [1-5, 13, 17-34] • Use the risk management process to manage the risk of using digital artifacts [3-5, 10, 15, 17-34]
Advanced	• Apply advanced concepts, principles, and practices of model-based systems engineering process [17-27, 29-34] • Coordinate the assessment of risks to the availability, integrity, and confidentiality of systems that support critical business processes, using model-based engineering methods and digital artifacts [3, 4, 10, 15] • Integrate supporting engineering disciplines and specification development into system architecture [17-27, 29-34] • Integrate MBSE processes for complex system development efforts to appropriately represent the system requirements and design within the digital enterprise environment [17-27, 29-34] • Identify sources of error in model-based engineering methods and take appropriate corrective action [12, 17-34] • Conduct analysis to ensure interoperability with external programs, systems, or capabilities [17-34] • Evaluate and select appropriate model-based engineering methods and tools in line with agreed policies and standards [2-4, 9, 10, 17-27, 29-34] • Design MBSE solutions for complex systems including operational, architectural, and requirements research, analysis, and documentation of assigned programs [2, 17-27, 29-34]

	• Ensure that digital engineering activities and digital artifacts development are performed according to intent [1, 3, 4, 13, 17-34] • Evaluate supervision of the system model and architectural products created and maintained by others [17-27, 29-34] • Identify and maintain an approach that integrates models generated by all stakeholders to digital represent the system of interest throughout the lifecycle [1-4, 17-27, 29-34] • Implement MBSE solutions for complex systems [2-4, 17-27, 29-34] • Implement plans to digitally represent the system of interest, using an approach that uses models to enable the orchestration of activities, the efficient management of work, and the integration of work products and multidisciplinary teams to result in the digital representation of the system of interest [2-4, 17-27, 29-34] • Determine appropriate representations or analysis of the digital model [17-34] • Determine appropriate representations or analysis of complex system or system elements [17-34] • Lead complex system model and architectural development and analysis efforts [17-34] • Lead the development of digital models in specific business, infrastructure, or functional area [17-27, 29-34] • Lead the integration and combination of different models and analyses for a system or system element [17-27, 29-34] • Maintain the system model and required architectural products for a system or system-of-systems in accordance with applicable standards and policies with minimal or no supervision [17-27, 29-34] • Plan modeling activities, selecting appropriate techniques and the correct level of detail for meeting assigned objectives [2, 3, 17-27, 29-34] • Plan and coordinate team modeling activities and for ensuring the quality of their work [2, 3, 17-27, 29-34] • Review the creation of system models and architectural products and artifacts produced by other systems engineers to ensure proper format and content [12, 13, 15, 17-34] • Review the maintenance of system models and architectural products and artifacts produced by other systems engineers to ensure proper format and content [12, 13, 15, 17-34] • Support the technical authority expert in approving standard modeling and architectural products and submitting waivers and deviations for approval [17-27, 29-34] • Understand system designs (including system elements and enabling system elements), which provides an overall understanding of the reasons for defects and failures at all levels within a system [1, 17-34] • Utilize digital model artifacts to assist with analysis of alternatives to provide a set of technically acceptable solutions [17_34] • Use system model and architectural products to conduct gap analysis [17-34]

	• Apply integration using the integrated modeling environment to execute the MBSE process for complex system development efforts to represent the system requirements and design [17-27, 29-34] • Implement MBSE operational, architectural, and requirements research, analysis, and documentation of assigned programs [2, 3, 17-27, 29-34] • Verify the creation of system models and architectural products (e.g., Interface Control Document, DoDAF viewpoints, modeling language-based diagrams) produced by other systems engineers to ensure proper format and content [12, 13, 15, 17-27, 29-34] • Verify the maintenance of system models and architectural products (e.g., Interface Control Document, DoDAF viewpoints, modeling language-based diagrams) produced by other systems engineers to ensure proper format and content [12, 13, 15, 17-27, 29-34] • Integrate MBSE solutions for intricate systems and is responsible for operational, architectural, and requirements research, analysis, and documentation of solutions for intricate systems and is responsible for assigned programs [17-27, 29-34]
Expert	• Evaluate multiple system models and architectures at the mission or system-of-system level [13, 17-27, 29-34] • Formalize the application of models to support system requirements, design, analysis, verification, and validation activities beginning in the conceptual design phase and continuing throughout all lifecycle phases [3, 4, 17-27, 29-34] • Create value from the model-based engineering process for stakeholders by maintaining the principles of professional standards, accountability, openness, equality, diversity, and clarity of purpose [1-4, 13, 15, 17-34] • Engage with senior managers to ensure the business portfolio will deliver the agreed-upon digital artifact objectives [1-4, 13] • Provide advice to support the design of service components including designing in flexible and scalable capacity, using model-based engineering methods and digital artifacts [17-27, 29-34] • Recommend and implement corrective action by engaging and influencing senior management, using results from model-based engineering methods and tools [1, 23, 27, 29, 30, 31] • Manage the target design, policies, and standards, working proactively to maintain a stable, viable modeling and simulation architecture and ensure consistency of design across projects within the program [17-27, 29-34]

Table 54. Tasks Mapped to the "Digital Model-Based Reviews" Competency

Proficiency Level	**KSABs**
Awareness	• Aware of the digital model-based review process [1, 3-5, 7, 8, 10, 12, 13, 17-31, 33, 34] • Understand the importance of peer reviews [12, 17-31, 34]
Basic	• Coordinate with subject matter experts to review and confirm information and results from models [5, 10, 12, 13, 17-31, 34]
Intermediate	• Conduct model-based reviews and audits, to ensure effective collaboration for system-of-interest evolution [10, 12, 13, 18-32, 34] • Confer with subject matter experts on models produced to gain concurrence on results [5, 10, 12, 13, 17-32, 34] • Review resulting models with stakeholders and gain resolution to resultant issues [10, 12, 13, 17-32, 34] • Use system models for analysis of design and technical reviews to execute trade-off and design analyses, prototype, manufacture, test, and sustainment of the developed system [5, 13, 28-30, 34] • Use system models for collaboration during design and technical reviews to execute trade-off and design analyses, prototype, manufacture, test, and sustainment of the developed system [5, 13, 29, 30, 34] • Verify that system model products developed are aligned with the review and/or analysis [13, 28, 29, 30, 34]
Advanced	• Define the series and sequence of model-based engineering activities to bring stakeholders to the required level of commitment, prior to formal reviews [1, 3, 7, 13, 17-31, 34] • Conduct technical reviews to evaluate digital products on a continuous basis as the technical baseline matures, and inform decisions [5, 12, 13, 17-32, 34] • Communicate modeling results to managers and obtain feedback for agreement [13] • Provide advice on technical aspects of solution development and integration (including requests for changes, deviations from specifications, etc.) and ensure that relevant technical strategies, policies, standards, and practices (including security) are applied correctly [5, 12, 13, 17-32, 34] • Utilize system model and architectural products to conduct reviews [5, 13, 17-32, 34]
Expert	•

Table 55. Tasks Mapped to the "Project and Program Management" Competency

Proficiency Level	KSABs
Awareness	• Understand that modeling and simulation provide insight into program cost, schedule, performance, and associated risks [2-7, 10, 17-34] • Understand the challenges and benefits for planning and execution of projects in digital engineering ecosystem [2-10, 12-14, 17-34]
Basic	• Understand the importance of including DE consideration in contracts: Build, extend, and maintain the DSM [2-4] • Understand the importance of including contractual systems tasks and elements in the DSM taxonomy and the WBS (DID, pricing, CDRL, SOO, PWS, SOW, specs, etc.) [2, 3, 14] • Understand how DE tasks and products are incorporated into a contract [1-7, 10, 14, 32, 34] • Understand the differences in contracting for document-based versus model-based acquisition [2-4, 6, 7, 14] • Understand the role and importance of models, simulations, and data in improving project management [2-7, 32, 34] • Understand the process for digital engineering as it relates to acquisition [1-7, 17-31, 33] • Identify the DE tasks and products that need to be accomplished [2, 5, 7, 10, 14, 17-34] • Identify the tasks that should be completed by the contractor/developer [2, 6-8] • Understand the importance of the Program and Contract WBSs. Identify how digital engineering tasks and artifacts can be included in WBS structures. [2, 5-7, 32, 34] • Understand how to reflect DE tasks and products in the SOW, SOO, and PWS. [2, 3, 7] • Understand the importance of including DE consideration in contracts: develop and maintain the digital twin [23, 29, 30] • Understand the importance of including DE consideration in contracts: use digital artifacts for analysis in place of briefing charts [3, 4, 13, 17-31, 33] • Understand the importance of including DE consideration in contracts: design and integrate architecture for the DE infrastructure [17-31, 33] • Understand how to include DE-related tasks and artifacts into the RFP, specifically sections B, C, L, and M [3] • Identify the ways models and source codes should be delivered to the government in the contract, including any programs required for running models or codes [3, 4, 8, 10, 14, 17-22, 24-28, 31, 33] • Understand the interaction between digital engineering and program risk (i.e., how digital engineering can mitigate some risks and introduces others) [5, 10, 22, 23, 25, 27, 29, 30, 32, 34]

	• Understand how cohesively using digital artifacts throughout the acquisition lifecycle is critical to program success [2-4, 6, 7, 10, 13, 23, 29, 30] • Understand the ways that stakeholders can use digital artifacts in a SoS context (describe, distinguish, determine, communicate, draw, and allow) [1, 17-31, 33]
Intermediate	• Ensure that program/project leads and/or service owners adhere to the agreed portfolio management model-based engineering approach and timetable and that they provide the appropriate information to agreed targets of timelines and accuracy [4, 5, 7, 10, 32, 34] • Advise on program cost, schedule, performance, and supportability risk assessments, using knowledge gleaned from digital engineering methods and tools [2, 5-7, 10, 23, 25, 29, 30, 32, 34] • Lead system modeling for a project [17-22, 24, 26-28, 31, 33] • Manage models are that produced within a project [9, 12, 14, 17-22, 24-28, 31, 33] • Understand the importance of including DE consideration in contracts: use DE practices during acquisition [2-4] • Understand how to properly reflect IP and Data Rights considerations in a contract [1-4, 8, 15, 17-31, 33] • Understand the importance of develop and maintain the digital artifacts for consideration in contracts [2-4, 9, 23, 29, 30] • Understand the importance of develop and maintain the digital twin for consideration in contracts [23, 29, 30] • Include the tasks, interfaces, and integration approaches in the RFP and final contract [2, 3, 7, 8] • Identify the mechanisms and artifacts for reflecting DE tasks and deliverables in a contract (e.g., WBS, CDRL, DID, SOW, SOO, PWS) [2, 3, 7, 14] • Use digital artifacts to mitigate risks in schedule, cost, requirements, and design [2-7, 10, 23, 25, 29, 30, 32, 34]
Advanced	• Able to formalize the development, integration, and use of models to inform enterprise and program decision making [1-7, 13, 17-34] • Use model-based engineering methods to reduce the time and cost of iterative build, test, and fix cycles in order to create greater efficiencies in design and manufacturing [2-7, 10, 17-34] • Design and implement a model-based testing strategy to ensure that continuity plans and procedures address exposure to risk and that agreed levels of continuity are maintained [23, 29, 30] • Define new project and support them throughout their lifecycle [1-4, 10] • Implement model-based engineering methods and tools at a program, project, and team level including selection and tailoring in line with agreed standards [2-4, 9, 17-31, 33] • Take action to ensure targets are met within established safety and quality procedures, including, where appropriate, handover of digital artifacts to the client [5-7, 10, 17-34]

	• Prioritize the creation of system model and architectural products to meet larger program milestones and events [2-5, 7, 13, 32, 34]
Expert	• Implement processes which support cost-effective technology development and selection decisions [3-7]

Table 56. Tasks Mapped to the "Organizational Development" Competency

Proficiency Level	**KSABs**
Awareness	• Aware of the organizational plans in the organization [8]
Basic	• Understand the organizational plans in the organization [8] • Understand the workforce needs in terms of: specific skills and abilities required; competency standards; and training and development needs [4] • Aware of the organizational plans in the organization [8]
Intermediate	•
Advanced	• Monitor and report progress on organization readiness targets, organization engagement activity, training design and deployment activities, key operational metrics, and return to productivity measures, using model-based engineering methods and digital artifacts [8] • Provide advice, guidance, and expertise to support adoption of model-based methods and tools, and adherence to policies and standards [3, 4, 9, 10, 12] • Play a leading role in establishing modeling language-based MBSE at an enterprise [3, 4]
Expert	• Establish a systems modeling culture and environment, leveraging the capabilities of the organization [3, 4, 8] • Develop organizational policies, standards, and guidelines for model-based engineering methods and artifacts [3, 12] • Lead the establishment of MBSE at an enterprise level [4] • Initiate the business implementation plan, including all the activities that the business needs to do to prepare for new technical components and technologies, including using model-based engineering methods [3] • Lead the establishment of an MBSE enterprise with the use of formalized modeling language and ontology [4\ • Set direction and lead in the introduction and use of model-based engineering techniques, methodologies, and tools to match overall business requirements, ensuring consistency across all user groups [3, 4, 8]

Table 57. Tasks Mapped to the "Digital Engineering Policy and Guidance" Competency

Proficiency Level	KSABs
Awareness	• Understand the maintenance of system models for system development efforts are accomplished in accordance with applicable standards and policies [2-4, 10, 12, 17-34]
Basic	• Define plans, processes, and appropriate tools for model governance and analysis on a project [3, 4, 9, 12, 14] • Understand the role of digital engineering with respect to existing DoD acquisition practices [3, 4]
Intermediate	• Create and update the documentation of digital engineering methods and tools [3, 4, 9, 12] • Update engineering processes, manuals, and instructions to achieve desired digital engineering benefits [3, 4, 12]
Advanced	• Contribute to organizational policies, standards, and guidelines for methods and tools [3, 4, 9, 12] • Tailor processes in line with agreed standards and evaluation of digital engineering methods and tools [3, 4, 12] • Develop policy and guidance about models, simulations, and digital engineering [3, 4, 12] • Maintain standards or guidance for the execution of model-based systems engineering and architectural design [3, 4, 10, 12] • Manage the system model and architecture products for policy compliance and framework alignment [2-4, 10, 12, 17-34] • Review and judge the adequacy of tailoring of enterprise-level systems modeling and analysis processes for specific requirements [12]
Expert	• Create standards or guidance for the execution of model-based system engineering and architectural design [3, 4, 12] • Define modeling standards and quality targets for an organization [3, 4, 12] • Define strategy and approach to be used for modeling and analysis of complex or novel system or system elements [3, 4, 12] • Ensure that appropriate model-based engineering methods and standards (corporate, industry, national, and international) are adhered to [2-4, 10, 12, 17-34] • Create governance approaches for model-based systems engineering activities and digital artifacts to enable governance activity to be conducted with reasonable independence from management activity, in line with the organization's corporate governance requirements [3, 4, 12]

Table 58. Tasks Mapped to the "Configuration Management" Competency

Proficiency Level	KSABs
Awareness	• Aware of the configuration management policies, standards, and guidelines [2, 4, 10, 12-14, 17-34]
Basic	• Apply tools, techniques, and processes to administer, track, log, report on, and correct configuration items, components, and changes [2, 12, 14, 15, 17-34] • Assist with audits to check the accuracy of information and undertakes any necessary corrective action under direction [2, 12, 14, 15, 17-34] • Contribute to configuration management using digital modeling [2, 12, 17-34]
Intermediate	• Create traceability records from test cases back to requirements [12, 23-31, 34] • Ensure that users comply with identification standards for object types, environments, processes, lifecycles, documentation, versions, formats, baselines, releases, and templates [2, 4, 12, 14, 17-34] • Perform audits to check the accuracy of information and undertake any necessary corrective action under direction [2, 12, 14, 15, 17-34] • Assess the details of digital enterprise environment hardware/software items that have been installed and removed so that configuration management records can be updated [12] • Verify and approve changes ensuring protection of assets and components from unauthorized change, diversion, and inappropriate use [2, 12, 14, 15, 17-34]
Advanced	• Contribute to development of configuration management strategies, policies, standards, and guidelines in accordance with model-based engineering methods and digital artifacts [12, 14, 33] • Agree to the scope of configuration management processes and the configuration items and related information to be controlled [10, 12, 33] • Develop, configure, and maintain tools (including automation) to identify, track, log, and record accurate, complete, and current information [12] • Ensure that operational processes are in place to maintain secure configuration, consistent classification and management of configuration items, and for the verification and audit of configuration items [3, 4, 12, 14] • Identify, evaluate, and manage the adoption of appropriate tools, techniques, and processes (including automation) for configuration management of digitally-based artifacts and systems [12] • Plan the capture and management of configuration items and related information [10, 12, 14, 33] • Propose and agree on the configuration items to be uniquely identified with naming conventions [12] • Assess reports on the status of the configuration management of digital artifacts and systems to define, measure, assess, improve, tailor, and/or automate methods and tools used to support the digital enterprise environment [12]

Expert	• Develop configuration management strategies, policies, standards, and guidelines for digital engineering-related artifacts [12] • Develop new methods such as automation and organizational capabilities for the configuration management of digital artifacts [12]

Table 59. Tasks Mapped to the "Software Construction" Competency

Proficiency Level	**KSABs**
Awareness	•
Basic	•
Intermediate	•
Advanced	• Specify user/system interfaces, including validation and error correction procedures, processing rules, access, security, and audit controls [11]
Expert	•

Table 60. Tasks Mapped to the "Software Engineering" Competency

Proficiency Level	**KSABs**
Awareness	•
Basic	• Identify and report testing software issues and risks, associated with own work [10] • Receive and respond to routine requests for software security support [15, 16]
Intermediate	• Assist in the configuration of software and equipment and the systems testing of platform-specific versions of one or more software products [16] • Carry out agreed system software maintenance tasks [9] • Correct malfunctions on system installations [9, 16] • Document software faults, implement resolutions, and retest to agreed standards [10]
Advanced	• Assess software-associated risks and specify recovery routines and contingency procedures [10, 16]

	• Contribute to the development of software information assurance policies, standards, and guidelines [9] • Investigate and coordinate the resolution of potential and actual software service problems [9, 16] • Investigate software security breaches in accordance with established procedures and recommend required actions and support/follow-up to ensure these are implemented [15, 16] • Plan the installation and testing of new versions of system software [9] • Prepare and maintain operational documentation for system software [9] • Process and analyze software security evidence in line with policy, standards, and guidelines and support production of forensics findings and reports [10, 16] • Provide reports on progress, anomalies, risks, and issues associated with the overall software project [10] • Provide software specialist advice to support others [9] • Specify requirements for software digital, data, resources, and tools [9]
Expert	• Lead complex security investigations engaging additional specialists if required [15] • Manage all risks associated with software testing and take preventative action when any risks become unacceptable • Manage complex software security investigations engaging additional specialists if required [15] • Review new software application proposals and provide specialist advice on security issues and implications [15, 16] • Set policies, standards, and guidelines for how an organization conducts software digital forensic investigations [15, 16]

Table 61. Tasks Mapped to the "Digital Environment Development" Competency

Proficiency Level	KSABs
Awareness	• Describe the basic concept of digital engineering within a digital enterprise environment [1-7, 9-34]
Basic	• Streamline contracting, procurement, legal, and business practices by transitioning to a model-based approach [3-7] • Relate the importance of methodology to achieving digital engineering within a digital engineering enterprise [3, 4] • Understand the definition of technical coherency [4] • Understand the characteristics of technical coherency [4] • Understand the challenges and benefits of developing a digital engineering ecosystem [4, 9, 16]

	• Understand the components of the digital engineering ecosystem [9, 16] • Understand at a high level the infrastructure components of the digital engineering ecosystem, including hardware, software, networks, and MPTs and how these will interact in a digital engineering ecosystem [9, 16] • Understand how digital thread and digital twin work within the DE Ecosystem [23-25, 27, 29, 30, 34]
Intermediate	• Leverage technologies currently available in the marketplace, while finding high-payoff solutions for decision making in acquiring, deploying, and maintaining the enterprise digital environment [9, 16] • Review digital enterprise environment requirements and specifications, and define test conditions [9, 16] • Ensure the digital enterprise environment supports evaluating concepts, engaging the user, and identifying tradeoffs using a digital representation of the system of interest [16]
Advanced	• Ensure that operational procedures and working practices for decision making in acquiring, deploying, and maintaining the enterprise digital environment are fit for purpose and current [9, 16] • Develop, mature, and implement digital enterprise environment tools [16] • Contribute to development of policy, standards, and procedures for decision-making for acquiring, deploying, and maintaining a digital environment that is compliant with relevant policies [10, 16] • Develop, mature, and use digital engineering methodologies in place of document-based approaches [1-7, 9, 10, 12-34] • Evaluate and identify digital engineering tools for stakeholders based on current and future needs [1, 9, 16] • Lead the processes of design, procurement, installation, upgrading, operation, control, maintenance (including storage, modification, and communication of data, voice, text, audio, and images) and the effective use of digital enterprise environment components, and monitor their performance [9, 16] • Identify information and communication systems that support the digital enterprise environment processes and manage the relationship with specialists with authority for those systems [9, 16] • Produce outline digital enterprise environment system designs and specifications, and overall architectures, topologies, configuration databases, and design documentation of networks and networking technology within the organization [9, 16] • Produce specifications of cloud-based or on-premises components, tiers, and interfaces, for translation into digital enterprise environment using selected services and products [9, 16] • Review digital enterprise environment-related requirements and specifications, and define digital enterprise environment test conditions [9, 16] • Develop digital enterprise environment application installation procedures and standards [16]
Expert	• Create and maintain overall digital enterprise environment network plans to support the organization's business strategy and service level agreements with customers [16]

	• Establish a digital enterprise environment supporting infrastructure and environment to perform activities, collaborate, and communicate across stakeholders [1, 16] • Establish an end-to-end digital engineering enterprise by focusing on production, delivery, and sustainment of the end item [16] • Lead the development of digital enterprise environment organizational capabilities for methods and tools (including automation) to ensure adoption and adherence to policies and standards [16] • Provide hardware and software recommendations to perform digital enterprise environment activities [16] • Review new digital enterprise environment-related software application procurement proposals and provide specialist advice on digital enterprise environment security issues and implications [16] • Specify requirements for digital enterprise environment, data, resources, and tools [1, 9, 16] • Take responsibility for major aspects of digital enterprise environment network specifications and design within the organization [16]

Table 62. Tasks Mapped to the "Management" Competency

Proficiency Level	**KSABs**
Awareness	• Describe how digital engineering tasks and products are incorporated into a contract [2-4, 6-8, 10, 13, 14] • Describe the risks and opportunities of using digital engineering [1-8, 10, 12, 15-34]
Basic	• Manage risks associated with digital enterprise environment testing and take preventative action when risks become unacceptable [9, 10, 15, 16] • Explain the concept of authoritative source of truth [1-5, 13, 17-34]
Intermediate	• Produce routine reports to assist in digital environment management activities and decision making [9, 16]
Advanced	• Produce reports as appropriate for digital enterprise environment portfolio governance, including making recommendations for changes to the portfolio [16] • Review current and proposed digital enterprise environment for compliance with the organization's obligations (including legislation, regulatory, contractual, and agreed standards/policies) and adherence to overall strategy [9, 10, 15] • Ensure the workforce has proper digital engineering qualifications [4, 8] • Control digital environment assets in one or more significant areas, ensuring that the administration of the acquisition, storage, distribution, movement, and disposal of assets is carried out [9, 12, 16]

	• Maintain and update content management processes to meet the needs of users including those with disabilities [12, 14] • Support a model-based culture and environment, leveraging capabilities of the digital enterprise environment infrastructure of the organization [3, 4, 8] • Take responsibility for organization's digital engineering projects, providing effective team leadership, including information flow to and from team members during project work [3, 4, 9, 16]
Expert	• Identify leadership teams (e.g., champions, sponsors, etc.) that are accountable to actively participate in managing and implementing the digital transformation efforts [3, 4, 8] • Make a deliberate effort to transform the workforce to promote a cultural change, including efforts such as training, education, strategic communication, leadership, and continuous improvements in model-based engineering methods [4, 8] • Transform the culture by encouraging the workforce to develop and implement enterprise-wide digital enterprise environment strategies [3, 4, 8]

Table 63. Tasks Mapped to the "Communications" Competency

Proficiency Level	**KSABs**
Awareness	• Advance digital engineering policy, guidance, specifications, and standards by using commonality in terminology, developing a shared understanding of concepts, and ensuring consistency and rigor in implementing digital engineering across engineering activities [1-5, 9, 10, 12, 13, 15, 17-34]
Basic	• Communicate using digital model artifacts from the digital enterprise environment [1-7, 10, 12, 13, 17-34]
Intermediate	• Communicate and share the digital modeling strategy for a specific project [1-5, 10, 12, 13, 17-34]
Advanced	• Investigate and manage the adoption of appropriate model-based tools, techniques, and processes (including automation) for the management of digital enterprise environment systems and services [9, 16] • Collate digital enterprise environment usage conclusions and recommendations and present lessons learned to stakeholders [9, 16]
Expert	• Engage with and influence senior-levels and project teams through digital enterprise environment management processes, ensuring that the infrastructure is managed to provide agreed levels of service and data integrity. [1]

	• Communicate and execute the digital engineering vision, strategy, and implementation by providing a mechanism for people to ask questions and provide feedback, establishing priorities and key milestones, and defining roles and responsibilities of staff [4, 8] • Establish the appropriate guidance to enable transparent decision-making to be demonstrated, working with senior leaders to ensure the needs of principal stakeholders are understood, the value proposition offered by digital enterprise environment is accepted by these stakeholders and the evolving needs of the stakeholders and their appetite for balancing benefits, opportunities, costs, and risks is embedded into strategic and operational plans. [1, 4]

Table 64. Tasks Mapped to the "Planning" Competency

Proficiency Level	**KSABs**
Awareness	• Aware of the digital enterprise environment continuity management plan [3, 9, 16]
Basic	• Participate in the coordination of the digital enterprise environment content management [3, 16] • Understand the stakeholder that will be impacted by the switch to a digital ecosystem and the roles and responsibilities of these stakeholders [1, 3, 4]
Intermediate	• Coordinate digital enterprise environment content management processes to meet the needs of users, including those with disabilities [3, 16] • Plan the digital enterprise environment infrastructure necessary to provide the digital application services to meet service-level agreements [9]
Advanced	• Implement and contribute to the development of a digital enterprise continuity management plan [3, 16] • Lead the preparation of digital enterprise environment technical plans and, in liaison with business assurance and project staff, ensure that appropriate digital engineering related resources are made available, within a change program [3, 9]
Expert	• Ensure that a framework of policies, standards, processes, and practices is in place to guide provision of digital enterprise environment services, and that suitable monitoring of the governance framework is in place to report on adherence to these obligations [3, 9]d

Table 65. Tasks Mapped to the "Digital Environment Operations" Competency

Proficiency Level	**KSABs**
Awareness	• Follow digital enterprise environment procedures, including performing simple installations, replacing consumable items, checking correct working of installations, and documenting/reporting on work done [9, 16] • Understand that as a model repository, the digital enterprise environment can be used as a single authoritative source of truth [1-5, 10, 12-34] • Understand established digital engineering publishing processes and dashboards used to distribute digital content (formally or informally) to interested stakeholders [1-7, 9, 10, 12-34]
Basic	• Adapt to changes in digital enterprise environment process and technology [16] • Identify digital environment-related operational problems and contribute to their resolution, checking that they are managed in accordance with agreed standards and procedures [9, 16] • Understand digital enterprise environment technical publication concepts, tools, and methods and they way in which these are used [1-7, 9, 10, 12-34] • Use organization's agreed-upon digital enterprise environment procedures to publish content, and create and maintain data records [1-7, 9, 10, 12-34]
Intermediate	• Carry out agreed-upon operational procedures, including infrastructure configuration, installation, and maintenance [9, 16] • Contribute to digital enterprise environment capacity modeling and planning [9, 16] • Provide technical expertise to enable the correct application of digital enterprise environment operational procedures [9, 16] • Configure digital engineering methods and tools to address the project needs [9, 16] • Implement systems and controls for digital enterprise environment to measure performance and manage risk [9, 10, 16] • Use digital enterprise environment content publishing systems to manage published content across different channels [1-3, 5-7, 9, 10, 12-34] • Use standard procedures and tools to carry out defined digital enterprise environment system backups, restoring data where necessary [9, 16] • Provide support on the use of existing model-based engineering methods and tools [9, 16]
Advanced	• Configure modeling tools to automate the provisioning, testing, and deployment of new and changed digital enterprise environment infrastructure [9, 16]

	• Create digital modeling and simulation artifacts and technology roadmaps, and share knowledge and insights from processes and results, with others [1, 2, 5, 17-34] • Define digital environment configurations required for testing with reference to agreed upon testing standards [9, 16] • Ensure that digital information is presented effectively [1-7, 9, 10, 12-34] • Provide expert technical knowledge in the systems testing of platform-specific versions of the digital enterprise environment products, on varying platforms [9, 16] • Perform digital enterprise environment activities related to administration of assets [1, 2, 5, 9, 12, 14-34] • Provide specialist guidance and advice to less experienced colleagues to ensure best use is made of available digital environment assets, and to maintain or improve the digital environment installation service [16] • Select appropriate channels through which digital content should be published, providing advice to content authors on how to leverage features of relevant digital channels and suggest methods and tools [3, 9, 14, 16]
Expert	• Control digital environment assets in one or more significant areas, ensuring that administration of the acquisition, storage, distribution, movement, and disposal of assets is carried out [9, 14, 16] • Set parameters for the prioritization of digital resources and the changes to be implemented [9, 16]

Table 66. Tasks Mapped to the "Digital Environment Support" Competency

Proficiency Level	**KSABs**
Awareness	• Aware of the maintenance and support plans of the digital enterprise environment [9, 16] • Understand the tools, techniques, and processes to log, track, and report on configuration items, components, and changes [9, 12, 16]
Basic	• Contribute to digital enterprise environment maintenance, installation, and problem resolution [9, 16] • Obtain and analyze digital enterprise environment usage data, and present it effectively [16] • Ensure that project-specific needs are supported in the digital enterprise environment [9] • Conduct tests on digital enterprise environment installations with guidance [9, 16]
Intermediate	• Apply tools, techniques, and processes to create and maintain an accurate digital enterprise environment register [9, 16] • Assess digital environment associated risks, and specify recovery routines and contingency procedures [9, 10, 16]

	• Contribute to the planning and implementation of maintenance and installation of infrastructure components for virtualized environments [9, 16] • Contribute to the planning and implementation of maintenance and installation work, including building and configuration of infrastructure components in digital environments [9, 16] • Contribute to investigations of problems and faults concerning the installation of digital environment hardware and/or software and confirm the correct working of digital installations [9, 16] • Correct digital environment malfunctions, calling on other experienced colleagues and external resources if required [9, 16] • Identify potential hazards or risks related to the use of digital enterprise environment tools and equipment [9, 10, 16] • Install or remove digital enterprise environment hardware and/or software, and associated connections, using supplied installation instructions and tools, and where appropriate, handover to the client [9, 16] • Maintain accurate records of various metrics related to digital artifacts and digital enterprise environment infrastructure [9, 16] • Provide assistance to digital enterprise environment users following agreed-upon procedures for further help or escalation [16] • Maintain and troubleshoot digital enterprise environment tools and technologies [9, 16] • Use infrastructure management tools to collect and report on digital enterprise environment load and performance statistics and to automate the provisioning, testing, and deployment of new and changed infrastructure [9, 16] • Create test cases using own in-depth technical analysis from model-based engineering methods, of both functional and non-functional specifications (such as reliability, efficiency, usability, maintainability, and portability) [9, 16] • Analyze and report test activities and results using model-based engineering methods and tools [9, 16] • Understand the specific definition of verification regarding DE [9, 16] • Understand the specific definition of validation with regard to DE [9, 16] • Understand the use of a digital ecosystem for VV&A of the system [9, 16] • Verify that products developed are aligned with review and/or analysis [9, 16]
Advanced	• Use appropriate digital enterprise environment tools, techniques, and proprietary guidelines to conform to application programming interface definitions for new or existing platforms and applications [9, 16] • Schedule and supervise all digital enterprise environment maintenance and installation work [9, 16] • Act to highlight and resolve potential instances of digital enterprise environment unauthorized usage such as unlicensed copies of software [9, 16]

	• Develop, mature, and implement methods and processes to support digital enterprise environment activities across the enterprise and lifecycle [9, 16] • Understand basic approaches for maintenance, installation, and problem resolution for digital environments [9, 16] • Create and maintain an inventory of information assets, which are subject to relevant oversight [9, 12, 16] • Analyze and implement technological innovations in digital environment to enable end-to-end digital enterprise [9, 16] • Develop digital enterprise environment installation procedures and standards, and schedule installation work [9, 16] • Document digital environment-related faults, implement resolutions, and retest to agreed standards [9, 16] • Draft and maintain standards and procedures for digital enterprise environment component capacity management [9, 16] • Identify and analyze problems and issues with decision making for acquiring, deploying, and maintaining enterprise digital environment and recommend corrective actions [9, 16] • Implement agreed-upon digital enterprise environment infrastructure changes and maintenance routines [9, 16] • Manage and maintain service compliance of all digital enterprise environment service assets in line with business and regulatory requirements involving knowledge of financial and technical processes, tools, and techniques [9, 16] • Manage digital enterprise environment capacity modeling and forecasting activities [9, 16] • Produce and analyze registers and histories of authorized digital enterprise environment assets (including secure master copies of software, documentation, data, licenses, and agreements for supply, warranty, and maintenance) and verify that all these assets are in a known state and location [9, 16] • Produce reports and analysis to support digital enterprise environment asset management activities and aid decision making [9, 16] • Produce reports on progress, anomalies, risks, and issues associated with a digital enterprise environment modeling project [9, 10, 16] • Provide specialist guidance information to support digital enterprise environment systems testing and quality assurance functions, to assist in improving procedures [9, 12, 16] • Undertake routing installations and deinstallations of digital enterprise environment items of hardware and/or software [9, 16] • Use infrastructure management tools to determine digital enterprise environment load and performance statistics [9, 16] • Oversee maintenance, installation, and problem resolution for digital enterprise environment [9, 16]

	• Configure digital enterprise environment tools to maintain records of user requests, contact details, and outcomes [9, 11, 16] • Extend the digital enterprise environment model to define test strategies or cases [9, 16]
Expert	• Contribute to the creation and maintenance of digital environment policy, standards, procedures, and documentation for security [9, 15, 16] • Determine digital environment testing policies, including processes related to security [9, 15, 16] • Investigate and coordinate the resolution of potential and actual digital enterprise environment service problems [9, 16] • Lead and manage investigations into complex digital enterprise environment issues, engaging additional specialists if required [9, 16] • Plan all aspects of the infrastructure necessary to ensure provision of digital enterprise environment network services to meet organization's business strategy and service level agreements with customers [9, 16] • Provide authoritative advice and guidance on any aspect of digital environment test planning and execution [9, 16] • Provide information and advice on digital enterprise environment issues such as maintenance of hardware assets, licensing of software, protection of intellectual property, and legal obligations [9, 15, 16] • Provide reports and proposals for digital enterprise environment improvements to specialists, users, and managers [9, 16] • Report on digital enterprise environment portfolio status as appropriate [9, 16] • Review information, in conjunction with service level agreements, to identify any digital enterprise environment capacity issues and specify any required changes [9, 16]

Table 67. Tasks Mapped to the "Digital Environment Security" Competency

Proficiency Level	**KSABs**
Awareness	• Understand digital enterprise environment access and controls for the authoritative source of truth in the digital enterprise environment [1-5, 9-34] • Understand the purpose of the application and operation of digital environment physical, procedural, and technical security controls AND Provide advice and guidance on the application and operation of digital environment physical, procedural, and technical security controls [11, 15, 16] • Maintain relevant records and documentation on digital enterprise environment security administration tasks [16]

	• Perform simple digital enterprise environment security administration tasks [16] • Receive and respond to routine digital enterprise environment requests for security support [11, 15, 16] • Secure digital enterprise environment infrastructure and protect intellectual property [11, 15, 16]
Basic	• Assist in the investigation and resolution of issues relating to access controls and security systems [11, 15, 16] • Develop policies, standards, processes, and guidelines for ensuring the physical and electronic security of digital environments [10, 11, 15, 16]
Intermediate	• Assist users in defining their access rights and privileges [11, 15, 16] • Interpret digital enterprise environment information assurance and security policies and apply these to appropriately manage risks [10, 15, 16] • Perform non-standard digital enterprise environment security administration tasks and resolve security administration issues [16] • Provide advice and guidance to ensure adoption of and adherence to digital enterprise environment information assurance architectures, strategies, policies, standards, and guidelines [10, 15, 16] • Apply and maintain specific security controls as required by organizational policy and local risk assessments [11, 15, 16] • Perform basic risk assessments for digital enterprise environment information systems [10, 15, 16] • Use digital testing methods to support digital enterprise environment information assurance [16]
Advanced	• Contribute to the development of information security policy, standards, and guidelines [15, 16] • Contribute to the creation and maintenance of digital environment policy, standards, procedures, and documentation for security [15, 16] • Develop corporate information assurance policy, standards, and guidelines [15, 16] • Obtain and act on vulnerability information and conduct security risk assessments, business impact analysis, and accreditation on digital enterprise environment [10, 15, 16] • Perform security risk, vulnerability assessments, and business impact analysis for digital enterprise environment [10, 15, 16] • Ensure that all identified breaches in digital enterprise environment security are promptly and thoroughly investigated and that any system changes required to maintain security are implemented [4, 11, 15, 16] • Ensure that digital enterprise environment security records are accurate and complete and that requests for support are dealt with accordinag to set standards and procedures [15, 16] • Investigate digital enterprise environment security breaches in accordance with established procedures and recommend required actions and support/follow up to ensure these are implemented [11, 15, 16]

	• Assess impact of suspected cyber-attacks and manage security incidents, supporting digital enterprise environment digital forensics where appropriate [11, 15, 16] • Maintain digital enterprise environment security administration processes and check that all requests for support are dealt with according to agreed procedures [11, 15, 16] • Monitor the application and compliance of digital enterprise environment security administration procedures and review information systems for actual or potential breaches in security [15, 16] • Process and analyze evidence of digital enterprise environment security breaches in line with policy, standards, and guidelines and support production of forensics findings and reports [11, 15, 16] • Provide advice and guidance on digital enterprise environment-based security strategies to manage identified risks and ensure adoption of IT-industry standard processes [10, 11, 15, 16] • Provide guidance in defining digital enterprise environment access rights and privileges [4, 11, 15, 16] • Provide secure connected information network recommendations to perform digital enterprise environment activities [9, 15, 16]
Expert	• Develop and communicate corporate information security policy, standards, and guidelines [3, 4, 15, 16] • Develop policies, standards, processes, and guidelines for ensuring the physical and electronic security of automated systems [15, 16] • Ensure compliance between business strategies and information assurance by setting strategies, policies, standards, and practices and leading the provision of information assurance expertise, advice, and guidance across all of the organization's digital enterprise environment [3, 4, 15, 16] • Ensure that all identified breaches in digital environment security are promptly and thoroughly investigated and that any changes required to maintain security are implemented [4, 15, 16] • Ensure that the digital environment policy and standards for security administration are fit for purpose, current, and are correctly implemented [4, 10, 15, 16] • Ensure that the policy and standards for digital enterprise environment security administration are fit for purpose, current, and are correctly implemented [4, 10, 15, 16] • Direct the development, implementation, delivery, and support of a digital enterprise environment information security strategy aligned to the strategic requirements of the business [3, 4, 15, 16] • Lead the provision of authoritative advice and guidance on the requirements for digital enterprise environment security controls in collaboration with experts in other functions such as legal, technical support [15, 16] • Lead the provision of information security resources expertise, guidance, and systems necessary to execute strategic and operational plans across all of the organization's digital enterprise environment systems [15, 16]

	• Set policies, standards, and guidelines for how the organization conducts digital enterprise environment digital forensic investigations [15, 16] • Establish digital enterprise environment access and controls for the authoritative source of truth [3, 4]

Table 68. Tasks Mapped to the "Digital Literacy" Competency

Proficiency Level	**KSABs**
Awareness	• Use established publishing processes according to appropriate guidelines, for example, to release, retire, or convert content into a format suitable for publication [2, 5, 14-34] • Follow digital engineering procedures, including performing simple installations, replacing consumable items, checking correct working of installations, and documenting/reporting on work done [16] • Understand that as a model repository, the digital engineering framework can be used as a single authoritative source of technical truth [1-5, 10, 12-15, 17-34]
Basic	• Act as a contributor to modeling tasks on a design engineering team [15, 17-34] • Apply modeling tasks employing a model-based systems engineering approach [2, 17-34] • Define test conditions for given requirements [23, 27, 29-32] • Describe digital artifacts' contribution to the following engineering concepts: Systems of Systems (SoS), program interoperability, and modularity [1-5, 10, 13, 15, 17-34] • Describe how digital artifacts advance the state of practice in Digital Engineering [1-5, 10, 13, 15, 17-34] • Describe the purpose of different stakeholder views [1, 2, 13, 15, 17-34] • Document results in accordance with agreed procedures [1, 2, 5-7, 10, 13, 15, 17-34] • Establish access and controls for the authoritative source of truth [11, 12, 14-16] • Explain the difference in stakeholder views [1, 2, 13, 15, 17-34] • Maintain records and advise relevant persons of actions taken [1, 2, 5-7, 10, 12-34] • Perform digital engineering activities related to administration of assets [12, 14, 16-34] • Relate the importance of a methodology to achieving Digital Engineering [1-3, 5, 10, 13, 17-34] • Understand technical publication concepts, tools, and methods and the way in which these are used [1-3, 5, 13-34] • Use agreed-on procedures to create and maintain an accurate register of assets [10, 12, 14, 16] • Use agreed procedures to publish content [1-3, 5, 9, 10, 13-34]
Intermediate	• Capture stakeholder high-level requirements [1-4, 15, 17-34]

	• Coordinate content management processes to meet the needs of users, including those with disabilities [1, 11, 12, 14] • Communicate information security risks and issues to business managers and others [10, 15, 16] • Maintain accurate records of user requests, contact details, and outcomes [11, 15, 16] • Provide advice and guidance to ensure adoption of and adherence to information assurance architectures, strategies, policies, standards, and guidelines [10, 12, 15, 16] • Respond to security breaches in line with security policy and record the incidents and take action [11, 15, 16] • Review the architectural products created by others [2, 13, 15, 17-34] • Submit waivers and deviations for approval [2, 5, 13, 17-34] • Take into account any legal issues related to publishing, including that associated copyright concerns are adequately managed [1, 14, 15] • Use content publishing systems to manage published content across different channels [1-3, 12, 14-34] • Use digital artifacts to advance the state of practice in Digital Engineering [1-5, 13, 15, 17-34]
Advanced	• Advise on the choice of techniques and approach and influence customers accordingly [1-4, 17-34] • Collate conclusions and recommendations and present forensics findings to stakeholders [1, 2, 5-7, 13, 17-34] • Conduct investigations to correctly gather, analyze, and present the totality of findings, including digital evidence – to both business and legal audiences [5-7] • Conduct technical reviews on a continuous basis, especially as the technical baseline matures, to produce digital artifacts and inform decisions [1, 5, 13, 17-34] • Coordinate information resources to meet specific business objectives whilst maintaining the principles of professional standards, accountability, openness, equality, diversity, and clarity of purpose [3, 5-7, 13] • Create and maintain an inventory of information assets, which are subject to relevant legislation [12] • Create reports and technology roadmaps and share knowledge and insights with others [1, 2, 5, 17-34] • Define and communicate the test strategy for the project [23, 27, 29-32] • Develop and implement quality plans and method statements [12] • Ensure asset controllers, infrastructure teams, and the business coordinate and optimize value, maintain control, and maintain appropriate legal compliance [10] • Explain the purpose of and provide advice and guidance on the application and operation of elementary physical, procedural, and technical security controls [15, 16] • Identify, assess, and communicate associated risks related to asset management [10, 15] • Identify information and communication systems that support the critical business processes and manage the relationship with specialists with authority for those systems [16]

	• Identify the implications of copyright, data protection, and other legal issues associated with publishing [1, 15] • Investigate major breaches of security and recommend appropriate control improvements [11, 15, 16] • Investigate suspected attacks and manage security incidents, using digital forensics where appropriate [11, 15, 16] • Manage client relationships with respect to testing matters [23, 27, 29-32] • Manage large programs [1-7] • Monitor the effectiveness of installations, and ensure that appropriate recommendations for change are made [9, 16] • Obtain and act on vulnerability information and conduct security risk assessments, business impact analysis, and accreditation on complex information systems [10, 15, 16] • Obtain input from and communicate modeling results to senior managers for agreement [17-34] • Perform security risk, vulnerability assessments, and business impact analysis for medium complexity information systems [10, 15, 16] • Plan effective data storage, sharing, and publishing within the organization [9, 16] • Plan large programs [1-4, 6, 7] • Produce and analyze registers and histories of authorized assets (including secure master copies of software, documentation, data, licenses and agreements for supply, warranty, and maintenance), and verify that all these assets are in a known state and location [16] • Propose and agree on the configuration items (CIs) to be uniquely identified with naming conventions [12] • Provide advice and guidance on security strategies to manage identified risks and ensure adoption and adherence to standards [10, 15, 16] • Provide specialist advice to those accountable for governance to correct compliance issues [10] • Provide specialist expertise in the design characteristics of data management systems (DBMS) or data warehouse products/services [9, 16] • Report on the status of configuration management [12] • Review current and proposed information systems for compliance with the organization's obligations (including legislation, regulatory, contractual, and agreed standards/policies) and adherence to overall strategy [10] • Review the benefits and value of digital engineering methods and tools [1, 2, 4, 5, 9, 13, 17-34] • Schedule and supervise all IT maintenance and installation work [16] • Select appropriate channels through which content should be published, providing advice to users and content authors to leverage the features of the relevant channels and tools used [1, 15] • Support a systems modeling culture and environment, leveraging the capabilities of the organization [2-5, 8, 13, 15, 17-34]

Expert	• Develop the overall strategy for the delivery of information and knowledge, including preferred media, overall information structure, and rules for formatting content to meet the needs of the organization and its desired audience [3, 4, 15] • Act as the organization's contact for relevant regulatory authorities [10] • Communicate and execute the digital engineering vision, strategy, and implementation by providing a mechanism for people to ask questions and provide feedback [4, 8] • Communicate and execute the digital engineering vision, strategy, and implementation by providing resources, establishing priorities and key milestones, and defining roles and responsibilities to enable [4] • Demonstrate efficient communication among stakeholders about relationships between system requirements and the system being developed, through creating and maintaining precise engineering artifacts and traceability of designs to requirements [1, 2, 4, 13, 17-34] • Develop configuration management strategies, policies, standards, and guidelines for digital engineering-related artifacts [12] • Develop new methods such as automation and organizational capabilities for the configuration management of digital artifacts [12] • Develop organizational policies, standards, and guidelines for data management, aligned with ethical principles [14, 15] • Develop organizational policies, standards, and guidelines for information and records management ensuring that uniformly recognized and accepted data definitions are developed and applied throughout the organization [14] • Develop policy and strategies to ensure all of the performance measures of IT services meet the needs of the business and performs to any service level agreements which may be in place [9, 16] • Engage with and influence senior-level stakeholders and project teams through change management processes, ensuring that the infrastructure is managed to provide agreed levels of service and data integrity [1, 2, 12] • Engage with and influence relevant stakeholders to obtain organizational commitment to technology roadmaps [1, 3, 4, 13] • Ensure that a framework of policies, standards, processes, and practices is in place to guide provision of enterprise IT services, and that suitable monitoring of the governance framework is in place to report on adherence to these obligations, as needed [16] • Ensure that adequate procedures, standards, tools, and resources are in place to ensure the appropriate quality of material published by or on behalf of the organization and it is in a form accessible to all potential users, including those with disabilities [1, 9, 12, 14]

	• Ensure that any legal issues related to publishing, including associate copyright concerns, are adequately managed [1, 10, 14, 15] • Ensure that the business processes and information required to support the organization are defined, and devise appropriate processes and data architecture [3, 4, 6, 7, 9] • Establish a supporting infrastructure and environment to perform activities, collaborate, and communicate across stakeholders [1, 9] • Establish and communicate the organization's information management strategy, developing it as an integral part of the business strategy [16] • Establish and maintain the policies for compliance with the organization's obligations (including legislation, regulatory, contractual, and agreed standards/policies), holding the management team to account [10] • Establish new projects and support them through their lifecycle [1-4, 6, 7, 10, 13] • Formalize the application of models to support system requirements, design, analysis, verification, and validation activities beginning in the conceptual design phase and continuing throughout development and later lifecycle phases [2-5, 13, 17-34] • Inspire creativity and flexibility in the management and application of IT [16] • Lead the establishment and maintenance of a function that provides a consistent and integrated approach to IT governance in line with the organization's corporate governance requirements [9, 16] • Lead the provision of authoritative advice and guidance on the requirements for security controls in collaboration with experts in other functions such as legal, technical support [15] • Lead the provision of information security resources expertise, guidance, and systems necessary to execute strategic and operational plans across all of the organization's information systems [9, 15, 16] • Manage client relationships with respect to all testing matters [23, 27, 29-32] • Measure and monitor adherence to standards and ensure consistent execution of the process across the organization [12, 15] • Outline key business engagement messages that need to be communicated throughout the program/project [1-4, 13] • Produce network design policies, philosophies, and criteria covering connectivity, capacity, interfacing, security, resilience, recovery, access, and remote access [9, 11, 16] • Promote awareness of, and commitment to, asset control [12] • Promote the continuing economic and effective provision of services, ensuring that all changes to assets and services are appropriately and accurately controlled and recorded [9, 12] • Provide assurance to principal stakeholders that IT services meet the organization's obligations (including legislation, regulatory, contractual, and agreed standards/policies) [9, 16]

	• Provide guidance in defining access rights and privileges [11, 12, 15, 16] • Provide information and advice on issues such as maintenance of hardware assets, licensing of software, protection of intellectual property, and legal obligations [9, 15, 16] • Provide resources to drive adoption of, and adherence to, policies and standards [3, 10, 12, 15] • Responsible for compliance with regulations, standards, and codes of good practice relating to information and documentation, records management, information assurance, and data protection [10, 12, 14-16] • Review information, in conjunction with service level agreements, to identify any capacity issues and specify any required changes [9] • Take overall responsibility for planning effective data storage, security, quality, sharing, availability, retention, and publishing within the organization [9, 14-16]

Table 69. Tasks Mapped to the "Digital Engineering Value Proposition" Competency

Proficiency Level	KSABs
Awareness	• Understand the benefits of working in a digital engineering environment (more efficient and effective) [1-7, 9-34] • Understand the definition of digital engineering [1-7, 9-34]
Basic	• Understand the benefits of digital engineering: greater integration among engineering activities that is enabled through the use of models, simulations, and data that are both well-defined and well-formed, all housed in a single DE Ecosystem; A complex system of systems may involve multiple geographically distributed stakeholders, sometimes with competing priorities and interests. Programs involve ever-greater levels of technology, software, and requirements for both capability and security. [1-7, 9, 10, 12-34] • Understand digital engineering guidance, capabilities, benefits, roles, responsibilities, and activities [1-5, 10-34] • Understand the benefits of digital engineering and the laws that support digital engineering [4, 6, 7] • Understand the benefits of implementing a digital engineering ecosystem: traceability, digital data, MPTs, historical systems information, authoritative source of truth, documents generated from environment, not by hand [1-7, 9, 10, 12-34] • Understand the "community acceptance" model, which includes review, V&V, and accreditation to create credibility and trust [4, 12] • Understand the elements of trust in the community acceptance model (context, governance, accuracy, applicability of MPTs, community buy-in) [1-5, 10, 12-34]

	• Understand the role of stakeholder engagement in building trust in the DE ecosystem [1, 4]
Intermediate	• Understand the limitations of current document-based engineering acquisition practices [1-7, 9, 10, 12-34] • Understand the challenges of current document-based acquisition system (linear, inefficient) [1-7, 9, 10, 12-34] • Understand how digital engineering can reduce program risk [1-7, 9, 10, 12-34]
Advanced	•
Expert	•

Table 70. Tasks Mapped to the "DoD Policy/Guidance" Competency

Proficiency Level	**KSABs**
Awareness	• Ensure the correct implementation of standards and procedures in digital enterprise environment projects [1-7, 9, 10, 12-34] • Understand DoD policy and guidance about models, simulations, and DE in the context of SE [1-7, 9, 10, 12-34] • Understand why the DoD is interested in digital engineering [3, 4]
Basic	•
Intermediate	•
Advanced	•
Expert	•

KSABs for the Coaching and Mentoring Competency were assigned to roles, not to tasks, so there is no table for this competency.

Table 71. Tasks Mapped to the "Decision Making" Competency

Proficiency Level	**KSABs**
Awareness	•
Basic	• Leverage technologies currently available in the marketplace, while finding high-payoff solutions [3, 4, 9]

Intermediate	• Use technological innovations to improve decision making, system capabilities, and performance of computationally intensive engineering activities [3-5] • Identify potential hazards or risks related to the use of tools and equipment [9, 10, 15, 16] • Interpret information assurance and security policies and apply these in order to manage risks [9, 10, 15, 16] • Produce routine reports and analysis to support asset management activities and decision making [5-7, 10-34]
Advanced	• Provide reports on the consolidated status of information controls to inform effective decision making [11, 15, 16] • Contribute to development of policy, standards, and procedures for compliance with relevant legislation [4, 10, 14-16] • Contribute to organizational policies, standards, and guidelines for methods and tools [3, 4, 9, 11, 12, 15, 16] • Contribute to the development of analytics policy, standards, and guidelines [4] • Ensure that operational procedures and working practices are fit for purpose and current [3, 4, 9-12, 14-16] • Identify problems and issues and recommend corrective actions [1-7, 9-34] • Make decisions based on that information, including the need to make changes to the systems [1-7, 9-34] • Manage and maintain the service compliance of all IT and service assets in line with business and regulatory requirements involving knowledge of financial and technical processes, tools, and techniques [9, 10, 16] • Produce reports and analysis to support asset management activities and aid decision making [5-7, 9-11, 13-34]
Expert	• Authorize allocation of resources for the planning, development, and delivery of all information systems services and products [3, 4, 9] • Authorize organizational policies governing the conduct of management of change initiatives and standards of professional conduct [3, 4] • Authorize the structure of portfolios, and be responsible for alignment with business strategy/objectives and with emerging IT and digital opportunities [3, 4] • Determine project testing standards for all phases, influencing all parties to conform to those standards [4] • Ensure that the policies and standards for capacity management are fit for purpose, current, and are correctly implemented [9] • Establish the appropriate guidance to enable transparent decision-making to be demonstrated, working with senior leaders to ensure the needs to principal stakeholders are understood, the value proposition offered by enterprise IT is accepted by these stakeholders and the evolving needs of the stakeholders and their appetite for balancing benefits, opportunities, costs, and risks is embedded into strategic and operational plans [1, 3, 4, 13] • Initiate assessment of consequences and risks arising from decisions to obtain, change, or continue the possession or use of an asset, system, or service [5, 9, 10, 32] • Monitor performance and take corrective action where necessary and in line with policies [3-7, 9, 14-34]

	• Plan and manage implementation of processes and procedures, tools and techniques for monitoring and managing the performance of automated systems and services [9, 11, 16] • Take full responsibility for budgeting, estimating, planning, and objective setting [2-4, 6, 7] • Undertake and/or direct reviews as necessary to ensure management decision-making is transparent, and that an appropriate balance between benefits, opportunities, costs, and risks can be demonstrated to principal stakeholders [3, 4, 5, 13]

Table 72. Tasks Mapped to the "Software Literacy" Competency

Proficiency Level	**KSABs**
Awareness	• Develop an understanding of the role of testing within system development, as a tool for design improvement as well as a validation process [23, 27, 29, 30] • Contribute, under supervision, to infrastructure operation [16] • Maintain relevant records and documentation on security administration tasks [15, 16] • Perform simple security administration tasks [15, 16] • Secure IT infrastructure and protect intellectual property [1-4, 9-11, 13-34]
Basic	• Adapt quickly to changes in process or technology [1-7, 10-34] • Assist with the evaluation of change requests [12, 16] • Conduct tests and correct malfunctions on system installations [9, 16] • Contribute to maintenance, installation, and problem resolution [9, 16] • Contribute, as required, to investigations of problems and faults concerning the installation of hardware and/or software and confirm the correct working of installations [9, 16] • Interpret, execute, and record test cases in accordance with project plans [23, 27, 29, 30] • Obtain and analyze usage data, and present it effectively [9, 16] • Receive and respond to routine requests for security support [15, 16]
Intermediate	• Apply tools, techniques and processes to create and maintain and accurate asset register [9, 12, 16] • Apply tools, techniques, and processes to track, log, and correct information related to configuration items [12, 16] • Contribute to the development of installation procedures and standards [9, 16] • Contribute to the implementation of maintenance and installation work [9, 16] • Contribute to vulnerability assessments [9, 11, 15, 16]

	• Document faults, implement resolutions, and retest to agreed standards [9, 16] • Install or remove hardware and/or software, and associated connections, using supplied installation instructions and tools, and where appropriate, handover to the client [9, 16] • Perform non-standard security administration tasks and resolve security administration issues [15, 16] • Provide assistance to users in a professional manner following agreed-upon procedures for further help or escalation [11, 16] • Report details of all hardware/software items that have been installed and removed so that configuration management records can be updated [9, 16] • Review requirements and specifications, and define test conditions [9] • Understand the capabilities and the requirement sets within modeling and simulation software [17-34] • Use infrastructure management tools to collect and report on load and performance statistics and to automate the provisioning, testing, and deployment of new and changed infrastructure [9, 16] • Use standard procedures and tools to carry out defined system backups, restoring data where necessary [9, 16]
Advanced	• Act to highlight and resolve potential instances of unauthorized assets such as unlicensed copies of software [9, 16] • Assess associated risks, and specify recovery routines and contingency procedures [9, 16] • Contribute to digital forensic investigations [9, 16] • Contribute to setting service level agreements, and plan the infrastructure necessary to provide the network services to meet such agreements [9, 16] • Contribute to the development of information assurance policies, standards, and guidelines [16] • Contribute to the planning and implementation of maintenance and installation work, including building and configuration of infrastructure components in virtualized environments [9, 16] • Control IT assets in one or more significant areas, ensuring that administration of the acquisition, storage, distribution, movement, and disposal of assets is carried out [9, 16] • Coordinate and manage planning of the system and/or acceptance tests, including software security testing, within development or integration project or program [15] • Correct malfunctions, calling on other experienced colleagues and external resources if required [9, 16] • Create and maintain network plans for own area of responsibility [9, 16] • Develop installation procedures and standards and schedule installation work [9, 16] • Develop the capabilities and the requirement sets within modeling and simulation software [17-34] • Document details of all hardware/software items that have been installed and removed so that configuration management records can be updated [9, 16]

	• Ensure that all identified breaches in security are promptly and thoroughly investigated and that any system changes required to maintain security are implemented [9, 11, 15, 16] • Ensure that security records are accurate and complete and that requests for support are dealt with according to set standards and procedures [15, 16] • Identify operational problems and contribute to their resolution, checking that they are managed in accordance with agreed standards and procedures [9, 16] • Implement agreed on infrastructure changes and maintenance routines [9, 16] • Install and test new versions of system software [9, 16] • Investigate and coordinate the resolution of potential and actual service problems [9, 16] • Investigate security breaches in accordance with established procedures and recommend required actions and support/follow-up to ensure these are implemented [11, 15, 16] • Maintain security administration processes and check that all requests for support are dealt with according to procedures [11, 15, 16] • Monitor the application and compliance of security administration procedures and review information systems for actual or potential breaches in security [11, 15, 16] • Process and analyze evidence in line with policy, standards, and guidelines and support production of forensics findings and reports [11, 15, 16] • Produce outline system designs and specifications, and overall architectures, topologies, configuration databases, and design documentation of networks and networking technology within the organization [9, 16] • Produce specifications of cloud-based or on-premises components, tiers, and interfaces, for translation into detailed designs using selected services and products [9] • Provide authoritative advice and guidance on any aspect of test planning and execution [3, 4, 23, 27, 29, 30] • Provide reports and proposals for improvement, to specialists, users, and managers [9, 16] • Provide reports on progress, anomalies, risks, and issues associated with the overall project [10, 15] • Provide specialist advice to support others [16] • Provide specialist guidance and advice to less experienced colleagues to ensure best use is made of available assets, and to maintain or improve the installation service [9, 16] • Provide specialist guidance information to support systems testing and quality assurance functions to assist in improving procedures [16] • Specify requirements for environment, data, resources, and tools [3, 4, 9] • Undertake routine installations and deinstallations of hardware and/or software [9, 16] • Use infrastructure management tools to determine load and performance statistics [9, 16]

Expert	• Ensure the availability of hardware, software, and resources for the systems testing of platform specific versions of one or more software products [16] • Contribute to the development of organizational strategies that address information control requirements [3, 4, 15] • Contribute to the development of organizational strategies that address the evolving business risk and information control requirements [3, 4, 15] • Define configurations required for testing with reference to agreed testing standards [23, 27, 29, 30] • Determine testing policy and own the supporting processes including software security testing [15] • Ensure sites deliver site implementation plans that align with the overall plan [3, 4, 9, 16] • Ensure that the policy and standards for security administration are fit for purpose, current, and are correctly implemented [16] • Lead complex investigations engaging additional specialists if required [9, 16] • Manage all risks associated with the testing and take preventative action when any risks become unacceptable [10, 23, 27, 29, 30] • Manage complex investigations engaging additional specialists if required [9, 16] • Plan all aspects of the infrastructure necessary to ensure provision of network services to meet organization's business strategy and service level agreements with customers [3, 4, 9] • Provide hardware and software to perform digital engineering activities [3, 4, 9, 16] • Provide secure connected information networks to perform digital engineering activities [3, 4, 9, 15, 16] • Provide technical management of an IT operation, ensuring that agreed service levels are met and all relevant policies and procedures are adhered to [9, 16] • Set policies, standards, and guidelines for how the organization conducts digital forensic investigation [16] • Set strategy for monitoring and managing the performance of IT-related systems and services, in respect of their contribution to business performance and benefits to the business [9, 16] • Take responsibility for major aspects of network specification and design within the organization [9, 16]

APPENDIX D: TOTAL AND PERCENTAGE OF KSABS TO ROLES

The following tables show the total number of KSABs in DECF v1.1 assigned to different roles in the different team sizes for the System Requirements Definition and Traceability project.

D.1 Ideal Team of 10

Table 73. KSAB Total and Percentage of DECF KSABs for the Program Manager for the System Requirements Definition and Traceability Project Ideal Team of 10

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	2	67	2	67
	Basic	11	8	73	8	73	4	36
	Intermediate	7	2	29	2	29	2	29
	Advanced	14	7	50	7	50	0	0
	Expert	13	5	38	5	38	0	0
Data Management	Awareness	2	2	100	2	100	2	100
	Basic	7	4	57	4	57	4	57
	Intermediate	1	1	100	1	100	0	0
	Advanced	14	12	86	11	79	2	14
	Expert	6	3	50	3	50	0	0
Modeling	Awareness	11	10	91	10	91	7	64
	Basic	25	15	60	15	60	10	40
	Intermediate	36	25	69	22	61	10	28
	Advanced	35	19	54	19	54	6	17
	Expert	15	6	40	6	40	1	7
Simulation	Awareness	8	3	38	3	38	1	13
	Basic	8	7	88	7	88	2	25
	Intermediate	16	9	56	5	31	5	31
	Advanced	16	6	38	3	19	3	19
	Expert	8	1	13	0	0	1	13
Artificial Intelligence/ Machine Learning	Awareness	2	1	50	1	50	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	2	100	2	100
	Basic	4	1	25	1	25	1	25
	Intermediate	12	7	58	7	58	3	25
	Advanced	2	2	100	2	100	1	50

	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	2	100	2	100	0	0
	Basic	5	5	100	5	100	2	40
	Intermediate	12	9	75	9	75	1	8
	Advanced	17	9	53	9	53	2	12
	Expert	11	0	0	0	0	0	0
Digital Architecting	Awareness	3	3	10	3	100	3	100
	Basic	14	11	79	10	71	8	57
	Intermediate	18	11	61	10	56	8	44
	Advanced	18	15	83	15	83	7	39
	Expert	2	1	50	1	50	0	0
Digital Requirements Modeling	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	2	67	3	100
	Intermediate	15	15	100	9	60	11	73
	Advanced	4	4	100	3	75	2	50
	Expert	1	1	100	1	100	0	0
Digital Validation and Verification	Awareness	2	1	50	1	50	1	50
	Basic	2	1	50	1	50	0	0
	Intermediate	6	4	67	4	67	1	17
	Advanced	3	1	33	1	33	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	11	100	11	100	11	100
	Basic	33	32	97	29	88	26	79
	Intermediate	17	14	82	14	82	12	71
	Advanced	35	23	66	17	49	11	31
	Expert	12	5	42	5	42	1	8
Digital Model-Based Reviews	Awareness	2	2	100	2	100	2	100
	Basic	1	1	100	1	100	1	100
	Intermediate	6	6	100	6	100	5	83
	Advanced	5	5	100	5	100	4	80
	Expert	1	1	100	1	100	0	0
Project and Program Management	Awareness	2	2	100	2	100	2	100
	Basic	18	17	94	16	89	6	33
	Intermediate	12	10	83	9	75	3	25
	Advanced	7	7	100	7	100	4	57
	Expert	3	1	33	1	33	0	0
Organizational Development	Awareness	1	1	100	1	100	0	0
	Basic	2	2	100	2	100	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	3	75	3	75	0	0
	Expert	10	6	60	6	60	0	0
Digital Engineering Policy and Guidance	Awareness	1	1	100	1	100	1	100
	Basic	3	2	67	2	67	0	0
	Intermediate	2	2	100	2	100	0	0
	Advanced	7	6	86	6	86	1	14

	Expert	10	5	50	5	50	1	10
Configuration Management	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	3	100	3	100
	Intermediate	5	5	100	5	100	4	80
	Advanced	8	8	100	8	100	0	0
	Expert	2	2	100	2	100	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	1	20	1	20	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	2	40	2	40	0	0
	Intermediate	5	4	80	4	80	0	0
	Advanced	24	10	42	10	42	0	0
	Expert	10	5	50	5	50	0	0
Digital Environment Development	Awareness	1	1	100	1	100	1	100
	Basic	15	7	47	7	47	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	15	12	82	12	80	1	7
	Expert	13	8	62	8	62	0	0
Management	Awareness	2	2	100	2	100	1	50
	Basic	2	2	100	2	100	1	50
	Intermediate	1	1	100	1	100	0	0
	Advanced	10	8	80	8	80	0	0
	Expert	8	3	38	3	38	0	0
Communications	Awareness	1	1	100	1	100	1	100
	Basic	2	1	50	1	50	1	50
	Intermediate	1	1	100	1	100	1	100
	Advanced	3	2	67	2	67	0	0
	Expert	5	3	60	3	60	0	0
Planning	Awareness	1	1	100	1	100	0	0
	Basic	2	2	100	2	100	0	0
	Intermediate	2	2	100	2	100	0	0
	Advanced	3	2	67	2	67	0	0
	Expert	3	1	33	1	33	0	0
Digital Environment Operations	Awareness	3	3	100	3	100	2	67
	Basic	4	4	100	4	100	2	50
	Intermediate	8	8	100	8	100	1	13
	Advanced	9	8	89	8	89	3	33
	Expert	2	2	100	2	100	0	0
Digital Environment Support	Awareness	3	2	67	2	67	0	0
	Basic	6	4	67	4	67	0	0
	Intermediate	18	18	100	18	100	0	0
	Advanced	25	23	92	23	92	0	0

	Expert	15	10	67	10	67	0	0
Digital Environment Security	Awareness	6	6	100	6	100	1	17
	Basic	2	2	100	2	100	0	0
	Intermediate	7	7	100	7	100	0	0
	Advanced	16	16	100	16	100	0	0
	Expert	11	11	100	11	100	0	0
Digital Literacy	Awareness	4	3	75	3	75	2	50
	Basic	16	14	88	14	88	13	81
	Intermediate	11	11	100	11	100	5	45
	Advanced	41	32	78	32	78	7	17
	Expert	48	37	77	37	77	2	4
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	2	100
	Basic	7	7	100	7	100	4	57
	Intermediate	3	3	100	3	100	3	100
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	3	100	3	100	2	67
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	1	100
	Basic	1	1	100	1	100	1	100
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	1	100	1	100	0	0
	Intermediate	5	5	100	5	100	1	20
	Advanced	10	9	90	9	90	3	30
	Expert	13	11	85	11	85	1	8
Software Literacy	Awareness	7	4	57	4	57	1	14
	Basic	10	7	70	7	70	1	10
	Intermediate	15	14	93	13	87	1	7
	Advanced	38	34	89	33	87	1	3
	Expert	20	16	80	16	80	0	0

Table 74. KSAB Total and Percentage of DECF KSABs for the Chief Engineer for the System Requirements Definition and Traceability Project Ideal Team of 10

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	2	67	2	67
	Basic	11	8	73	8	73	5	45
	Intermediate	7	3	43	2	29	3	43
	Advanced	14	7	50	6	43	5	36
	Expert	13	4	31	3	23	1	8
Data Management	Awareness	2	2	100	2	100	2	100
	Basic	7	4	57	4	57	4	57
	Intermediate	1	1	100	1	100	0	0
	Advanced	14	11	79	10	71	4	29
	Expert	6	3	50	3	50	0	0
Modeling	Awareness	11	11	100	10	91	11	100
	Basic	25	25	100	12	48	25	100
	Intermediate	36	36	100	21	58	36	100
	Advanced	35	29	83	18	51	28	80
	Expert	15	9	60	4	27	8	53
Simulation	Awareness	8	8	100	2	25	8	100
	Basic	8	7	88	5	63	7	88
	Intermediate	16	15	94	4	25	15	94
	Advanced	16	14	88	2	13	13	81
	Expert	8	4	50	0	0	4	50
Artificial Intelligence/ Machine Learning	Awareness	2	1	50	1	50	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	2	100	2	100
	Basic	4	1	25	1	25	1	25
	Intermediate	12	7	58	7	58	3	25
	Advanced	2	2	100	2	100	1	50
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	2	100	2	100	0	0
	Basic	5	5	100	5	100	2	40
	Intermediate	12	11	92	8	67	6	50
	Advanced	17	10	59	9	53	8	47
	Expert	11	1	9	0	0	1	9
Digital Architecting	Awareness	3	3	100	3	100	3	100
	Basic	14	12	86	10	71	12	86
	Intermediate	18	18	100	9	50	18	100
	Advanced	18	18	100	14	78	18	100

	Expert	2	1	50	0	0	1	50
Digital Requirements Modeling	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	2	67	3	100
	Intermediate	15	15	100	9	60	15	100
	Advanced	4	4	100	3	75	4	100
	Expert	1	1	100	0	0	1	100
Digital Validation and Verification	Awareness	2	1	50	1	50	1	50
	Basic	2	1	50	1	50	1	50
	Intermediate	6	6	100	4	67	6	100
	Advanced	3	1	33	1	33	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	11	100	10	91	11	100
	Basic	33	32	97	29	88	31	94
	Intermediate	17	16	94	14	82	16	94
	Advanced	35	32	91	15	43	31	89
	Expert	12	7	58	3	25	6	50
Digital Model-Based Reviews	Awareness	2	2	100	2	100	2	100
	Basic	1	1	100	1	100	1	100
	Intermediate	6	6	100	6	100	6	100
	Advanced	5	5	100	5	100	4	80
	Expert	1	1	100	0	0	0	0
Project and Program Management	Awareness	2	2	100	2	100	2	100
	Basic	18	16	89	14	78	12	67
	Intermediate	12	11	92	9	75	8	67
	Advanced	7	7	100	6	86	6	86
	Expert	3	1	33	1	33	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	1	25	1	25	0	0
	Expert	10	1	10	1	10	0	0
Digital Engineering Policy and Guidance	Awareness	1	1	100	1	100	1	100
	Basic	3	1	33	1	33	0	0
	Intermediate	2	2	100	2	100	0	0
	Advanced	7	6	86	6	86	1	14
	Expert	10	5	50	5	50	1	10
Configuration Management	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	3	100	3	100
	Intermediate	5	5	100	5	100	4	80
	Advanced	8	8	100	8	100	3	38
	Expert	2	2	100	2	100	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0

	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	1	20	1	20	0	0
	Intermediate	5	3	60	3	60	0	0
	Advanced	24	8	33	8	33	0	0
	Expert	10	4	40	4	40	0	0
Digital Environment Development	Awareness	1	1	100	1	100	1	100
	Basic	15	5	33	4	27	1	7
	Intermediate	3	3	100	3	100	0	0
	Advanced	15	11	73	11	73	1	7
	Expert	13	8	62	8	62	0	0
Management	Awareness	2	2	100	2	100	1	50
	Basic	2	2	100	2	100	1	50
	Intermediate	1	1	100	1	100	0	0
	Advanced	10	5	50	5	50	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	1	100	1	100
	Basic	2	1	50	1	50	1	50
	Intermediate	1	1	100	1	100	1	100
	Advanced	3	2	67	2	67	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	1	100	1	100	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	2	2	100	2	100	0	0
	Advanced	3	2	67	2	67	0	0
	Expert	3	1	33	1	33	0	0
Digital Environment Operations	Awareness	3	3	100	3	100	2	67
	Basic	4	4	100	4	100	2	50
	Intermediate	8	8	100	8	100	1	13
	Advanced	9	8	89	8	89	3	33
	Expert	2	2	100	2	100	0	0
Digital Environment Support	Awareness	3	2	67	2	67	0	0
	Basic	6	4	67	4	67	0	0
	Intermediate	18	18	100	18	100	0	0
	Advanced	25	23	92	23	92	0	0
	Expert	15	10	67	10	67	0	0
Digital Environment Security	Awareness	6	6	100	6	100	1	17
	Basic	2	2	100	2	100	0	0
	Intermediate	7	7	100	7	100	0	0
	Advanced	16	16	100	16	100	0	0
	Expert	11	11	100	11	100	0	0
Digital Literacy	Awareness	4	3	75	3	75	2	50
	Basic	16	15	94	14	88	14	88
	Intermediate	11	11	100	11	100	5	45
	Advanced	41	31	76	28	68	9	22

	Expert	48	34	71	33	69	3	6
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	2	100
	Basic	7	6	86	6	86	4	57
	Intermediate	3	3	100	3	100	3	100
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	2	67	2	67
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	1	100
	Basic	1	1	100	1	100	1	100
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	1	100	1	100	1	100
	Intermediate	5	5	100	5	100	1	20
	Advanced	10	8	80	8	80	3	30
	Expert	13	8	62	8	62	1	8
Software Literacy	Awareness	7	5	71	4	57	2	29
	Basic	10	8	80	7	70	2	20
	Intermediate	15	14	93	13	87	1	7
	Advanced	38	33	87	31	82	2	5
	Expert	20	16	80	14	70	2	10

Table 75. KSAB Total and Percentage of DECF KSABs for the Systems Engineer for the System Requirements Definition and Traceability Project Ideal Team of 10

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	2	67	2	67
	Basic	11	7	64	7	64	4	36
	Intermediate	7	3	43	2	29	3	43
	Advanced	14	7	50	6	43	5	36
	Expert	13	4	31	3	23	1	8
Data Management	Awareness	2	2	100	2	100	2	100
	Basic	7	4	57	4	57	4	57
	Intermediate	1	0	0	0	0	0	0
	Advanced	14	5	36	4	29	5	36
	Expert	6	3	50	3	50	0	0
Modeling	Awareness	11	11	100	10	91	11	100

	Basic	25	25	100	14	56	25	100
	Intermediate	36	36	100	22	61	36	100
	Advanced	35	29	83	19	54	28	80
	Expert	15	9	60	5	33	8	53
Simulation	Awareness	8	8	100	3	38	7	88
	Basic	8	8	100	7	88	7	88
	Intermediate	16	15	94	4	25	15	94
	Advanced	16	15	94	3	19	13	81
	Expert	8	4	50	0	0	4	50
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	2	100	2	100
	Basic	4	1	25	1	25	1	25
	Intermediate	12	6	50	6	50	3	25
	Advanced	2	2	100	2	100	1	50
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	2	100	2	100	0	0
	Basic	5	5	100	5	100	2	40
	Intermediate	12	11	92	8	67	6	50
	Advanced	17	10	59	8	47	8	47
	Expert	11	1	9	0	0	1	9
Digital Architecting	Awareness	3	3	100	3	100	3	100
	Basic	14	13	93	10	71	12	86
	Intermediate	18	18	100	9	50	18	100
	Advanced	18	18	100	15	83	18	100
	Expert	2	1	50	1	50	1	50
Digital Requirements Modeling	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	2	67	3	100
	Intermediate	15	15	100	9	60	15	100
	Advanced	4	4	100	3	75	4	100
	Expert	1	1	100	1	100	1	100
Digital Validation and Verification	Awareness	2	1	50	1	50	1	50
	Basic	2	2	100	1	50	1	50
	Intermediate	6	6	100	4	67	6	100
	Advanced	3	1	33	1	33	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	11	100	11	100	11	100
	Basic	33	32	97	29	88	31	94
	Intermediate	17	16	94	14	82	16	94
	Advanced	35	32	91	16	46	31	89
	Expert	12	7	58	4	33	6	50
	Awareness	2	2	100	2	100	2	100

Digital Model-Based Reviews	Basic	1	1	100	1	100	1	100
	Intermediate	6	6	100	6	100	6	100
	Advanced	5	5	100	5	100	4	80
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	2	100	2	100	2	100
	Basic	18	15	83	15	83	12	67
	Intermediate	12	11	92	9	75	8	67
	Advanced	7	7	100	4	57	6	86
	Expert	3	1	33	1	33	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	2	50	2	50	0	0
	Expert	10	4	40	4	40	0	0
Digital Engineering Policy and Guidance	Awareness	1	1	100	1	100	1	100
	Basic	3	2	67	2	67	0	0
	Intermediate	2	2	100	2	100	0	0
	Advanced	7	6	86	6	86	1	14
	Expert	10	5	50	5	50	1	10
Configuration Management	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	3	100	3	100
	Intermediate	5	5	100	5	100	4	80
	Advanced	8	8	100	8	100	3	38
	Expert	2	2	100	2	100	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	1	20	1	20	0	0
	Intermediate	5	1	20	1	20	0	0
	Advanced	24	2	8	2	8	0	0
	Expert	10	1	10	1	10	0	0
Digital Environment Development	Awareness	1	1	100	1	100	1	100
	Basic	15	3	20	2	13	1	7
	Intermediate	3	0	0	0	0	0	0
	Advanced	15	3	20	3	20	1	7
	Expert	13	0	0	0	0	0	0
Management	Awareness	2	2	100	2	100	1	50
	Basic	2	2	100	2	100	1	50
	Intermediate	1	0	0	0	0	0	0
	Advanced	10	5	50	5	50	0	0
	Expert	8	2	25	2	25	0	0
Communications	Awareness	1	1	100	1	100	1	100

	Basic	2	1	50	1	50	1	50
	Intermediate	1	1	100	1	100	1	100
	Advanced	3	0	0	0	0	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	1	100	1	100	0	0
	Basic	2	2	100	2	100	0	0
	Intermediate	2	1	50	1	50	0	0
	Advanced	3	2	67	2	67	0	0
	Expert	3	1	33	1	33	0	0
Digital Environment Operations	Awareness	3	2	67	2	67	2	67
	Basic	4	2	50	2	50	2	50
	Intermediate	8	2	25	2	25	1	13
	Advanced	9	4	44	4	44	3	33
	Expert	2	0	0	0	0	0	0
Digital Environment Support	Awareness	3	1	33	1	33	0	0
	Basic	6	0	0	0	0	0	0
	Intermediate	18	2	11	2	11	0	0
	Advanced	25	3	12	3	12	0	0
	Expert	15	0	0	0	0	0	0
Digital Environment Security	Awareness	6	1	17	1	17	1	17
	Basic	2	1	50	1	50	0	0
	Intermediate	7	3	43	3	43	0	0
	Advanced	16	3	43	3	19	0	0
	Expert	11	6	19	6	55	0	0
Digital Literacy	Awareness	4	2	55	2	50	2	50
	Basic	16	14	50	13	81	14	88
	Intermediate	11	9	88	9	82	5	45
	Advanced	41	29	82	26	63	9	22
	Expert	48	24	71	23	48	3	6
Digital Engineering Value Proposition	Awareness	2	2	50	2	100	2	100
	Basic	7	6	100	6	86	4	57
	Intermediate	3	3	86	3	100	3	100
	Advanced	0	0	100	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	3	0	3	100	2	67
	Basic	0	0	100	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	1	100
	Basic	1	1	100	1	100	1	100
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
	Awareness	0	0	0	0	0	0	0

Decision Making	Basic	1	1	100	1	100	0	0
	Intermediate	5	4	80	4	80	1	20
	Advanced	10	7	70	7	70	3	30
	Expert	13	8	62	8	62	2	15
Software Literacy	Awareness	7	2	29	1	14	2	29
	Basic	10	3	30	2	20	2	20
	Intermediate	15	3	20	2	13	1	7
	Advanced	38	4	11	3	8	2	5
	Expert	20	8	40	7	35	2	10

Table 76. KSAB Total and Percentage of DECF KSABs for the Tech SME for the System Requirements Definition and Traceability Project Ideal Team of 10

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	0	0	2	67
	Basic	11	4	36	0	0	4	36
	Intermediate	7	2	29	0	0	2	29
	Advanced	14	1	7	0	0	1	7
	Expert	13	0	0	0	0	0	0
Data Management	Awareness	2	2	100	0	0	2	100
	Basic	7	4	57	0	0	4	57
	Intermediate	1	0	0	0	0	0	0
	Advanced	14	4	29	0	0	4	29
	Expert	6	0	0	0	0	0	0
Modeling	Awareness	11	11	100	0	0	11	100
	Basic	25	25	100	0	0	25	100
	Intermediate	36	36	100	0	0	36	100
	Advanced	35	28	80	0	0	28	80
	Expert	15	8	53	0	0	8	53
Simulation	Awareness	8	7	88	0	0	7	88
	Basic	8	7	88	0	0	7	88
	Intermediate	16	15	94	0	0	15	94
	Advanced	16	13	81	0	0	13	81
	Expert	8	4	50	0	0	4	50
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	0	0	2	100
	Basic	4	1	25	0	0	1	25
	Intermediate	12	3	25	0	0	3	25

	Advanced	2	1	50	0	0	1	50
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	0	0	0	0	0	0
	Basic	5	2	40	0	0	2	40
	Intermediate	12	6	50	0	0	6	50
	Advanced	17	8	47	0	0	8	47
	Expert	11	1	9	0	0	1	9
Digital Architecting	Awareness	3	3	100	0	0	3	100
	Basic	14	12	86	0	0	12	86
	Intermediate	18	18	100	0	0	18	100
	Advanced	18	18	100	0	0	18	100
	Expert	2	1	50	0	0	1	50
Digital Requirements Modeling	Awareness	1	1	100	0	0	1	100
	Basic	3	3	100	0	0	3	100
	Intermediate	15	15	100	0	0	15	100
	Advanced	4	4	100	0	0	4	100
	Expert	1	1	100	0	0	1	100
Digital Validation and Verification	Awareness	2	1	50	0	0	1	50
	Basic	2	1	50	0	0	1	50
	Intermediate	6	5	83	0	0	5	83
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	11	100	0	0	11	100
	Basic	33	31	94	0	0	31	94
	Intermediate	17	16	94	0	0	16	94
	Advanced	35	31	89	0	0	31	89
	Expert	12	6	50	0	0	6	50
Digital Model-Based Reviews	Awareness	2	2	100	0	0	2	100
	Basic	1	1	100	0	0	1	100
	Intermediate	6	6	100	0	0	6	100
	Advanced	5	4	80	0	0	4	80
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	2	100	0	0	2	100
	Basic	18	12	67	0	0	12	67
	Intermediate	12	8	67	0	0	8	67
	Advanced	7	6	86	0	0	6	86
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering	Awareness	1	1	100	0	0	1	100
	Basic	3	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0

Policy and Guidance	Advanced	7	1	14	0	0	1	14
	Expert	10	1	10	0	0	1	10
Configuration Management	Awareness	1	1	100	0	0	1	100
	Basic	3	3	100	0	0	3	100
	Intermediate	5	4	80	0	0	4	80
	Advanced	8	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	24	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	0	0	1	100
	Basic	15	1	7	0	0	1	7
	Intermediate	3	0	0	0	0	0	0
	Advanced	15	1	7	0	0	1	7
	Expert	13	0	0	0	0	0	0
Management	Awareness	2	1	50	0	0	1	50
	Basic	2	1	50	0	0	1	50
	Intermediate	1	0	0	0	0	0	0
	Advanced	10	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	0	0	1	100
	Basic	2	1	50	0	0	1	50
	Intermediate	1	1	100	0	0	1	100
	Advanced	3	0	0	0	0	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Digital Environment Operations	Awareness	3	2	67	0	0	2	67
	Basic	4	2	50	0	0	2	50
	Intermediate	8	1	13	0	0	1	13
	Advanced	9	3	33	0	0	3	33
	Expert	2	0	0	0	0	0	0
Digital Environment Support	Awareness	3	0	0	0	0	0	0
	Basic	6	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0

	Advanced	25	0	0	0	0	0	0
	Expert	15	0	0	0	0	0	0
Digital Environment Security	Awareness	6	1	17	0	0	1	17
	Basic	2	0	0	0	0	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	11	0	0	0	0	0	0
Digital Literacy	Awareness	4	2	50	0	0	2	50
	Basic	16	12	75	0	0	12	75
	Intermediate	11	5	45	0	0	5	45
	Advanced	41	9	22	0	0	9	22
	Expert	48	3	6	0	0	3	6
Digital Engineering Value Proposition	Awareness	2	2	100	0	0	2	100
	Basic	7	4	57	0	0	4	57
	Intermediate	3	3	100	0	0	3	100
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	0	0	2	67
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	0	0	1	100
	Basic	1	1	100	0	0	1	100
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	5	1	20	0	0	1	20
	Advanced	10	3	30	0	0	3	30
	Expert	13	1	8	0	0	1	8
Software Literacy	Awareness	7	2	29	0	0	2	29
	Basic	10	2	20	0	0	2	20
	Intermediate	15	1	7	0	0	1	7
	Advanced	38	2	5	0	0	2	5
	Expert	20	2	10	0	0	2	10

Table 77. KSAB Total and Percentage of DECF KSABs for the MBSE SME for the System Requirements Definition and Traceability Project Ideal Team of 10

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	2	67	2	67
	Basic	11	7	64	7	64	5	45
	Intermediate	7	3	43	2	29	3	43
	Advanced	14	5	36	3	21	5	36
	Expert	13	3	23	2	15	1	8
Data Management	Awareness	2	2	100	2	100	2	100
	Basic	7	4	57	4	57	4	57
	Intermediate	1	0	0	0	0	0	0
	Advanced	14	5	36	2	14	5	36
	Expert	6	3	50	3	50	0	0
Modeling	Awareness	11	11	100	6	55	11	100
	Basic	25	25	100	6	24	25	100
	Intermediate	36	36	100	5	14	36	100
	Advanced	35	28	80	7	20	28	80
	Expert	15	8	53	1	7	8	53
Simulation	Awareness	8	7	88	1	13	7	88
	Basic	8	7	88	4	50	7	88
	Intermediate	16	15	94	0	0	15	94
	Advanced	16	14	88	1	6	13	81
	Expert	8	4	50	0	0	4	50
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	2	100	2	100
	Basic	4	1	25	1	25	1	25
	Intermediate	12	4	33	4	33	3	25
	Advanced	2	1	50	1	50	1	50
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	0	0	2	100	0	0
	Basic	5	4	80	4	80	2	40
	Intermediate	12	7	58	3	25	6	50
	Advanced	17	8	47	3	18	8	47
	Expert	11	1	9	0	0	1	9
Digital Architecting	Awareness	3	3	100	0	0	3	100
	Basic	14	12	86	0	0	12	86
	Intermediate	18	18	100	6	33	18	100
	Advanced	18	18	100	8	44	18	100

	Expert	2	1	50	0	0	1	50
Digital Requirements Modeling	Awareness	1	1	100	0	0	1	100
	Basic	3	3	100	0	0	3	100
	Intermediate	15	15	100	1	7	15	100
	Advanced	4	4	100	1	25	4	100
	Expert	1	1	100	0	0	1	100
Digital Validation and Verification	Awareness	2	1	50	1	50	1	50
	Basic	2	1	50	0	0	1	50
	Intermediate	6	6	100	2	33	6	100
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	11	100	8	73	11	100
	Basic	33	32	97	15	45	31	94
	Intermediate	17	16	94	4	24	16	94
	Advanced	35	31	89	6	17	31	89
	Expert	12	7	58	3	25	6	50
Digital Model-Based Reviews	Awareness	2	2	100	1	50	2	100
	Basic	1	1	100	1	100	1	100
	Intermediate	6	6	100	6	100	6	100
	Advanced	5	5	100	5	100	4	80
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	2	100	1	50	2	100
	Basic	18	14	78	7	39	12	67
	Intermediate	12	9	75	2	17	8	67
	Advanced	7	6	86	2	29	6	86
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering Policy and Guidance	Awareness	1	1	100	0	0	1	100
	Basic	3	1	33	1	33	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	7	1	14	0	0	1	14
	Expert	10	1	10	0	0	1	10
Configuration Management	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	2	67	3	100
	Intermediate	5	4	80	3	60	4	80
	Advanced	8	5	63	4	50	3	38
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0

	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	24	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	1	100	1	100
	Basic	15	1	7	0	0	1	7
	Intermediate	3	0	0	0	0	0	0
	Advanced	15	1	7	1	7	1	7
	Expert	13	0	0	0	0	0	0
Management	Awareness	2	2	100	2	100	1	50
	Basic	2	1	50	1	50	1	50
	Intermediate	1	0	0	0	0	0	0
	Advanced	10	1	10	1	10	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	1	100	1	100
	Basic	2	1	50	1	50	1	50
	Intermediate	1	1	100	1	100	1	100
	Advanced	3	0	0	0	0	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Digital Environment Operations	Awareness	3	2	67	2	67	2	67
	Basic	4	2	50	2	50	2	50
	Intermediate	8	1	13	1	13	1	13
	Advanced	9	4	44	3	33	3	33
	Expert	2	1	50	1	50	0	0
Digital Environment Support	Awareness	3	0	0	0	0	0	0
	Basic	6	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0
	Advanced	25	0	0	0	0	0	0
	Expert	15	0	0	0	0	0	0
Digital Environment Security	Awareness	6	1	17	1	17	1	17
	Basic	2	0	0	0	0	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	11	0	0	0	0	0	0
Digital Literacy	Awareness	4	2	50	2	50	2	50
	Basic	16	14	88	12	75	14	88
	Intermediate	11	7	64	6	55	5	45
	Advanced	41	16	39	11	27	9	22

	Expert	48	12	25	11	23	3	6
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	2	100
	Basic	7	4	57	4	57	4	57
	Intermediate	3	3	100	3	100	3	100
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	2	67	2	67
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	2	2	100	2	100	2	100
	Advanced	3	3	100	3	100	3	100
	Expert	2	2	100	2	100	2	100
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	5	1	20	1	20	1	20
	Advanced	10	5	50	5	50	3	30
	Expert	13	3	23	3	23	1	8
Software Literacy	Awareness	7	2	29	1	14	2	29
	Basic	10	2	20	1	10	2	20
	Intermediate	15	1	7	0	0	1	7
	Advanced	38	2	5	0	0	2	5
	Expert	20	2	10	0	0	2	10

Table 78. KSAB Total and Percentage of DECF KSABs for the Program Security Specialist for the System Requirements Definition and Traceability Project Ideal Team of 10

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	0	0	0	0	0	0
	Basic	11	3	27	3	27	0	0
	Intermediate	7	1	14	1	14	0	0
	Advanced	14	5	36	5	36	0	0
	Expert	13	2	15	2	15	0	0
Data Management	Awareness	2	2	100	2	100	0	0
	Basic	7	4	57	4	57	0	0
	Intermediate	1	1	100	1	100	0	0
	Advanced	14	10	71	10	71	0	0
	Expert	6	2	33	2	33	0	0
Modeling	Awareness	11	6	55	6	55	0	0

	Basic	25	6	20	6	20	0	0
	Intermediate	36	10	28	10	28	0	0
	Advanced	35	4	11	4	11	0	0
	Expert	15	0	0	0	0	0	0
Simulation	Awareness	8	1	13	1	13	0	0
	Basic	8	4	50	4	50	0	0
	Intermediate	16	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Artificial Intelligence/ Machine Learning	Awareness	2	1	50	1	50	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	0	0	0	0	0	0
	Basic	4	0	0	0	0	0	0
	Intermediate	12	0	0	0	0	0	0
	Advanced	2	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	2	100	2	100	0	0
	Basic	5	1	20	1	20	0	0
	Intermediate	12	0	0	0	0	0	0
	Advanced	17	1	6	1	6	0	0
	Expert	11	0	0	0	0	0	0
Digital Architecting	Awareness	3	0	0	0	0	0	0
	Basic	14	0	0	0	0	0	0
	Intermediate	18	2	11	2	11	0	0
	Advanced	18	3	17	3	17	0	0
	Expert	2	0	0	0	0	0	0
Digital Requirements Modeling	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	15	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Digital Validation and Verification	Awareness	2	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	8	73	8	73	0	0
	Basic	33	16	48	16	48	0	0
	Intermediate	17	6	35	6	35	0	0
	Advanced	35	5	14	5	14	0	0
	Expert	12	0	0	0	0	0	0
	Awareness	2	0	0	0	0	0	0

Digital Model-Based Reviews	Basic	1	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	0	0	0	0	0	0
	Basic	18	0	0	0	0	0	0
	Intermediate	12	1	8	1	8	0	0
	Advanced	7	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering Policy and Guidance	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	7	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Configuration Management	Awareness	1	0	0	0	0	0	0
	Basic	3	2	67	2	67	0	0
	Intermediate	5	2	40	2	40	0	0
	Advanced	8	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	1	20	1	20	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	1	20	1	20	0	0
	Intermediate	5	2	40	2	40	0	0
	Advanced	24	4	17	4	17	0	0
	Expert	10	4	40	4	40	0	0
Digital Environment Development	Awareness	1	1	100	1	100	0	0
	Basic	15	3	20	3	20	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	15	10	67	10	67	0	0
	Expert	13	8	52	8	52	0	0
Management	Awareness	2	1	50	1	50	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	1	1	100	1	100	0	0
	Advanced	10	3	30	3	30	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	1	100	0	0

	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	3	2	67	2	67	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	1	100	1	100	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	2	1	50	1	50	0	0
	Advanced	3	1	33	1	33	0	0
	Expert	3	0	0	0	0	0	0
Digital Environment Operations	Awareness	3	3	100	3	100	0	0
	Basic	4	4	100	4	100	0	0
	Intermediate	8	8	100	8	100	0	0
	Advanced	9	7	78	7	78	0	0
	Expert	2	2	100	2	100	0	0
Digital Environment Support	Awareness	3	2	67	2	67	0	0
	Basic	6	3	50	3	50	0	0
	Intermediate	18	18	100	18	100	0	0
	Advanced	25	23	92	23	92	0	0
	Expert	15	9	60	9	60	0	0
Digital Environment Security	Awareness	6	6	100	6	100	0	0
	Basic	2	2	100	2	100	0	0
	Intermediate	7	7	100	7	100	0	0
	Advanced	16	16	100	16	100	0	0
	Expert	11	11	100	11	100	0	0
Digital Literacy	Awareness	4	3	75	3	75	0	0
	Basic	16	12	75	12	75	0	0
	Intermediate	11	9	82	9	82	0	0
	Advanced	41	16	39	16	39	0	0
	Expert	48	19	40	19	40	0	0
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	0	0
	Basic	7	4	57	4	57	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	2	67	0	0
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	0	0
	Basic	1	1	100	1	100	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
	Awareness	0	0	0	0	0	0	0

Decision Making	Basic	1	0	0	0	0	0	0
	Intermediate	5	3	60	3	60	0	0
	Advanced	10	8	80	8	80	0	0
	Expert	13	2	15	2	15	0	0
Software Literacy	Awareness	7	4	57	4	57	0	0
	Basic	10	7	70	7	70	0	0
	Intermediate	15	12	80	12	80	0	0
	Advanced	38	30	79	30	79	0	0
	Expert	20	14	70	14	70	0	0

Table 79. KSAB Total and Percentage of DECF KSABs for the IT Specialist for the System Requirements Definition and Traceability Project Ideal Team of 10

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	0	0	0	0	0	0
	Basic	11	3	27	3	27	0	0
	Intermediate	7	1	14	1	14	0	0
	Advanced	14	4	29	4	29	0	0
	Expert	13	2	15	2	15	0	0
Data Management	Awareness	2	2	100	2	100	0	0
	Basic	7	4	57	4	57	0	0
	Intermediate	1	1	100	1	100	0	0
	Advanced	14	10	71	10	71	0	0
	Expert	6	1	17	1	17	0	0
Modeling	Awareness	11	0	0	0	0	0	0
	Basic	25	1	4	1	4	0	0
	Intermediate	36	2	6	2	6	0	0
	Advanced	35	1	3	1	3	0	0
	Expert	15	0	0	0	0	0	0
Simulation	Awareness	8	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	16	1	6	1	6	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Artificial Intelligence/ Machine Learning	Awareness	2	1	50	1	50	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	0	0	0	0	0	0
	Basic	4	0	0	0	0	0	0
	Intermediate	12	1	8	1	8	0	0

	Advanced	2	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	2	100	2	100	0	0
	Basic	5	1	20	1	20	0	0
	Intermediate	12	1	8	1	8	0	0
	Advanced	17	0	0	0	0	0	0
	Expert	11	0	0	0	0	0	0
Digital Architecting	Awareness	3	0	0	0	0	0	0
	Basic	14	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0
	Advanced	18	1	6	1	6	0	0
	Expert	2	0	0	0	0	0	0
Digital Requirements Modeling	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	15	0	0	0	0	0	0
	Advanced	4	1	25	1	25	0	0
	Expert	1	0	0	0	0	0	0
Digital Validation and Verification	Awareness	2	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	0	0	0	0	0	0
	Basic	33	0	0	0	0	0	0
	Intermediate	17	0	0	0	0	0	0
	Advanced	35	1	3	1	3	0	0
	Expert	12	0	0	0	0	0	0
Digital Model-Based Reviews	Awareness	2	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	1	50	1	50	0	0
	Basic	18	0	0	0	0	0	0
	Intermediate	12	2	17	2	17	0	0
	Advanced	7	1	14	1	14	0	0
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	1	25	1	25	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering	Awareness	1	0	0	0	0	0	0
	Basic	3	1	33	1	33	0	0
	Intermediate	2	1	50	1	50	0	0

Policy and Guidance	Advanced	7	1	14	1	14	0	0
	Expert	10	0	0	0	0	0	0
Configuration Management	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	8	2	25	2	25	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	1	20	1	20	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	1	20	1	20	0	0
	Intermediate	5	3	60	3	60	0	0
	Advanced	24	9	38	9	38	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	1	100	0	0
	Basic	15	3	20	3	20	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	15	11	73	11	73	0	0
	Expert	13	7	54	7	54	0	0
Management	Awareness	2	1	50	1	50	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	1	1	100	1	100	0	0
	Advanced	10	4	40	4	40	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	1	100	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	3	2	67	2	67	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	1	100	1	100	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	2	2	100	2	100	0	0
	Advanced	3	2	67	2	67	0	0
	Expert	3	1	33	1	33	0	0
Digital Environment Operations	Awareness	3	3	100	3	100	0	0
	Basic	4	4	100	4	100	0	0
	Intermediate	8	8	100	8	100	0	0
	Advanced	9	7	78	7	78	0	0
	Expert	2	2	100	2	100	0	0
Digital Environment Support	Awareness	3	2	67	2	67	0	0
	Basic	6	4	67	4	67	0	0
	Intermediate	18	18	100	18	100	0	0

	Advanced	25	23	92	23	92	0	0
	Expert	15	10	67	10	67	0	0
Digital Environment Security	Awareness	6	6	100	6	100	0	0
	Basic	2	2	100	2	100	0	0
	Intermediate	7	7	100	7	100	0	0
	Advanced	16	16	100	16	100	0	0
	Expert	11	11	100	11	100	0	0
Digital Literacy	Awareness	4	2	50	2	50	0	0
	Basic	16	6	38	6	38	0	0
	Intermediate	11	5	45	5	45	0	0
	Advanced	41	13	32	13	32	0	0
	Expert	48	17	35	17	35	0	0
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	0	0
	Basic	7	3	43	3	43	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	2	67	0	0
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	1	100	1	100	0	0
	Intermediate	5	3	60	3	60	0	0
	Advanced	10	8	80	8	80	0	0
	Expert	13	5	38	5	38	0	0
Software Literacy	Awareness	7	4	57	4	57	0	0
	Basic	10	7	70	7	70	0	0
	Intermediate	15	13	87	13	87	0	0
	Advanced	38	31	82	31	82	0	0
	Expert	20	12	60	12	60	0	0

There were no tasks assigned to the Physical Security Specialist for the System Requirements Definition and Traceability project for the ideal team of 10, so there is no table for that role.

Table 80. KSAB Total and Percentage of DECF KSABs for the Configuration Control Specialist for the System Requirements Definition and Traceability Project Ideal Team of 10

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	2	67	0	0
	Basic	11	4	36	4	36	0	0
	Intermediate	7	2	29	2	29	0	0
	Advanced	14	4	29	4	29	0	0
	Expert	13	0	0	0	0	0	0
Data Management	Awareness	2	2	100	2	100	0	0
	Basic	7	4	57	4	57	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	14	3	21	3	21	0	0
	Expert	6	2	33	2	33	0	0
Modeling	Awareness	11	2	18	2	18	0	0
	Basic	25	1	4	1	4	0	0
	Intermediate	36	3	8	3	8	0	0
	Advanced	35	7	20	7	20	0	0
	Expert	15	1	7	1	7	0	0
Simulation	Awareness	8	1	13	1	13	0	0
	Basic	8	4	50	4	50	0	0
	Intermediate	16	2	13	2	13	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	2	100	0	0
	Basic	4	1	25	1	25	0	0
	Intermediate	12	3	25	3	25	0	0
	Advanced	2	1	50	1	50	0	0
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	12	0	0	0	0	0	0
	Advanced	17	1	6	1	6	0	0
	Expert	11	0	0	0	0	0	0
Digital Architecting	Awareness	3	0	0	0	0	0	0
	Basic	14	2	14	2	14	0	0
	Intermediate	18	1	6	1	6	0	0
	Advanced	18	3	17	3	17	0	0

	Expert	2	0	0	0	0	0	0
Digital Requirements Modeling	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	15	1	7	1	7	0	0
	Advanced	4	1	25	1	25	0	0
	Expert	1	0	0	0	0	0	0
Digital Validation and Verification	Awareness	2	1	50	1	50	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	6	3	50	3	50	0	0
	Advanced	3	1	33	1	33	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	1	9	1	9	0	0
	Basic	33	1	3	1	3	0	0
	Intermediate	17	1	6	1	6	0	0
	Advanced	35	5	14	5	14	0	0
	Expert	12	0	0	0	0	0	0
Digital Model-Based Reviews	Awareness	2	2	100	2	100	0	0
	Basic	1	1	100	1	100	0	0
	Intermediate	6	3	50	3	50	0	0
	Advanced	5	2	40	2	40	0	0
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	1	50	1	50	0	0
	Basic	18	0	0	0	0	0	0
	Intermediate	12	1	8	1	8	0	0
	Advanced	7	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	1	25	1	25	0	0
	Expert	10	1	10	1	10	0	0
Digital Engineering Policy and Guidance	Awareness	1	1	100	1	100	0	0
	Basic	3	1	33	1	33	0	0
	Intermediate	2	2	100	2	100	0	0
	Advanced	7	6	86	6	86	0	0
	Expert	10	5	50	5	50	0	0
Configuration Management	Awareness	1	1	100	1	100	0	0
	Basic	3	3	100	3	100	0	0
	Intermediate	5	5	100	5	100	0	0
	Advanced	8	8	100	8	100	0	0
	Expert	2	2	100	2	100	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0

	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	24	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	1	100	0	0
	Basic	15	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	15	1	7	1	7	0	0
	Expert	13	0	0	0	0	0	0
Management	Awareness	2	1	50	1	50	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	10	1	10	1	10	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	1	100	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	1	1	100	1	100	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Digital Environment Operations	Awareness	3	2	67	2	67	0	0
	Basic	4	2	50	2	50	0	0
	Intermediate	8	1	13	1	13	0	0
	Advanced	9	2	22	2	22	0	0
	Expert	2	0	0	0	0	0	0
Digital Environment Support	Awareness	3	1	33	1	33	0	0
	Basic	6	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0
	Advanced	25	2	8	2	8	0	0
	Expert	15	0	0	0	0	0	0
Digital Environment Security	Awareness	6	1	17	1	17	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	11	0	0	0	0	0	0
Digital Literacy	Awareness	4	1	25	1	25	0	0
	Basic	16	4	25	4	25	0	0
	Intermediate	11	3	27	3	27	0	0
	Advanced	41	4	10	4	10	0	0

	Expert	48	10	21	10	21	0	0
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	0	0
	Basic	7	2	29	2	29	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	2	67	0	0
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	5	1	20	1	20	0	0
	Advanced	10	4	40	4	40	0	0
	Expert	13	0	0	0	0	0	0
Software Literacy	Awareness	7	0	0	0	0	0	0
	Basic	10	2	20	2	20	0	0
	Intermediate	15	2	13	2	13	0	0
	Advanced	38	0	0	0	0	0	0
	Expert	20	0	0	0	0	0	0

Table 81. KSAB Total and Percentage of DECF KSABs for the T&E SME for the System Requirements Definition and Traceability Project Ideal Team of 10

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	0	0	2	67
	Basic	11	4	36	0	0	4	36
	Intermediate	7	2	29	0	0	2	29
	Advanced	14	1	7	0	0	1	7
	Expert	13	0	0	0	0	0	0
Data Management	Awareness	2	2	100	0	0	2	100
	Basic	7	4	57	0	0	4	57
	Intermediate	1	0	0	0	0	0	0
	Advanced	14	2	14	0	0	2	14
	Expert	6	0	0	0	0	0	0
Modeling	Awareness	11	11	100	0	0	11	100

	Basic	25	25	100	0	0	25	100
	Intermediate	36	36	100	0	0	36	100
	Advanced	35	30	86	0	0	30	86
	Expert	15	8	53	0	0	8	53
Simulation	Awareness	8	7	88	0	0	7	88
	Basic	8	7	88	0	0	7	88
	Intermediate	16	15	94	0	0	15	94
	Advanced	16	13	81	0	0	13	81
	Expert	8	4	50	0	0	4	50
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	0	0	2	100
	Basic	4	1	25	0	0	1	25
	Intermediate	12	3	25	0	0	3	25
	Advanced	2	1	50	0	0	1	50
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	0	0	0	0	0	0
	Basic	5	2	40	0	0	2	40
	Intermediate	12	6	50	0	0	6	50
	Advanced	17	8	47	0	0	8	47
	Expert	11	1	9	0	0	1	9
Digital Architecting	Awareness	3	3	100	0	0	3	100
	Basic	14	12	86	0	0	12	86
	Intermediate	18	18	100	0	0	18	100
	Advanced	18	18	100	0	0	18	100
	Expert	2	0	0	0	0	0	0
Digital Requirements Modeling	Awareness	1	1	100	0	0	1	100
	Basic	3	3	100	0	0	3	100
	Intermediate	15	15	100	0	0	15	100
	Advanced	4	4	100	0	0	4	100
	Expert	1	1	100	0	0	1	100
Digital Validation and Verification	Awareness	2	1	50	0	0	1	50
	Basic	2	1	50	0	0	1	50
	Intermediate	6	6	100	0	0	6	100
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	11	100	0	0	11	100
	Basic	33	30	91	0	0	30	91
	Intermediate	17	16	94	0	0	16	94
	Advanced	35	31	89	0	0	31	89
	Expert	12	6	50	0	0	6	50
	Awareness	2	2	100	0	0	2	100

Digital Model-Based Reviews	Basic	1	1	100	0	0	1	100
	Intermediate	6	6	100	0	0	6	100
	Advanced	5	4	80	0	0	4	80
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	2	100	0	0	2	100
	Basic	18	8	44	0	0	8	44
	Intermediate	12	7	58	0	0	7	58
	Advanced	7	5	71	0	0	5	71
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering Policy and Guidance	Awareness	1	1	100	0	0	1	100
	Basic	3	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	7	1	14	0	0	1	14
	Expert	10	1	10	0	0	1	10
Configuration Management	Awareness	1	1	100	0	0	1	100
	Basic	3	3	100	0	0	3	100
	Intermediate	5	4	80	0	0	4	80
	Advanced	8	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	24	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	0	0	1	100
	Basic	15	1	7	0	0	1	7
	Intermediate	3	0	0	0	0	0	0
	Advanced	15	1	7	0	0	1	7
	Expert	13	0	0	0	0	0	0
Management	Awareness	2	1	50	0	0	1	50
	Basic	2	1	50	0	0	1	50
	Intermediate	1	0	0	0	0	0	0
	Advanced	10	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	0	0	1	100

	Basic	2	1	50	0	0	1	50
	Intermediate	1	1	100	0	0	1	100
	Advanced	3	0	0	0	0	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Digital Environment Operations	Awareness	3	2	67	0	0	2	67
	Basic	4	2	50	0	0	2	50
	Intermediate	8	1	13	0	0	1	13
	Advanced	9	3	33	0	0	3	33
	Expert	2	0	0	0	0	0	0
Digital Environment Support	Awareness	3	0	0	0	0	0	0
	Basic	6	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0
	Advanced	25	0	0	0	0	0	0
	Expert	15	0	0	0	0	0	0
Digital Environment Security	Awareness	6	1	17	0	0	1	17
	Basic	2	0	0	0	0	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	11	0	0	0	0	0	0
Digital Literacy	Awareness	4	2	50	0	0	2	50
	Basic	16	14	88	0	0	14	88
	Intermediate	11	5	45	0	0	5	45
	Advanced	41	9	22	0	0	9	22
	Expert	48	3	6	0	0	3	6
Digital Engineering Value Proposition	Awareness	2	2	100	0	0	2	100
	Basic	7	4	57	0	0	4	57
	Intermediate	3	3	100	0	0	3	100
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	0	0	2	67
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	0	0	1	100
	Basic	1	1	100	0	0	1	100
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
	Awareness	0	0	0	0	0	0	0

Decision Making	Basic	1	0	0	0	0	0	0
	Intermediate	5	1	20	0	0	1	20
	Advanced	10	3	30	0	0	3	30
	Expert	13	1	8	0	0	1	8
Software Literacy	Awareness	7	2	29	0	0	2	29
	Basic	10	2	20	0	0	2	20
	Intermediate	15	1	7	0	0	1	7
	Advanced	38	2	5	0	0	2	5
	Expert	20	2	10	0	0	2	10

There were no tasks assigned to the Finance Specialist for the System Requirements Definition and Traceability project for the ideal team of 10, so there is no table for that role.

Table 82. KSAB Total and Percentage of DECF KSABs for the Scheduler for the System Requirements Definition and Traceability Project Ideal Team of 10

Competency	**Proficiency Level**	**Number in DECF**	**All Tasks**		**PM/Admin Tasks**		**Project Tasks**	
			Total	**% of DECF**	**Total**	**% of DECF**	**Total**	**% of DECF**
Data Governance	Awareness	3	1	33	1	33	0	0
	Basic	11	3	27	3	27	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	14	0	0	0	0	0	0
	Expert	13	0	0	0	0	0	0
Data Management	Awareness	2	2	100	2	100	0	0
	Basic	7	3	43	3	43	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	14	0	0	0	0	0	0
	Expert	6	0	0	0	0	0	0
Modeling	Awareness	11	0	0	0	0	0	0
	Basic	25	0	0	0	0	0	0
	Intermediate	36	0	0	0	0	0	0
	Advanced	35	0	0	0	0	0	0
	Expert	15	0	0	0	0	0	0
Simulation	Awareness	8	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	16	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0

	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	2	100	0	0
	Basic	4	1	25	1	25	0	0
	Intermediate	12	6	50	6	50	0	0
	Advanced	2	2	100	2	100	0	0
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	0	0	0	0	0	0
	Basic	5	2	40	2	40	0	0
	Intermediate	12	5	42	5	42	0	0
	Advanced	17	5	29	5	29	0	0
	Expert	11	0	0	0	0	0	0
Digital Architecting	Awareness	3	0	0	0	0	0	0
	Basic	14	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0
	Advanced	18	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Digital Requirements Modeling	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	15	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Digital Validation and Verification	Awareness	2	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	0	0	0	0	0	0
	Basic	33	0	0	0	0	0	0
	Intermediate	17	0	0	0	0	0	0
	Advanced	35	0	0	0	0	0	0
	Expert	12	0	0	0	0	0	0
Digital Model-Based Reviews	Awareness	2	1	50	1	50	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	5	1	20	1	20	0	0
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	2	100	2	100	0	0
	Basic	18	9	50	9	50	0	0
	Intermediate	12	5	42	5	42	0	0
	Advanced	7	4	57	4	57	0	0
	Expert	3	1	33	1	33	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0

	Expert	10	0	0	0	0	0	0
Digital Engineering Policy and Guidance	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	7	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Configuration Management	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	8	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	24	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	1	100	0	0
	Basic	15	1	7	1	7	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	15	1	7	1	7	0	0
	Expert	13	0	0	0	0	0	0
Management	Awareness	2	2	100	2	100	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	10	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	0	0	0	0	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Digital Environment Operations	Awareness	3	1	33	1	33	0	0
	Basic	4	2	50	2	50	0	0
	Intermediate	8	1	13	1	13	0	0
	Advanced	9	1	11	1	11	0	0

	Expert	2	0	0	0	0	0	0
Digital Environment Support	Awareness	3	0	0	0	0	0	0
	Basic	6	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0
	Advanced	25	0	0	0	0	0	0
	Expert	15	0	0	0	0	0	0
Digital Environment Security	Awareness	6	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	11	0	0	0	0	0	0
Digital Literacy	Awareness	4	0	0	0	0	0	0
	Basic	16	2	13	2	13	0	0
	Intermediate	11	0	0	0	0	0	0
	Advanced	41	5	12	5	12	0	0
	Expert	48	2	4	2	4	0	0
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	0	0
	Basic	7	3	43	3	43	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	2	67	0	0
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	5	1	20	1	20	0	0
	Advanced	10	3	30	3	30	0	0
	Expert	13	2	15	2	15	0	0
Software Literacy	Awareness	7	0	0	0	0	0	0
	Basic	10	1	10	1	10	0	0
	Intermediate	15	0	0	0	0	0	0
	Advanced	38	0	0	0	0	0	0
	Expert	20	0	0	0	0	0	0

There were no tasks assigned to the Contracts Specialist for the System Requirements Definition and Traceability project for the ideal team of 10, so there is no table for that role.

D.2 Ideal Team of 50

Table 83. KSAB Total and Percentage of DECF KSABs for the Program Manager for the System Requirements Definition and Traceability Project Ideal Team of 50

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	2	67	2	67
	Basic	11	7	64	7	64	4	36
	Intermediate	7	2	29	2	29	2	29
	Advanced	14	6	43	6	43	0	0
	Expert	13	4	31	4	31	0	0
Data Management	Awareness	2	2	100	2	100	2	100
	Basic	7	4	57	4	57	4	57
	Intermediate	1	0	0	0	0	0	0
	Advanced	14	6	43	5	36	2	14
	Expert	6	3	50	3	50	0	0
Modeling	Awareness	11	10	91	10	91	7	64
	Basic	25	15	60	15	60	10	40
	Intermediate	36	21	58	19	53	10	28
	Advanced	35	17	49	17	49	6	17
	Expert	15	6	40	6	40	1	7
Simulation	Awareness	8	3	38	3	38	1	13
	Basic	8	7	88	7	88	2	25
	Intermediate	16	6	38	2	13	5	31
	Advanced	16	6	38	3	19	3	19
	Expert	8	1	13	0	0	1	13
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	2	100	2	100
	Basic	4	1	25	1	25	1	25
	Intermediate	12	6	50	6	50	3	25
	Advanced	2	2	100	2	100	1	50
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	2	100	2	100	0	0
	Basic	5	5	100	5	100	2	40
	Intermediate	12	8	67	8	67	1	8

	Advanced	17	9	53	9	53	2	12
	Expert	11	0	0	0	0	0	0
Digital Architecting	Awareness	3	3	100	3	100	3	100
	Basic	14	11	79	10	71	8	57
	Intermediate	18	11	61	10	56	8	44
	Advanced	18	15	83	15	83	7	39
	Expert	2	1	50	1	50	0	0
Digital Requirements Modeling	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	2	67	3	100
	Intermediate	15	15	100	9	60	11	73
	Advanced	4	4	100	3	75	2	50
	Expert	1	1	100	1	100	0	0
Digital Validation and Verification	Awareness	2	1	50	1	50	1	50
	Basic	2	0	0	0	0	0	0
	Intermediate	6	1	17	1	17	1	17
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	11	100	9	82	11	100
	Basic	33	31	94	28	85	26	79
	Intermediate	17	14	82	14	82	12	71
	Advanced	35	23	66	16	46	11	31
	Expert	12	5	42	3	25	1	8
Digital Model-Based Reviews	Awareness	2	2	100	1	50	2	100
	Basic	1	1	100	1	100	1	100
	Intermediate	6	6	100	6	100	5	83
	Advanced	5	5	100	5	100	4	80
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	2	100	2	100	2	100
	Basic	18	17	94	16	89	6	33
	Intermediate	12	10	83	9	75	3	25
	Advanced	7	7	100	7	100	4	57
	Expert	3	1	33	1	33	0	0
Organizational Development	Awareness	1	1	100	1	100	0	0
	Basic	2	2	100	2	100	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	3	75	3	75	0	0
	Expert	10	6	60	6	60	0	0
Digital Engineering Policy and Guidance	Awareness	1	1	100	1	100	1	100
	Basic	3	2	67	2	67	0	0
	Intermediate	2	2	100	2	100	0	0
	Advanced	7	5	71	5	71	1	14
	Expert	10	5	50	5	50	1	10
Configuration Management	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	3	100	3	100
	Intermediate	5	4	80	3	60	4	80

	Advanced	8	5	63	5	63	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	1	20	1	20	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	1	20	1	20	0	0
	Intermediate	5	1	20	1	20	0	0
	Advanced	24	2	8	2	8	0	0
	Expert	10	1	10	1	10	0	0
Digital Environment Development	Awareness	1	1	100	1	100	1	100
	Basic	15	5	33	5	33	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	15	4	27	4	27	1	7
	Expert	13	2	15	2	15	0	0
Management	Awareness	2	2	100	2	100	1	50
	Basic	2	2	100	2	100	1	50
	Intermediate	1	0	0	0	0	0	0
	Advanced	10	5	50	5	50	0	0
	Expert	8	3	38	3	38	0	0
Communications	Awareness	1	1	100	1	100	1	100
	Basic	2	1	50	1	50	1	50
	Intermediate	1	1	100	1	100	1	100
	Advanced	3	0	0	0	0	0	0
	Expert	5	4	80	3	60	0	0
Planning	Awareness	1	1	100	1	100	0	0
	Basic	2	2	100	2	100	0	0
	Intermediate	2	1	50	1	50	0	0
	Advanced	3	2	67	2	67	0	0
	Expert	3	1	33	1	33	0	0
Digital Environment Operations	Awareness	3	2	67	2	67	2	67
	Basic	4	2	50	2	50	2	50
	Intermediate	8	1	13	1	13	1	13
	Advanced	9	4	44	4	44	3	33
	Expert	2	1	50	1	50	0	0
Digital Environment Support	Awareness	3	0	0	0	0	0	0
	Basic	6	0	0	0	0	0	0
	Intermediate	18	2	11	2	11	0	0
	Advanced	25	2	8	2	8	0	0
	Expert	15	0	0	0	0	0	0
Digital Environment Security	Awareness	6	4	67	4	67	1	17
	Basic	2	2	100	2	100	0	0
	Intermediate	7	5	71	5	71	0	0

	Advanced	16	9	56	9	56	0	0
	Expert	11	7	64	7	64	0	0
Digital Literacy	Awareness	4	2	50	2	50	2	50
	Basic	16	14	88	13	81	13	81
	Intermediate	11	11	100	11	100	5	45
	Advanced	41	25	61	25	61	7	17
	Expert	48	22	46	22	46	2	4
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	2	100
	Basic	7	7	100	7	100	4	57
	Intermediate	3	3	100	3	100	3	100
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	3	100	3	100	2	67
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	1	100
	Basic	1	1	100	1	100	1	100
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	1	100	1	100	0	0
	Intermediate	5	4	80	4	80	1	20
	Advanced	10	9	90	9	90	3	30
	Expert	13	10	77	10	77	1	8
Software Literacy	Awareness	7	1	14	1	14	1	14
	Basic	10	1	10	1	10	1	10
	Intermediate	15	3	20	2	13	1	7
	Advanced	38	9	24	8	21	1	3
	Expert	20	7	35	7	35	0	0

Table 84. KSAB Total and Percentage of DECF KSABs for the Chief Engineer for the System Requirements Definition and Traceability Project Ideal Team of 50

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	2	67	2	67
	Basic	11	5	45	5	45	4	36
	Intermediate	7	2	29	2	29	2	29
	Advanced	14	2	14	1	7	1	7
	Expert	13	1	8	1	8	0	0

Data Management	Awareness	2	2	100	2	100	2	100
	Basic	7	4	57	4	57	4	57
	Intermediate	1	1	100	1	100	0	0
	Advanced	14	3	21	1	7	2	14
	Expert	6	0	0	0	0	0	0
Modeling	Awareness	11	11	100	10	91	11	100
	Basic	25	25	100	12	48	25	100
	Intermediate	36	36	100	19	53	36	100
	Advanced	35	29	83	13	37	28	80
	Expert	15	8	53	3	20	8	53
Simulation	Awareness	8	6	75	2	25	6	75
	Basic	8	7	88	5	63	7	88
	Intermediate	16	15	94	2	13	15	94
	Advanced	16	11	69	1	6	11	69
	Expert	8	4	50	0	0	4	50
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	2	100	2	100
	Basic	4	1	25	1	25	1	25
	Intermediate	12	7	58	7	58	3	25
	Advanced	2	2	100	2	100	1	50
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	0	0	0	0	0	0
	Basic	5	3	60	2	40	2	40
	Intermediate	12	7	58	7	58	3	25
	Advanced	17	10	59	9	53	8	47
	Expert	11	0	0	0	0	0	0
Digital Architecting	Awareness	3	3	100	3	100	3	100
	Basic	14	12	86	10	71	12	86
	Intermediate	18	18	100	9	50	18	100
	Advanced	18	18	100	13	72	18	100
	Expert	2	0	0	0	0	0	0
Digital Requirements Modeling	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	2	67	3	100
	Intermediate	15	15	100	9	60	15	100
	Advanced	4	4	100	3	75	4	100
	Expert	1	1	100	0	0	1	100
Digital Validation and Verification	Awareness	2	1	50	1	50	1	50
	Basic	2	0	0	0	0	0	0
	Intermediate	6	3	50	2	33	2	33
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0

Model-Based Systems Engineering Processes	Awareness	11	11	100	9	82	11	100
	Basic	33	31	94	24	73	30	91
	Intermediate	17	16	94	14	82	16	94
	Advanced	35	31	89	13	37	31	89
	Expert	12	6	50	3	25	6	50
Digital Model-Based Reviews	Awareness	2	2	100	1	50	2	100
	Basic	1	1	100	1	100	1	100
	Intermediate	6	6	100	6	100	6	100
	Advanced	5	5	100	5	100	4	80
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	2	100	2	100	2	100
	Basic	18	17	94	13	72	9	50
	Intermediate	12	11	92	9	75	7	58
	Advanced	7	7	100	6	86	5	71
	Expert	3	1	33	1	33	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	1	25	1	25	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering Policy and Guidance	Awareness	1	1	100	1	100	1	100
	Basic	3	1	33	1	33	0	0
	Intermediate	2	1	50	1	50	0	0
	Advanced	7	2	29	2	29	1	14
	Expert	10	1	10	1	10	1	10
Configuration Management	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	3	100	3	100
	Intermediate	5	4	80	3	60	4	80
	Advanced	8	2	25	2	25	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	5	2	40	2	40	0	0
	Advanced	24	5	21	5	21	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	1	100	1	100
	Basic	15	4	27	3	20	1	7
	Intermediate	3	2	67	2	67	0	0
	Advanced	15	12	80	8	53	1	7
	Expert	13	1	8	1	8	0	0

Management	Awareness	2	2	100	2	100	1	50
	Basic	2	2	100	2	100	1	50
	Intermediate	1	1	100	1	100	0	0
	Advanced	10	3	30	3	30	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	1	100	1	100
	Basic	2	1	50	1	50	1	50
	Intermediate	1	1	100	1	100	1	100
	Advanced	3	2	67	2	67	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	1	100	1	100	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	2	1	50	1	50	0	0
	Advanced	3	1	33	1	33	0	0
	Expert	3	1	33	1	33	0	0
Digital Environment Operations	Awareness	3	2	67	2	67	2	67
	Basic	4	3	75	3	75	2	50
	Intermediate	8	8	100	8	100	1	13
	Advanced	9	7	78	7	78	3	33
	Expert	2	2	100	2	100	0	0
Digital Environment Support	Awareness	3	2	67	2	67	0	0
	Basic	6	3	50	3	50	0	0
	Intermediate	18	17	94	17	94	0	0
	Advanced	25	23	92	23	92	0	0
	Expert	15	10	67	10	67	0	0
Digital Environment Security	Awareness	6	1	17	1	17	1	17
	Basic	2	0	0	0	0	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	16	1	6	1	6	0	0
	Expert	11	0	0	0	0	0	0
Digital Literacy	Awareness	4	2	50	2	50	2	50
	Basic	16	14	88	10	63	14	88
	Intermediate	11	5	45	5	45	5	45
	Advanced	41	15	37	13	32	9	22
	Expert	48	18	38	17	35	3	6
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	2	100
	Basic	7	5	71	5	71	4	57
	Intermediate	3	3	100	3	100	3	100
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	2	67	2	67
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0

Coaching and Mentoring	Awareness	1	1	100	1	100	1	100
	Basic	1	1	100	1	100	1	100
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	1	100	1	100	0	0
	Intermediate	5	4	80	4	80	1	20
	Advanced	10	6	60	6	60	3	30
	Expert	13	8	62	8	62	1	8
Software Literacy	Awareness	7	2	29	1	14	2	29
	Basic	10	5	50	5	50	2	20
	Intermediate	15	11	73	10	67	1	7
	Advanced	38	23	61	21	55	2	5
	Expert	20	11	55	9	45	2	10

Table 85. KSAB Total and Percentage of DECF KSABs for the Systems Engineer for the System Requirements Definition and Traceability Project Ideal Team of 50

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	2	67	2	67
	Basic	11	8	73	8	73	4	36
	Intermediate	7	3	43	2	29	3	43
	Advanced	14	8	57	7	50	5	36
	Expert	13	4	31	3	23	1	8
Data Management	Awareness	2	2	100	1	50	2	100
	Basic	7	4	57	4	57	4	57
	Intermediate	1	1	100	1	100	0	0
	Advanced	14	6	43	5	36	5	36
	Expert	6	3	50	3	50	0	0
Modeling	Awareness	11	11	100	8	73	11	100
	Basic	25	25	100	9	36	25	100
	Intermediate	36	36	100	10	28	36	100
	Advanced	35	29	83	15	43	28	80
	Expert	15	9	60	4	27	8	53
Simulation	Awareness	8	8	100	3	38	7	88
	Basic	8	8	100	6	75	7	88
	Intermediate	16	15	94	5	31	15	94
	Advanced	16	15	94	2	13	13	81
	Expert	8	4	50	0	0	4	50
Artificial Intelligence/	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0

Machine Learning	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	2	100	2	100
	Basic	4	1	25	1	25	1	25
	Intermediate	12	5	42	5	42	3	25
	Advanced	2	1	50	1	50	1	50
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	2	100	2	100	0	0
	Basic	5	4	80	4	80	2	40
	Intermediate	12	7	58	6	42	6	50
	Advanced	17	8	47	3	18	8	47
	Expert	11	1	9	0	0	1	9
Digital Architecting	Awareness	3	3	100	3	100	3	100
	Basic	14	13	93	8	57	12	86
	Intermediate	18	18	100	7	39	18	100
	Advanced	18	18	100	14	78	18	100
	Expert	2	1	50	1	50	1	50
Digital Requirements Modeling	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	0	0	3	100
	Intermediate	15	15	100	1	7	15	100
	Advanced	4	4	100	2	50	4	100
	Expert	1	1	100	1	100	1	100
Digital Validation and Verification	Awareness	2	1	50	1	50	1	50
	Basic	2	2	100	1	50	1	50
	Intermediate	6	6	100	4	67	6	100
	Advanced	3	1	33	1	33	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	11	100	11	100	11	100
	Basic	33	32	97	23	70	31	94
	Intermediate	17	16	94	9	53	16	94
	Advanced	35	32	91	15	43	31	89
	Expert	12	7	58	4	33	6	50
Digital Model-Based Reviews	Awareness	2	2	100	2	100	2	100
	Basic	1	1	100	1	100	1	100
	Intermediate	6	6	100	6	100	6	100
	Advanced	5	5	100	5	100	4	80
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	2	100	2	100	2	100
	Basic	18	16	89	13	72	12	67
	Intermediate	12	11	92	9	75	8	67
	Advanced	7	7	100	7	100	6	86
	Expert	3	1	33	1	33	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0

	Intermediate	1	0	0	0	0	0	0
	Advanced	4	2	50	2	50	0	0
	Expert	10	4	40	4	40	0	0
Digital Engineering Policy and Guidance	Awareness	1	1	100	1	100	1	100
	Basic	3	2	67	2	67	0	0
	Intermediate	2	2	100	2	100	0	0
	Advanced	7	6	86	6	86	1	14
	Expert	10	5	50	5	50	1	10
Configuration Management	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	3	100	3	100
	Intermediate	5	5	100	5	100	4	80
	Advanced	8	8	100	8	100	3	38
	Expert	2	2	100	2	100	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	1	20	1	20	0	0
	Intermediate	5	3	60	3	60	0	0
	Advanced	24	8	33	8	33	0	0
	Expert	10	1	10	1	10	0	0
Digital Environment Development	Awareness	1	1	100	1	100	1	100
	Basic	15	5	33	4	27	1	7
	Intermediate	3	2	67	2	67	0	0
	Advanced	15	11	73	11	73	1	7
	Expert	13	1	8	1	8	0	0
Management	Awareness	2	2	100	2	100	1	50
	Basic	2	2	100	2	100	1	50
	Intermediate	1	1	100	1	100	0	0
	Advanced	10	5	50	5	50	0	0
	Expert	8	2	25	2	25	0	0
Communications	Awareness	1	1	100	1	100	1	100
	Basic	2	1	50	1	50	1	50
	Intermediate	1	1	100	1	100	1	100
	Advanced	3	2	67	2	67	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	1	100	1	100	0	0
	Basic	2	2	100	2	100	0	0
	Intermediate	2	2	100	2	100	0	0
	Advanced	3	2	67	2	67	0	0
	Expert	3	1	33	1	33	0	0
	Awareness	3	3	100	3	100	2	67
	Basic	4	3	75	3	75	2	50

Digital Environment Operations	Intermediate	8	8	100	8	100	1	13
	Advanced	9	7	78	6	67	3	33
	Expert	2	2	100	2	100	0	0
Digital Environment Support	Awareness	3	2	67	2	67	0	0
	Basic	6	3	50	3	50	0	0
	Intermediate	18	15	83	15	83	0	0
	Advanced	25	23	92	23	92	0	0
	Expert	15	10	67	10	67	0	0
Digital Environment Security	Awareness	6	1	17	1	17	1	17
	Basic	2	1	50	1	50	0	0
	Intermediate	7	3	43	3	43	0	0
	Advanced	16	4	25	4	25	0	0
	Expert	11	6	55	6	55	0	0
Digital Literacy	Awareness	4	2	50	2	50	2	50
	Basic	16	15	94	12	75	14	88
	Intermediate	11	9	82	9	82	5	45
	Advanced	41	29	71	25	61	9	22
	Expert	48	32	67	31	65	3	6
Digital Engineering Value Proposition	Awareness	2	1	50	2	100	2	100
	Basic	7	6	86	6	86	4	57
	Intermediate	3	3	100	3	100	3	100
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	3	100	3	100	2	67
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	1	100
	Basic	1	1	100	1	100	1	100
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	1	100	1	100	0	0
	Intermediate	5	4	80	4	80	1	20
	Advanced	10	7	70	7	70	3	30
	Expert	13	10	77	10	77	2	15
Software Literacy	Awareness	7	2	29	1	14	2	29
	Basic	10	7	70	6	60	2	20
	Intermediate	15	12	80	11	73	1	7
	Advanced	38	25	66	24	63	2	5
	Expert	20	14	70	13	65	2	10

Table 86. KSAB Total and Percentage of DECF KSABs for the Tech SME for the System Requirements Definition and Traceability Project Ideal Team of 50

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	0	0	2	67
	Basic	11	4	36	0	0	4	36
	Intermediate	7	2	29	0	0	2	29
	Advanced	14	1	7	0	0	1	7
	Expert	13	0	0	0	0	0	0
Data Management	Awareness	2	2	100	0	0	2	100
	Basic	7	4	57	0	0	4	57
	Intermediate	1	0	0	0	0	0	0
	Advanced	14	2	14	0	0	2	14
	Expert	6	0	0	0	0	0	0
Modeling	Awareness	11	11	100	0	0	11	100
	Basic	25	25	100	0	0	25	100
	Intermediate	36	36	100	0	0	36	100
	Advanced	35	28	80	0	0	28	80
	Expert	15	8	53	0	0	8	53
Simulation	Awareness	8	7	88	0	0	7	88
	Basic	8	7	88	0	0	7	88
	Intermediate	16	15	94	0	0	15	94
	Advanced	16	13	81	0	0	13	81
	Expert	8	4	50	0	0	4	50
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	0	0	2	100
	Basic	4	1	25	0	0	1	25
	Intermediate	12	3	25	0	0	3	25
	Advanced	2	1	50	0	0	1	50
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	0	0	0	0	0	0
	Basic	5	2	40	0	0	2	40
	Intermediate	12	6	50	0	0	6	50
	Advanced	17	8	47	0	0	8	47
	Expert	11	1	9	0	0	1	9
Digital Architecting	Awareness	3	3	100	0	0	3	100
	Basic	14	12	86	0	0	12	86
	Intermediate	18	18	100	0	0	18	100
	Advanced	18	18	100	0	0	18	100

	Expert	2	1	50	0	0	1	50
Digital Requirements Modeling	Awareness	1	1	100	0	0	1	100
	Basic	3	3	100	0	0	3	100
	Intermediate	15	15	100	0	0	15	100
	Advanced	4	4	100	0	0	4	100
	Expert	1	1	100	0	0	1	100
Digital Validation and Verification	Awareness	2	1	50	0	0	1	50
	Basic	2	1	50	0	0	1	50
	Intermediate	6	5	83	0	0	5	83
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	11	100	0	0	11	100
	Basic	33	30	91	0	0	30	91
	Intermediate	17	16	94	0	0	16	94
	Advanced	35	31	89	0	0	31	89
	Expert	12	6	50	0	0	6	50
Digital Model-Based Reviews	Awareness	2	2	100	0	0	2	100
	Basic	1	1	100	0	0	1	100
	Intermediate	6	6	100	0	0	6	100
	Advanced	5	4	80	0	0	4	80
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	2	100	0	0	2	100
	Basic	18	9	50	0	0	9	50
	Intermediate	12	7	58	0	0	7	58
	Advanced	7	5	71	0	0	5	71
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering Policy and Guidance	Awareness	1	1	100	0	0	1	100
	Basic	3	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	7	1	14	0	0	1	14
	Expert	10	0	10	0	0	0	10
Configuration Management	Awareness	1	1	100	0	0	1	100
	Basic	3	3	100	0	0	3	100
	Intermediate	5	4	80	0	0	4	80
	Advanced	8	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0

	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	24	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	0	0	1	100
	Basic	15	1	7	0	0	1	7
	Intermediate	3	0	0	0	0	0	0
	Advanced	15	1	7	0	0	1	7
	Expert	13	0	0	0	0	0	0
Management	Awareness	2	1	50	0	0	1	50
	Basic	2	1	50	0	0	1	50
	Intermediate	1	0	0	0	0	0	0
	Advanced	10	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	0	0	1	100
	Basic	2	1	50	0	0	1	50
	Intermediate	1	1	100	0	0	1	100
	Advanced	3	0	0	0	0	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Digital Environment Operations	Awareness	3	2	67	0	0	2	67
	Basic	4	2	50	0	0	2	50
	Intermediate	8	1	13	0	0	1	13
	Advanced	9	3	33	0	0	3	33
	Expert	2	0	0	0	0	0	0
Digital Environment Support	Awareness	3	0	0	0	0	0	0
	Basic	6	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0
	Advanced	25	0	0	0	0	0	0
	Expert	15	0	0	0	0	0	0
Digital Environment Security	Awareness	6	1	17	0	0	1	17
	Basic	2	0	0	0	0	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	11	0	0	0	0	0	0
Digital Literacy	Awareness	4	2	50	0	0	2	50
	Basic	16	14	88	0	0	14	88
	Intermediate	11	5	45	0	0	5	45
	Advanced	41	9	22	0	0	9	22

	Expert	48	3	6	0	0	3	6
Digital Engineering Value Proposition	Awareness	2	2	100	0	0	2	100
	Basic	7	4	57	0	0	4	57
	Intermediate	3	3	100	0	0	3	100
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	0	0	2	67
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	0	0	1	100
	Basic	1	1	100	0	0	1	100
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	5	1	20	0	0	1	20
	Advanced	10	3	30	0	0	3	30
	Expert	13	1	8	0	0	1	8
Software Literacy	Awareness	7	2	29	0	0	2	29
	Basic	10	2	20	0	0	2	20
	Intermediate	15	1	7	0	0	1	7
	Advanced	38	2	5	0	0	2	5
	Expert	20	2	10	0	0	2	10

Table 87. KSAB Total and Percentage of DECF KSABs for the MBSE SME for the System Requirements Definition and Traceability Project Ideal Team of 50

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	2	67	2	67
	Basic	11	8	73	8	73	5	45
	Intermediate	7	3	43	2	29	3	43
	Advanced	14	6	43	4	29	5	36
	Expert	13	3	23	2	15	1	8
Data Management	Awareness	2	2	100	2	100	2	100
	Basic	7	4	57	4	57	4	57
	Intermediate	1	1	100	1	100	0	0
	Advanced	14	5	36	3	21	5	36
	Expert	6	3	50	3	50	0	0
Modeling	Awareness	11	11	100	6	55	11	100

	Basic	25	25	100	7	28	25	100
	Intermediate	36	36	100	7	19	36	100
	Advanced	35	28	83	8	23	28	80
	Expert	15	8	53	1	7	8	53
Simulation	Awareness	8	7	88	1	13	7	88
	Basic	8	7	88	4	50	7	88
	Intermediate	16	15	94	1	6	15	94
	Advanced	16	14	88	1	6	13	81
	Expert	8	4	50	0	0	4	50
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	2	100	2	100
	Basic	4	1	25	1	25	1	25
	Intermediate	12	5	42	5	42	3	25
	Advanced	2	1	50	1	50	1	50
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	2	100	2	100	0	0
	Basic	5	4	80	4	80	2	40
	Intermediate	12	7	58	4	33	6	50
	Advanced	17	8	47	3	18	8	47
	Expert	11	1	9	0	0	1	9
Digital Architecting	Awareness	3	3	100	0	0	3	100
	Basic	14	12	86	0	0	12	86
	Intermediate	18	18	100	6	33	18	100
	Advanced	18	18	100	9	50	18	100
	Expert	2	1	50	0	0	1	50
Digital Requirements Modeling	Awareness	1	1	100	0	0	1	100
	Basic	3	3	100	0	0	3	100
	Intermediate	15	15	100	1	7	15	100
	Advanced	4	4	100	2	50	4	100
	Expert	1	1	100	0	0	1	100
Digital Validation and Verification	Awareness	2	1	50	1	50	1	50
	Basic	2	1	50	0	0	1	50
	Intermediate	6	6	100	2	33	5	83
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	11	100	8	73	11	100
	Basic	33	32	97	15	45	31	94
	Intermediate	17	16	94	4	24	16	94
	Advanced	35	31	89	7	20	31	89
	Expert	12	7	58	3	25	6	50
	Awareness	2	2	100	1	50	2	100

Digital Model-Based Reviews	Basic	1	1	100	1	100	1	100
	Intermediate	6	6	100	6	100	6	100
	Advanced	5	5	100	5	100	4	80
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	2	100	1	50	2	100
	Basic	18	14	78	7	39	12	67
	Intermediate	12	9	75	3	25	8	67
	Advanced	7	6	86	3	43	6	86
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	1	25	1	25	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering Policy and Guidance	Awareness	1	1	100	0	0	1	100
	Basic	3	1	33	1	33	0	0
	Intermediate	2	1	50	1	50	0	0
	Advanced	7	2	29	1	14	1	14
	Expert	10	1	10	0	0	1	10
Configuration Management	Awareness	1	1	100	1	100	1	100
	Basic	3	3	100	2	67	3	100
	Intermediate	5	4	80	3	60	4	80
	Advanced	8	7	88	6	75	3	38
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	5	2	40	2	40	0	0
	Advanced	24	6	25	6	25	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	1	100	1	100
	Basic	15	3	20	2	13	1	7
	Intermediate	3	2	67	2	67	0	0
	Advanced	15	9	60	9	60	1	7
	Expert	13	1	8	1	8	0	0
Management	Awareness	2	2	100	2	100	1	50
	Basic	2	2	100	2	100	1	50
	Intermediate	1	1	100	1	100	0	0
	Advanced	10	4	40	4	40	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	1	100	1	100

	Basic	2	1	50	1	50	1	50
	Intermediate	1	1	100	1	100	1	100
	Advanced	3	2	67	2	67	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	1	100	1	100	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	2	1	50	1	50	0	0
	Advanced	3	1	33	1	33	0	0
	Expert	3	1	33	1	33	0	0
Digital Environment Operations	Awareness	3	3	100	3	100	2	67
	Basic	4	3	75	3	75	2	50
	Intermediate	8	8	100	8	100	1	13
	Advanced	9	7	78	6	67	3	33
	Expert	2	2	100	2	100	0	0
Digital Environment Support	Awareness	3	2	67	2	67	0	0
	Basic	6	3	50	3	50	0	0
	Intermediate	18	17	94	17	94	0	0
	Advanced	25	23	92	23	92	0	0
	Expert	15	10	67	10	67	0	0
Digital Environment Security	Awareness	6	1	17	1	17	1	17
	Basic	2	0	0	0	0	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	16	1	6	1	6	0	0
	Expert	11	0	0	0	0	0	0
Digital Literacy	Awareness	4	2	50	2	50	2	50
	Basic	16	15	94	12	75	14	88
	Intermediate	11	7	64	6	55	5	45
	Advanced	41	16	39	12	29	9	22
	Expert	48	22	46	21	44	3	6
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	2	100
	Basic	7	4	57	4	57	4	57
	Intermediate	3	3	100	3	100	3	100
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	2	67	2	67
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	2	2	100	2	100	2	100
	Advanced	3	3	100	3	100	3	100
	Expert	2	2	100	2	100	2	100
	Awareness	0	0	0	0	0	0	0

Decision Making	Basic	1	1	100	1	100	0	0
	Intermediate	5	3	60	3	60	1	20
	Advanced	10	7	70	7	70	3	30
	Expert	13	7	54	7	54	1	8
Software Literacy	Awareness	7	2	29	1	14	2	29
	Basic	10	6	60	5	50	2	20
	Intermediate	15	11	73	10	67	1	7
	Advanced	38	23	61	21	55	2	5
	Expert	20	11	55	9	45	2	10

Table 88. KSAB Total and Percentage of DECF KSABs for the Program Security Specialist for the System Requirements Definition and Traceability Project Ideal Team of 50

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	0	0	0	0	0	0
	Basic	11	3	27	3	27	0	0
	Intermediate	7	1	14	1	14	0	0
	Advanced	14	5	36	5	36	0	0
	Expert	13	2	15	2	15	0	0
Data Management	Awareness	2	2	100	2	100	0	0
	Basic	7	4	57	4	57	0	0
	Intermediate	1	1	100	1	100	0	0
	Advanced	14	10	71	10	71	0	0
	Expert	6	2	33	2	33	0	0
Modeling	Awareness	11	6	55	6	55	0	0
	Basic	25	5	20	5	20	0	0
	Intermediate	36	10	28	10	28	0	0
	Advanced	35	4	11	4	11	0	0
	Expert	15	0	0	0	0	0	0
Simulation	Awareness	8	1	13	1	13	0	0
	Basic	8	4	50	4	50	0	0
	Intermediate	16	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Artificial Intelligence/ Machine Learning	Awareness	2	1	50	1	50	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	0	0	0	0	0	0
	Basic	4	0	0	0	0	0	0
	Intermediate	12	0	0	0	0	0	0

	Advanced	2	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	2	100	2	100	0	0
	Basic	5	1	20	1	20	0	0
	Intermediate	12	0	0	0	0	0	0
	Advanced	17	1	6	1	6	0	0
	Expert	11	0	0	0	0	0	0
Digital Architecting	Awareness	3	0	0	0	0	0	0
	Basic	14	0	0	0	0	0	0
	Intermediate	18	2	11	2	11	0	0
	Advanced	18	3	17	3	17	0	0
	Expert	2	0	0	0	0	0	0
Digital Requirements Modeling	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	15	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Digital Validation and Verification	Awareness	2	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	8	73	8	73	0	0
	Basic	33	16	48	16	48	0	0
	Intermediate	17	6	35	6	35	0	0
	Advanced	35	5	14	5	14	0	0
	Expert	12	0	0	0	0	0	0
Digital Model-Based Reviews	Awareness	2	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	0	0	0	0	0	0
	Basic	18	0	0	0	0	0	0
	Intermediate	12	1	8	1	8	0	0
	Advanced	7	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0

Policy and Guidance	Advanced	7	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Configuration Management	Awareness	1	0	0	0	0	0	0
	Basic	3	2	67	2	67	0	0
	Intermediate	5	2	40	2	40	0	0
	Advanced	8	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	1	20	1	20	0	0
	Intermediate	5	2	40	2	40	0	0
	Advanced	24	4	17	4	17	0	0
	Expert	10	4	40	4	40	0	0
Digital Environment Development	Awareness	1	1	100	1	100	0	0
	Basic	15	3	20	3	20	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	15	10	67	10	67	0	0
	Expert	13	8	62	8	62	0	0
Management	Awareness	2	1	50	1	50	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	1	1	100	1	100	0	0
	Advanced	10	3	30	3	30	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	1	100	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	3	2	67	2	67	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	1	100	1	100	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	2	1	50	1	50	0	0
	Advanced	3	1	33	1	33	0	0
	Expert	3	0	0	0	0	0	0
Digital Environment Operations	Awareness	3	3	100	3	100	0	0
	Basic	4	4	100	4	100	0	0
	Intermediate	8	8	100	8	100	0	0
	Advanced	9	7	78	7	78	0	0
	Expert	2	2	100	2	100	0	0
Digital Environment Support	Awareness	3	2	67	2	67	0	0
	Basic	6	3	50	3	50	0	0
	Intermediate	18	18	100	18	100	0	0

	Advanced	25	23	92	23	92	0	0
	Expert	15	9	60	9	60	0	0
Digital Environment Security	Awareness	6	6	100	6	100	0	0
	Basic	2	2	100	2	100	0	0
	Intermediate	7	7	100	7	100	0	0
	Advanced	16	16	100	16	100	0	0
	Expert	11	11	100	11	100	0	0
Digital Literacy	Awareness	4	3	75	3	75	0	0
	Basic	16	12	75	12	75	0	0
	Intermediate	11	9	82	9	82	0	0
	Advanced	41	16	39	16	39	0	0
	Expert	48	19	40	19	40	0	0
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	0	0
	Basic	7	4	57	4	57	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	2	67	0	0
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	0	0
	Basic	1	1	100	1	100	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	5	3	60	3	60	0	0
	Advanced	10	8	80	8	80	0	0
	Expert	13	2	15	2	15	0	0
Software Literacy	Awareness	7	4	57	4	57	0	0
	Basic	10	7	70	7	70	0	0
	Intermediate	15	12	80	12	80	0	0
	Advanced	38	30	79	30	79	0	0
	Expert	20	14	70	14	70	0	0

Table 89. KSAB Total and Percentage of DECF KSABs for the IT Specialist for the System Requirements Definition and Traceability Project Ideal Team of 50

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	0	0	0	0	0	0
	Basic	11	3	27	3	27	0	0
	Intermediate	7	1	14	1	14	0	0
	Advanced	14	4	29	5	29	0	0
	Expert	13	2	15	2	15	0	0
Data Management	Awareness	2	2	100	2	100	0	0
	Basic	7	4	57	4	57	0	0
	Intermediate	1	1	100	1	100	0	0
	Advanced	14	10	71	10	71	0	0
	Expert	6	1	17	2	17	0	0
Modeling	Awareness	11	0	0	6	0	0	0
	Basic	25	1	4	5	4	0	0
	Intermediate	36	2	6	10	6	0	0
	Advanced	35	1	3	4	3	0	0
	Expert	15	0	0	0	0	0	0
Simulation	Awareness	8	0	0	1	0	0	0
	Basic	8	0	0	4	0	0	0
	Intermediate	16	1	6	0	6	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Artificial Intelligence/ Machine Learning	Awareness	2	1	50	1	50	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	0	0	0	0	0	0
	Basic	4	0	0	0	0	0	0
	Intermediate	12	1	8	0	8	0	0
	Advanced	2	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	2	100	2	100	0	0
	Basic	5	1	20	1	20	0	0
	Intermediate	12	1	8	0	8	0	0
	Advanced	17	0	0	1	0	0	0
	Expert	11	0	0	0	0	0	0
Digital Architecting	Awareness	3	0	0	0	0	0	0
	Basic	14	0	0	0	0	0	0
	Intermediate	18	0	0	2	0	0	0

	Advanced	18	1	6	3	6	0	0
	Expert	2	0	0	0	0	0	0
Digital Requirements Modeling	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	15	0	0	0	0	0	0
	Advanced	4	1	25	0	25	0	0
	Expert	1	0	0	0	0	0	0
Digital Validation and Verification	Awareness	2	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	0	0	0	0	0	0
	Basic	33	0	0	0	0	0	0
	Intermediate	17	0	0	0	0	0	0
	Advanced	35	1	3	1	3	0	0
	Expert	12	0	0	0	0	0	0
Digital Model-Based Reviews	Awareness	2	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	1	50	1	50	0	0
	Basic	18	0	0	0	0	0	0
	Intermediate	12	2	17	2	17	0	0
	Advanced	7	1	14	1	14	0	0
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	1	25	1	25	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering Policy and Guidance	Awareness	1	0	0	0	0	0	0
	Basic	3	1	33	1	33	0	0
	Intermediate	2	1	50	1	50	0	0
	Advanced	7	1	14	1	14	0	0
	Expert	10	0	0	0	0	0	0
Configuration Management	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	8	2	25	2	25	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0

	Advanced	5	1	20	1	20	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	1	20	1	20	0	0
	Intermediate	5	3	60	3	60	0	0
	Advanced	24	9	38	9	38	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	1	100	0	0
	Basic	15	3	20	3	20	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	15	11	73	11	73	0	0
	Expert	13	7	54	7	54	0	0
Management	Awareness	2	1	50	1	50	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	1	1	100	1	100	0	0
	Advanced	10	4	40	4	40	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	1	100	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	3	2	67	2	67	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	1	100	1	100	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	2	2	100	2	100	0	0
	Advanced	3	2	67	2	67	0	0
	Expert	3	1	33	1	33	0	0
Digital Environment Operations	Awareness	3	3	100	3	100	0	0
	Basic	4	4	100	4	100	0	0
	Intermediate	8	8	100	8	100	0	0
	Advanced	9	7	78	7	78	0	0
	Expert	2	2	100	2	100	0	0
Digital Environment Support	Awareness	3	2	67	2	67	0	0
	Basic	6	4	67	4	67	0	0
	Intermediate	18	18	100	18	100	0	0
	Advanced	25	23	92	23	92	0	0
	Expert	15	10	67	10	67	0	0
Digital Environment Security	Awareness	6	6	100	6	100	0	0
	Basic	2	2	100	2	100	0	0
	Intermediate	7	7	100	7	100	0	0
	Advanced	16	16	100	16	100	0	0
	Expert	11	11	100	11	100	0	0
Digital Literacy	Awareness	4	2	50	2	50	0	0
	Basic	16	6	38	6	38	0	0
	Intermediate	11	5	45	5	45	0	0

	Advanced	41	13	32	13	32	0	0
	Expert	48	17	35	17	35	0	0
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	0	0
	Basic	7	3	43	3	43	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	2	67	0	0
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	1	100	1	100	0	0
	Intermediate	5	3	60	3	60	0	0
	Advanced	10	8	80	8	80	0	0
	Expert	13	5	38	5	38	0	0
Software Literacy	Awareness	7	4	57	4	57	0	0
	Basic	10	7	70	7	70	0	0
	Intermediate	15	13	87	13	87	0	0
	Advanced	38	31	82	31	82	0	0
	Expert	20	12	60	12	60	0	0

Table 90. KSAB Total and Percentage of DECF KSABs for the Physical Security Specialist for the System Requirements Definition and Traceability Project Ideal Team of 50

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	0	0	0	0	0	0
	Basic	11	1	9	1	9	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	14	0	0	0	0	0	0
	Expert	13	0	0	0	0	0	0
Data Management	Awareness	2	0	0	0	0	0	0
	Basic	7	1	14	1	14	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	14	1	7	1	7	0	0
	Expert	6	0	0	0	0	0	0

Modeling	Awareness	11	0	0	0	0	0	0
	Basic	25	0	0	0	0	0	0
	Intermediate	36	0	0	0	0	0	0
	Advanced	35	0	0	0	0	0	0
	Expert	15	0	0	0	0	0	0
Simulation	Awareness	8	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	16	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	0	0	0	0	0	0
	Basic	4	0	0	0	0	0	0
	Intermediate	12	0	0	0	0	0	0
	Advanced	2	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	12	0	0	0	0	0	0
	Advanced	17	0	0	0	0	0	0
	Expert	11	0	0	0	0	0	0
Digital Architecting	Awareness	3	0	0	0	0	0	0
	Basic	14	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0
	Advanced	18	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Digital Requirements Modeling	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	15	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Digital Validation and Verification	Awareness	2	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	0	0	0	0	0	0
	Basic	33	0	0	0	0	0	0
	Intermediate	17	0	0	0	0	0	0
	Advanced	35	0	0	0	0	0	0
	Expert	12	0	0	0	0	0	0

Digital Model-Based Reviews	Awareness	2	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	0	0	0	0	0	0
	Basic	18	0	0	0	0	0	0
	Intermediate	12	0	0	0	0	0	0
	Advanced	7	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering Policy and Guidance	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	7	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Configuration Management	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	8	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	1	20	1	20	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	24	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	1	100	0	0
	Basic	15	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	15	0	0	0	0	0	0
	Expert	13	0	0	0	0	0	0
Management	Awareness	2	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	10	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0

Communications	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Digital Environment Operations	Awareness	3	0	0	0	0	0	0
	Basic	4	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	9	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Digital Environment Support	Awareness	3	0	0	0	0	0	0
	Basic	6	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0
	Advanced	25	1	4	1	4	0	0
	Expert	15	0	0	0	0	0	0
Digital Environment Security	Awareness	6	4	67	4	67	0	0
	Basic	2	2	100	2	100	0	0
	Intermediate	7	2	29	2	29	0	0
	Advanced	16	7	44	7	44	0	0
	Expert	11	2	18	2	18	0	0
Digital Literacy	Awareness	4	0	0	0	0	0	0
	Basic	16	1	6	1	6	0	0
	Intermediate	11	3	27	3	27	0	0
	Advanced	41	2	5	2	5	0	0
	Expert	48	2	4	2	4	0	0
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	0	0
	Basic	7	1	14	1	14	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	0	0	0	0	0	0
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0

Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	5	1	20	1	20	0	0
	Advanced	10	6	60	6	60	0	0
	Expert	13	1	8	1	8	0	0
Software Literacy	Awareness	7	1	14	1	14	0	0
	Basic	10	1	10	1	10	0	0
	Intermediate	15	2	13	2	13	0	0
	Advanced	38	5	13	5	13	0	0
	Expert	20	0	0	0	0	0	0

Table 91. KSAB Total and Percentage of DECF KSABs for the Configuration Control Specialist for the System Requirements Definition and Traceability Project Ideal Team of 50

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	2	67	0	0
	Basic	11	4	36	4	36	0	0
	Intermediate	7	2	29	2	29	0	0
	Advanced	14	4	29	4	29	0	0
	Expert	13	0	0	0	0	0	0
Data Management	Awareness	2	2	100	2	100	0	0
	Basic	7	4	57	4	57	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	14	3	21	3	21	0	0
	Expert	6	2	33	2	33	0	0
Modeling	Awareness	11	2	18	2	18	0	0
	Basic	25	1	4	1	4	0	0
	Intermediate	36	3	8	3	8	0	0
	Advanced	35	7	20	7	20	0	0
	Expert	15	1	7	1	7	0	0
Simulation	Awareness	8	1	13	1	13	0	0
	Basic	8	4	50	4	50	0	0
	Intermediate	16	2	13	2	13	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	2	100	0	0
	Basic	4	1	25	1	25	0	0

	Intermediate	12	3	25	3	25	0	0
	Advanced	2	1	50	1	50	0	0
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	12	0	0	0	0	0	0
	Advanced	17	1	6	1	6	0	0
	Expert	11	0	0	0	0	0	0
Digital Architecting	Awareness	3	0	0	0	0	0	0
	Basic	14	2	14	2	14	0	0
	Intermediate	18	1	6	1	6	0	0
	Advanced	18	3	17	3	17	0	0
	Expert	2	0	0	0	0	0	0
Digital Requirements Modeling	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	15	1	7	1	7	0	0
	Advanced	4	1	25	1	25	0	0
	Expert	1	0	0	0	0	0	0
Digital Validation and Verification	Awareness	2	1	50	1	50	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	6	3	50	3	50	0	0
	Advanced	3	1	33	1	33	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	1	9	1	9	0	0
	Basic	33	1	3	1	3	0	0
	Intermediate	17	1	6	1	6	0	0
	Advanced	35	5	14	5	14	0	0
	Expert	12	0	0	0	0	0	0
Digital Model-Based Reviews	Awareness	2	2	100	2	100	0	0
	Basic	1	1	100	1	100	0	0
	Intermediate	6	3	50	3	50	0	0
	Advanced	5	2	40	2	40	0	0
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	1	50	1	50	0	0
	Basic	18	0	0	0	0	0	0
	Intermediate	12	1	8	1	8	0	0
	Advanced	7	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	1	25	1	25	0	0
	Expert	10	1	10	1	10	0	0
Digital Engineering	Awareness	1	1	100	1	100	0	0
	Basic	3	1	33	1	33	0	0

Policy and Guidance	Intermediate	2	2	100	2	100	0	0
	Advanced	7	6	86	6	86	0	0
	Expert	10	5	50	5	50	0	0
Configuration Management	Awareness	1	1	100	1	100	0	0
	Basic	3	3	100	3	100	0	0
	Intermediate	5	5	100	5	100	0	0
	Advanced	8	8	100	8	100	0	0
	Expert	2	2	100	2	100	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	24	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	1	100	0	0
	Basic	15	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	15	1	7	1	7	0	0
	Expert	13	0	0	0	0	0	0
Management	Awareness	2	1	50	1	50	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	10	1	10	1	10	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	1	100	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	1	1	100	1	100	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Digital Environment Operations	Awareness	3	2	67	2	67	0	0
	Basic	4	2	50	2	50	0	0
	Intermediate	8	1	13	1	13	0	0
	Advanced	9	2	22	2	22	0	0
	Expert	2	0	0	0	0	0	0
	Awareness	3	1	33	1	33	0	0
	Basic	6	0	0	0	0	0	0

Digital Environment Support	Intermediate	18	0	0	0	0	0	0
	Advanced	25	2	8	2	8	0	0
	Expert	15	0	0	0	0	0	0
Digital Environment Security	Awareness	6	1	17	1	17	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	11	0	0	0	0	0	0
Digital Literacy	Awareness	4	1	25	1	25	0	0
	Basic	16	4	25	4	25	0	0
	Intermediate	11	3	27	3	27	0	0
	Advanced	41	4	10	4	10	0	0
	Expert	48	10	21	10	21	0	0
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	0	0
	Basic	7	2	29	2	29	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	2	67	0	0
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	5	1	20	1	20	0	0
	Advanced	10	4	40	4	40	0	0
	Expert	13	0	0	0	0	0	0
Software Literacy	Awareness	7	0	0	0	0	0	0
	Basic	10	2	20	2	20	0	0
	Intermediate	15	2	13	2	13	0	0
	Advanced	38	0	0	0	0	0	0
	Expert	20	0	0	0	0	0	0

Table 92. KSAB Total and Percentage of DECF KSABs for the T&E SME for the System Requirements Definition and Traceability Project Ideal Team of 50

Competency	Proficiency Level	Number in DECF	All Tasks		PM/Admin Tasks		Project Tasks	
			Total	% of DECF	Total	% of DECF	Total	% of DECF
Data Governance	Awareness	3	2	67	0	0	2	67
	Basic	11	4	36	0	0	4	36
	Intermediate	7	2	29	0	0	2	29
	Advanced	14	1	7	0	0	1	7
	Expert	13	0	0	0	0	0	0
Data Management	Awareness	2	2	100	0	0	2	100
	Basic	7	4	57	0	0	4	57
	Intermediate	1	0	0	0	0	0	0
	Advanced	14	2	14	0	0	2	14
	Expert	6	0	0	0	0	0	0
Modeling	Awareness	11	11	100	0	0	11	100
	Basic	25	25	100	0	0	25	100
	Intermediate	36	36	100	0	0	36	100
	Advanced	35	30	86	0	0	30	86
	Expert	15	8	53	0	0	8	53
Simulation	Awareness	8	7	88	0	0	7	88
	Basic	8	7	88	0	0	7	88
	Intermediate	16	15	94	0	0	15	94
	Advanced	16	11	69	0	0	11	69
	Expert	8	2	25	0	0	2	25
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	0	0	2	100
	Basic	4	1	25	0	0	1	25
	Intermediate	12	3	25	0	0	3	25
	Advanced	2	1	50	0	0	1	50
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	0	0	0	0	0	0
	Basic	5	2	40	0	0	2	40
	Intermediate	12	6	50	0	0	6	50
	Advanced	17	8	47	0	0	8	47
	Expert	11	1	9	0	0	1	9
Digital Architecting	Awareness	3	3	100	0	0	3	100
	Basic	14	12	86	0	0	12	86
	Intermediate	18	18	100	0	0	18	100
	Advanced	18	18	100	0	0	18	100

	Expert	2	0	0	0	0	0	0
Digital Requirements Modeling	Awareness	1	1	100	0	0	1	100
	Basic	3	3	100	0	0	3	100
	Intermediate	15	15	100	0	0	15	100
	Advanced	4	4	100	0	0	4	100
	Expert	1	1	100	0	0	1	100
Digital Validation and Verification	Awareness	2	1	50	0	0	1	50
	Basic	2	1	50	0	0	1	50
	Intermediate	6	6	100	0	0	6	100
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems Engineering Processes	Awareness	11	11	100	0	0	11	100
	Basic	33	30	91	0	0	30	91
	Intermediate	17	16	94	0	0	16	94
	Advanced	35	31	89	0	0	31	89
	Expert	12	6	50	0	0	6	50
Digital Model-Based Reviews	Awareness	2	2	100	0	0	2	100
	Basic	1	1	100	0	0	1	100
	Intermediate	6	6	100	0	0	6	100
	Advanced	5	4	80	0	0	4	80
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	2	100	0	0	2	100
	Basic	18	7	39	0	0	7	39
	Intermediate	12	5	42	0	0	5	42
	Advanced	7	5	71	0	0	5	71
	Expert	3	0	0	0	0	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering Policy and Guidance	Awareness	1	1	100	0	0	1	100
	Basic	3	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	7	1	14	0	0	1	14
	Expert	10	1	10	0	0	1	10
Configuration Management	Awareness	1	1	100	0	0	1	100
	Basic	3	3	100	0	0	3	100
	Intermediate	5	4	80	0	0	4	80
	Advanced	8	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0

	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	24	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	0	0	1	100
	Basic	15	1	7	0	0	1	7
	Intermediate	3	0	0	0	0	0	0
	Advanced	15	1	7	0	0	1	7
	Expert	13	0	0	0	0	0	0
Management	Awareness	2	1	50	0	0	1	50
	Basic	2	1	50	0	0	1	50
	Intermediate	1	0	0	0	0	0	0
	Advanced	10	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	1	100	0	0	1	100
	Basic	2	1	50	0	0	1	50
	Intermediate	1	1	100	0	0	1	100
	Advanced	3	0	0	0	0	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Digital Environment Operations	Awareness	3	2	67	0	0	2	67
	Basic	4	2	50	0	0	2	50
	Intermediate	8	1	13	0	0	1	13
	Advanced	9	3	33	0	0	3	33
	Expert	2	0	0	0	0	0	0
Digital Environment Support	Awareness	3	0	0	0	0	0	0
	Basic	6	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0
	Advanced	25	0	0	0	0	0	0
	Expert	15	0	0	0	0	0	0
Digital Environment Security	Awareness	6	1	17	0	0	1	17
	Basic	2	0	0	0	0	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	11	0	0	0	0	0	0
Digital Literacy	Awareness	4	2	50	0	0	2	50
	Basic	16	14	88	0	0	14	88
	Intermediate	11	5	45	0	0	5	45
	Advanced	41	9	22	0	0	9	22

	Expert	48	3	6	0	0	3	6
Digital Engineering Value Proposition	Awareness	2	2	100	0	0	2	100
	Basic	7	4	57	0	0	4	57
	Intermediate	3	3	100	0	0	3	100
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	0	0	2	67
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	0	0	1	100
	Basic	1	1	100	0	0	1	100
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	5	1	20	0	0	1	20
	Advanced	10	3	30	0	0	3	30
	Expert	13	1	8	0	0	1	8
Software Literacy	Awareness	7	2	29	0	0	2	29
	Basic	10	2	20	0	0	2	20
	Intermediate	15	1	7	0	0	1	7
	Advanced	38	2	5	0	0	2	5
	Expert	20	2	10	0	0	2	10

There were no tasks assigned to the Finance Specialist for the System Requirements Definition and Traceability project for the ideal team of 50, so there is no table for that role.

Table 93. KSAB Total and Percentage of DECF KSABs for the Scheduler for the System Requirements Definition and Traceability Project Ideal Team of 50

Competency	**Proficiency Level**	**Number in DECF**	**All Tasks**		**PM/Admin Tasks**		**Project Tasks**	
			Total	**% of DECF**	**Total**	**% of DECF**	**Total**	**% of DECF**
Data Governance	Awareness	3	1	33	1	33	0	0
	Basic	11	3	27	3	27	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	14	0	0	0	0	0	0
	Expert	13	0	0	0	0	0	0
Data Management	Awareness	2	2	100	2	100	0	0
	Basic	7	3	43	3	43	0	0

	Intermediate	1	0	0	0	0	0	0
	Advanced	14	0	0	0	0	0	0
	Expert	6	0	0	0	0	0	0
Modeling	Awareness	11	0	0	0	0	0	0
	Basic	25	0	0	0	0	0	0
	Intermediate	36	0	0	0	0	0	0
	Advanced	35	0	0	0	0	0	0
	Expert	15	0	0	0	0	0	0
Simulation	Awareness	8	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	16	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Artificial Intelligence/ Machine Learning	Awareness	2	0	0	0	0	0	0
	Basic	19	0	0	0	0	0	0
	Intermediate	8	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Data Visualization	Awareness	2	2	100	2	100	0	0
	Basic	4	1	25	1	25	0	0
	Intermediate	12	6	50	6	50	0	0
	Advanced	2	2	100	2	100	0	0
	Expert	2	0	0	0	0	0	0
Data Analytics	Awareness	2	0	0	0	0	0	0
	Basic	5	2	40	2	40	0	0
	Intermediate	12	5	42	5	42	0	0
	Advanced	17	5	29	5	29	0	0
	Expert	11	0	0	0	0	0	0
Digital Architecting	Awareness	3	0	0	0	0	0	0
	Basic	14	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0
	Advanced	18	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Digital Requirements Modeling	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	15	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Digital Validation and Verification	Awareness	2	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
Model-Based Systems	Awareness	11	0	0	0	0	0	0
	Basic	33	0	0	0	0	0	0

Engineering Processes	Intermediate	17	0	0	0	0	0	0
	Advanced	35	0	0	0	0	0	0
	Expert	12	0	0	0	0	0	0
Digital Model-Based Reviews	Awareness	2	1	50	1	50	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	6	0	0	0	0	0	0
	Advanced	5	1	20	1	20	0	0
	Expert	1	0	0	0	0	0	0
Project and Program Management	Awareness	2	2	100	2	100	0	0
	Basic	18	9	50	9	50	0	0
	Intermediate	12	5	42	5	42	0	0
	Advanced	7	4	57	4	57	0	0
	Expert	3	1	33	1	33	0	0
Organizational Development	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	4	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Engineering Policy and Guidance	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	7	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Configuration Management	Awareness	1	0	0	0	0	0	0
	Basic	3	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	8	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Software Construction	Awareness	1	0	0	0	0	0	0
	Basic	8	0	0	0	0	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	5	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Software Engineering	Awareness	3	0	0	0	0	0	0
	Basic	5	0	0	0	0	0	0
	Intermediate	5	0	0	0	0	0	0
	Advanced	24	0	0	0	0	0	0
	Expert	10	0	0	0	0	0	0
Digital Environment Development	Awareness	1	1	100	1	100	0	0
	Basic	15	1	7	1	7	0	0
	Intermediate	3	0	0	0	0	0	0
	Advanced	15	1	7	1	7	0	0
	Expert	13	0	0	0	0	0	0
Management	Awareness	2	2	100	2	100	0	0
	Basic	2	0	0	0	0	0	0

	Intermediate	1	0	0	0	0	0	0
	Advanced	10	0	0	0	0	0	0
	Expert	8	0	0	0	0	0	0
Communications	Awareness	1	0	0	0	0	0	0
	Basic	2	1	50	1	50	0	0
	Intermediate	1	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	5	0	0	0	0	0	0
Planning	Awareness	1	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	3	0	0	0	0	0	0
Digital Environment Operations	Awareness	3	1	33	1	33	0	0
	Basic	4	2	50	2	50	0	0
	Intermediate	8	1	13	1	13	0	0
	Advanced	9	1	11	1	11	0	0
	Expert	2	0	0	0	0	0	0
Digital Environment Support	Awareness	3	0	0	0	0	0	0
	Basic	6	0	0	0	0	0	0
	Intermediate	18	0	0	0	0	0	0
	Advanced	25	0	0	0	0	0	0
	Expert	15	0	0	0	0	0	0
Digital Environment Security	Awareness	6	0	0	0	0	0	0
	Basic	2	0	0	0	0	0	0
	Intermediate	7	0	0	0	0	0	0
	Advanced	16	0	0	0	0	0	0
	Expert	11	0	0	0	0	0	0
Digital Literacy	Awareness	4	0	0	0	0	0	0
	Basic	16	2	13	2	13	0	0
	Intermediate	11	0	0	0	0	0	0
	Advanced	41	5	12	5	12	0	0
	Expert	48	2	4	2	4	0	0
Digital Engineering Value Proposition	Awareness	2	2	100	2	100	0	0
	Basic	7	3	43	3	43	0	0
	Intermediate	3	3	100	3	100	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	0	0	0	0	0	0	0
DoD Policy/ Guidance	Awareness	3	2	67	2	67	0	0
	Basic	0	0	0	0	0	0	0
	Intermediate	0	0	0	0	0	0	0
	Advanced	0	0	0	0	0	0	0
	Expert	1	0	0	0	0	0	0
Coaching and Mentoring	Awareness	1	1	100	1	100	0	0
	Basic	1	0	0	0	0	0	0

	Intermediate	2	0	0	0	0	0	0
	Advanced	3	0	0	0	0	0	0
	Expert	2	0	0	0	0	0	0
Decision Making	Awareness	0	0	0	0	0	0	0
	Basic	1	0	0	0	0	0	0
	Intermediate	5	1	20	1	20	0	0
	Advanced	10	3	30	3	30	0	0
	Expert	13	2	15	2	15	0	0
Software Literacy	Awareness	7	0	0	0	0	0	0
	Basic	10	1	10	1	10	0	0
	Intermediate	15	0	0	0	0	0	0
	Advanced	38	0	0	0	0	0	0
	Expert	20	0	0	0	0	0	0

There were no tasks assigned to the Contracts Specialist for the System Requirements Definition and Traceability project for the ideal team of 50, so there is no table for that role.