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WRT-1006 Technical Report: Developing the Digital Engineering Competency Framework (DECF) – Phase 2

23 March 2021

Technical Report SERC-2021-TR-005



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The team would also like to acknowledge and offer our sincere thanks and appreciation to Dr. Jon Wade who contributed immensely during Phase 1 of this research project and reviewed this final technical report.

Executive Summary

This document describes the updated Digital Engineering Competency Framework (DECF) version 1.1 (DECF v. 1.1). This document also summarizes the findings of the comparison between the DECF competencies and the training resources from the US Department of Defense (DoD), and provide recommendations on how to build a competent DoD digital engineering workforce.

Digital engineering (DE) is “an integrated digital approach that uses authoritative sources of systems’ data and models as a continuum across disciplines to support lifecycle activities from concept through disposal. A DE ecosystem is an interconnected infrastructure, environment, and methodology that enables the exchange of digital artifacts from an authoritative source of truth.”¹ DE is a critical practice necessary to support acquisition in an environment of increasing global challenges, dynamic threats, rapidly evolving technologies, and increasing life expectancy of our systems currently in operation.

Digital transformation is fundamentally changing the way acquisition and engineering are performed across a wide range of government agencies, industries, and academia and is characterized by the integration of digital technology into all areas of a business, changing fundamental operations and how results are delivered in terms of new value to customers. It includes cultural change centered on alignment across leadership, strategy, customers, operations, and workforce evolution.

On 23 July 2020, the Systems Engineering Research Center (SERC) developed the DECF to support the DoD by providing clear guidance for the DoD acquisition workforce, in particular the engineering (ENG) acquisition workforce (Phase 1) (SERC, 2020). The guidance comprised of well-defined competencies with the associated knowledge, skills, abilities, and behaviors (KSABs) that are required for the DE workforce.

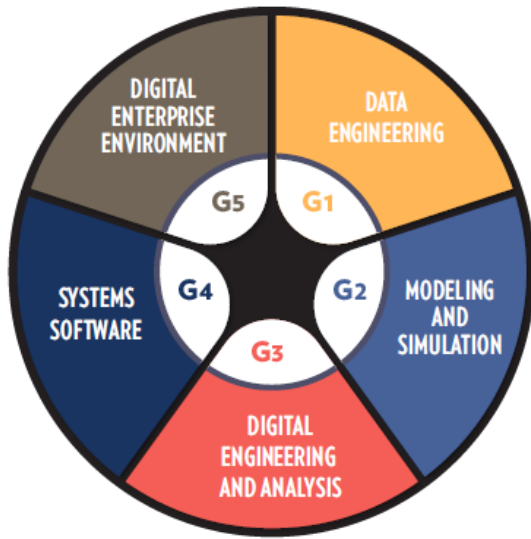
Phase 2 of this research task focused on mapping existing DoD DE training resources against the DECF to identify gaps and provide recommendations on how to build the digital engineering competency of the DoD workforce. The current Defense Acquisition University (DAU) ENG curriculum was analyzed against the DECF to:

- Identify which competencies are already covered within the existing curriculum;
- Identify clear gaps between the existing curriculum and the DECF; and
- Create specific recommendations for training that could help address DECF competencies that are not currently covered in the curriculum.

The updated DECF v. 1.1 includes new competencies that were discovered from the gaps identified when comparing the DECF with the DoD training resources. The DECF competency groups were also updated to reflect a cohesive categorization of the competencies. In DECF v. 1.1, there are five (5) competency groups, nine (9) competency subgroups, and 31 competencies (including six (6) foundational digital competencies) identified as shown in Figure 1.

¹ Office of the Deputy Assistant Secretary of Defense (Systems Engineering) [ODASD (SE)], “DAU Glossary: Digital Engineering,” Defense Acquisition University (DAU), 2017.

DIGITAL ENGINEERING COMPETENCY FRAMEWORK (DECF) VERSION 1.1



FOUNDATIONAL DIGITAL COMPETENCIES	
F1	Digital Literacy
F2	Digital Engineering Value Proposition
F3	DoD Policy/Guidance
F4	Coaching and Mentoring
F5	Decision Making
F6	Software Literacy

LEGEND:
 C# - Competency Title
 F# - Foundational Competency Title
 G# - Competency Group
 S# - Competency Subgroup

G1 DATA ENGINEERING		
S1	Data Engineering	C1 Data Governance
		C2 Data Management

G2 MODELING AND SIMULATION		
S2	Modeling and Simulation	C3 Modeling
		C4 Simulation
		C5 Artificial Intelligence/Machine Learning
		C6 Data Visualization
		C7 Data Analytics

G3 DIGITAL ENGINEERING AND ANALYSIS		
S3	Digital Systems Engineering	C8 Digital Architecting
		C9 Digital Requirements Modeling
		C10 Digital Validation and Verification
		C11 Model-Based Systems Engineering Processes
		C12 Digital Model-Based Reviews
S4	Engineering Management	C13 Project and Program Management
		C14 Organizational Development
		C15 Digital Engineering Policy and Guidance
		C16 Configuration Management

G4 SYSTEMS SOFTWARE		
S5	Systems Software	C17 Software Construction
		C18 Software Engineering

G5 DIGITAL ENTERPRISE ENVIRONMENT		
S6	Digital Enterprise Environment Development	C19 Digital Environment Development
S7	Digital Enterprise Environment Management	C20 Management
		C21 Communications
		C22 Planning
S8	Digital Enterprise Environment Operations and Support	C23 Digital Environment Operations
		C24 Digital Environment Support
S9	Digital Enterprise Environment Security	C25 Digital Environment Security

Figure 1. Overview of DECF v. 1.1.

The competency hierarchy provides a logical structure for the individual competencies:

- **G1 Data Engineering** includes data governance and data management which incorporates model-based processes to ensure the formal management of data assets within a digital enterprise.
- **G2 Modeling and Simulation** in the digital enterprise environment is the process of creating and analyzing a digital prototype of a physical model to predict its performance in the real world. Modeling and simulation are used to help system designers and engineers understand whether, under what conditions, and in which ways a system component could fail and what loads it can withstand through analysis. Data analytics and data visualization play an important role to improve the decision-making process in the system lifecycle. Artificial intelligence and machine learning (AI/ML) are critical tools to enable systems that continuously evolve to behave differently based both on input data and statistical, logical, and knowledge-based inference. AI/ML skills must be applied in a digital environment.
- **G3 Digital Engineering and Analysis** includes systems engineering and engineering management which constitute how digital engineering takes full advantage of the digital power of computation and communication to take better, faster actions throughout the defense system lifecycle. Configuration management refers to the development of strategies, policies, standards,

and guidelines for configuration management of DE related artifacts in accordance with model-based systems engineering methods.

- **G4 Systems Software** is the systemic application of DE approaches to the development of software.
- **G5 Digital Enterprise Environment** addresses development of the DE environment including hardware and software aspects. Digital Enterprise Environment Management is for management, communications and planning related to enabling the workforce to manage the adoption of appropriate model-based tools and approaches, techniques and processes for the operation of digital enterprise environment systems that ensure transformational processes in enterprises occur with pace, high-quality and security. Digital Enterprise Environment Operations and Support within a digital enterprise environment include abilities to operate and support the digital enterprise environment across the enterprise and lifecycle. Digital Enterprise Environment Security involves developing policies, standards, processes, and guidelines to ensure the physical and electronic security of digital environments and automated systems.

1. Introduction

Digital transformation is fundamentally changing the way acquisition and engineering are performed across a wide range of government agencies, industries, and academia. Digital transformation is characterized by the integration of digital technology into all areas of a business, changing fundamental operations and how results are delivered in terms of new value to customers. It includes cultural change centered on alignment across leadership, strategy, customers, operations, and workforce evolution.

Digital engineering (DE) is “an integrated digital approach that uses authoritative sources of systems’ data and models as a continuum across disciplines to support lifecycle activities from concept through disposal. A DE ecosystem is an interconnected infrastructure, environment, and methodology that enables the exchange of digital artifacts from an authoritative source of truth.”²

There is evidence across the Services and industry affirming that DE is a critical practice necessary to support acquisition in an environment of increasing global challenges, dynamic threats, rapidly evolving technologies, and increasing life expectancy of our systems currently in operation. The DoD must continue to practice systems engineering efficiently and effectively to provide the best advantage for successful acquisitions and sustainment. DE updates the systems engineering practices to take full advantage of the digital power of computation, visualization, and communication to take better, faster actions throughout the lifecycle.

The purpose of the Digital Engineering Competency Framework (DECF) is to provide clear guidance for the DoD acquisition workforce, in particular the ENG acquisition workforce, through clearly defined competencies that illuminate the KSABs required for DE professionals. Though the DECF includes considerations specific to the Defense acquisition workforce, data was gathered from outside the defense community and the structure of the DECF provides a useful model for any individual or organization that needs to understand the skills required to successfully implement DE. Version 1.0 of the DECF, published in 2020, was used as an input for this work.

The team had a comprehensive review of all the relevant competency models and identified competencies that would relate to aspects of DE. Then, the team took the ones related to DE and translated or modified them to develop the DECF so that it would be relevant in the digital environment. Any ongoing modifications or updates to the competency models listed in Section 2.1, such as the INCOSE Systems Engineering Competency Framework that is currently going through a modification have not been updated and incorporated in DECF v. 1.1. Though DECF v. 1.1 has been updated to include new competencies and is rather large, further refinement may be required. For instance, though cybersecurity is lightly covered in DECF v. 1.1, iteration with practitioners may lead to the inclusion of additional KSABs or even elevate cybersecurity to its own competency.

This research task (Phase 2) is a continuation of Phase 1 and focuses on mapping existing DoD DE training resources against the DECF to identify gaps and provide recommendations on how to build the digital engineering competency of the DoD workforce. The framework has been refined into DECF v. 1.1, as reflected here. Version 1.1 formed the basis for comparisons against existing curricula. The current Defense Acquisition University (DAU) ENG curriculum was analyzed against the DECF to:

- Identify which competencies are already covered within the existing curriculum;
- Identify clear gaps between the existing curriculum and the DECF; and

² Office of the Deputy Assistant Secretary of Defense (Systems Engineering) [ODASD (SE)], “DAU Glossary: Digital Engineering,” Defense Acquisition University (DAU), 2017.

- Create specific recommendations for training that could help address the DECF competencies that are not currently covered in curriculum.

1.1 Digital Engineering Strategy

The Office of the Under Secretary of Defense for Research and Engineering (OUSDR&E) published a Digital Engineering Strategy in June 2018, outlining the vision for DE and five goals of the transition to a digitally based engineering and acquisition approach (DoD 2018). According to the DoD, DE is defined as “an integrated digital approach that uses authoritative sources of system data and models a continuum across disciplines to support lifecycle activities from concept through disposal” (DoD 2018). In order for a DE ecosystem to succeed, the five goals described in the Digital Engineering Strategy are:

1. Formalize the development, integration, and use of models to inform enterprise and pro-gram decision making;
2. Provide an enduring, authoritative source of truth;
3. Incorporate technological innovation to improve the engineering practice;
4. Establish a supporting infrastructure and environment to perform activities, collaborate, and communicate across stakeholders; and
5. Transform the culture and workforce to adopt and support digital engineering across the life cycle.

This task helps to address Goal 5. The DECF provides a foundation for workforce transformation by identifying the critical competencies required for individuals to successfully work in a digital environment. In addition, competencies identified in the DECF relate to, or align with the other four (4) Goals.

1.2 Digital Transformation

As the DoD transitions to DE, there is a need to develop and maintain an acquisition workforce and culture that is literate in model-based engineering, competent in DE models, methods, and tools, and understands digital artifacts across the acquisition lifecycle. This is significant as DE impacts how engineers and the acquisition workforce will perform their job functions, their interaction and sharing of information either locally or in a distributed manner, and the digital artifacts delivered. There are a number of initiatives in the DoD to support progress toward these goals. In order to succeed in DE, deliberate efforts to identify new competencies for the DoD acquisition workforce and develop appropriate education and training around these competencies must be undertaken and the results implemented. Phase 1 of this research task created a DECF that:

- Defines the critical knowledge, skills, abilities, and behaviors (competencies) required to implement digital engineering approaches;
- Highlights the competencies that are most critical for the DoD acquisition workforce, in particular the ENG workforce and other acquisition career fields that will be most impacted by digital engineering; and
- Provides the basis for ensuring the acquisition workforce has the appropriate competencies to work within the envisioned digital environment.

In Phase 2, the DECF was further refined through reviews with subject matter experts and analysis against existing DE or related curricula.

1.3 This Report

The outline of this report is:

- Section 2 provides the methodology and approaches used for updating the DECF to version 1.1 and for conducting the analysis of existing curricula;
- Section 3 lays out the structure of DECF v. 1.1;
- Section 4 describes the evaluation of the DoD training resources related to DE and the findings from the comparison of the DECF and the competencies discovered in the DoD training resources;
- Section 5 provides conclusions and outlines future work; and
- Appendices contain tables for all the KSABs within DECF v. 1.1.

The DECF, while described and outlined here, primarily exists as a model. This model is available at <https://sercuarc.org/decf-review/>.

2. Research Approach

DoD Instruction 1400.25, volume 250, “DoD Civilian Personnel Management Systems: Civilian Strategic Human Capital Planning” was taken into consideration for developing the DECF, which outlines the following five tiers of competencies:

- *Tier 1* – Core Competencies, which apply across DoD regardless of DoD component or occupation.
- *Tier 2* – Primary Occupational Competencies, which apply across discrete occupational series and or functions.
- *Tier 3* – Sub-occupational Specialty Competencies, which are unique to sub-occupational specialties.
- *Tier 4* – DoD Component-Unique Competencies, which are so unlike any of the other competencies identified that they exist at the component level and are unique to the context or environment in which the work is performed.
- *Tier 5* – Position-Specific Competencies, which are required for a particular position within an occupation and are not addressed in tiers above.

DECF v. 1.1 addresses competencies in Tiers 2-5, with Tier 2 for acquisition professionals and Tier 3 specifically for acquisition ENG professionals being the primary focus. Where competencies apply to additional acquisition roles (e.g., PM, IT, T&E, logistics), these may also be highlighted. Though focused on the DoD, the overarching framework is intended to be relevant to a wide variety of stakeholders across government and industry and should provide critical insights for any organization looking to successfully implement digital engineering. Note that some Tier 1 or 2 competencies are listed as foundational for the DECF, meaning there is an expectation that individuals possess these competencies prior to entering the digital engineering workforce.

The overarching structure of the DECF is:

- Competency Group – Top-level grouping of related competencies that represents a core area of expertise in digital engineering;
- Competency Subgroup – Subgroups contain related/like competencies.
- Competency - Major grouping of related KSABs; each competency is identified by its title and includes a description that succinctly encompasses the general knowledge and skills related to said competency.
- KSAB – A brief statement of *knowledge, skill, ability, or behavior* related to a competency and associated with a specific proficiency level in said competency.
- Proficiency Level – For each competency, there will be five possible levels of attainment or proficiency: awareness, basic, intermediate, advanced, and expert.

The structure of DECF v. 1.1 evolved significantly from v. 1.0 to improve the logical structure for individual competencies and enable a better understanding and utilization of the DECF. The entire DECF rests on a foundation of general digital competencies that are required for any individual who may have tasks within a digital environment.

2.1 Utilization of Existing Competency Models

Existing competency models and guidance from the practicing DE community were used to develop the DECF.³ For baseline terminology, the DoD competency models (DAU ENG and PM and US Department of the Navy Systems Engineering Career Competency Model (SECCM)) are used, as these are already in use within the DoD for systems acquisition. The non-DoD competency models are being mapped against the DoD models to identify gaps between the DoD and non-DoD models. The existing competencies are also being assessed to determine if and how they need to be changed to reflect a digital environment in lieu of the traditional acquisition environment.

The existing relevant competency models being examined include:

- DAU ENG and PM competency models (DAU, 2016a and 2016b)
- INCOSE Systems Engineering Competency Framework (INCOSE, 2018)
- MITRE Systems Engineering Competency Model (MITRE, 2007)
- NASA SE/PM Competency Model (NASA, 2019)
- Helix *Atlas* Proficiency Model (Hutchison et al., 2020)
- IEEE Software Engineering Competency Model (IEEE, 2014)
- US Department of Labor Engineering Competency Model (US Department of Labor, 2017)
- Mission Engineering Competency Framework (Vesonder et al., 2018)
- US Department of the Navy Systems Engineering Career Competency Model (SECCM) (Whitcomb et al., 2017)

The team also gathered materials from the DE community related to competencies, including in-progress competency frameworks such as the Naval Digital Engineering Body of Knowledge. Paired with the assessment of existing models, experts, and practitioners in DE and Model-Based Systems Engineering (MBSE) are providing insights into their common activities and current training programs. These inputs are being collected and compared to existing competency models to determine where these fit in the existing frameworks and where new competencies need to be created to account for them.

2.2 Use Cases for the DECF

The overall objective is for the DECF to enable transformation of the acquisition workforce – in particular the ENG workforce – for successful acquisitions in a digital engineering environment. The DECF is being created in compliance with DoDI-1400.25 to facilitate its use in the DoD environment. The following are some of the avenues for this transformation:

- Grow workforce
 - Creating position descriptions
 - Hiring for DE positions
- Increase skills of current workforce
 - Workforce evaluation
 - Creating DE training programs
 - Career planning
- Transform organization
 - Identifying critical roles

Currently, the most critical use case for the DECF is to enable transformation of the workforce by providing competency models and frameworks to ensure that individuals have the required and

³ Most of this work was conducted in Phase 1 for DECF v. 1.0 but is still relevant to v. 1.1.

appropriate skillsets to adequately perform their jobs. The following describes more detailed use cases. The DECF is expected to be tailored based on these roles. For example, all individuals working in a DE environment require a basic level of modeling competencies, while only some need to be able to run analyses using such models and fewer will need the deep knowledge to be able to build a model themselves. The specific competencies and proficiencies associated with critical roles will be incorporated into the DECF.

Creating Position Descriptions – An established competency model or framework can be used as a way to clearly lay out the expectations and requirements for a given description. For example, Helix (Hutchison et al., 2018) established a proficiency model and, using this, worked with multiple organizations to map out the expected KSABs based on a given description. This was reviewed with organizational managers and leaders to determine whether these expectations were what was intended by the position descriptions and, where there was misalignment, to rewrite the position descriptions to better reflect expectations. A baseline (minimum skills required) competency profile can also be used to further clarify position descriptions.

Workforce Evaluation – It is common to use competency models or frameworks to assess individuals and, collectively, the workforce with respect to a certain discipline or function. When used for this purpose, the DECF must be sufficiently simple and streamlined to facilitate understanding and provide guidance on the different levels of proficiency for a given competency. If the data is available, example profiles of competencies related to specific roles may be created.

Creating DE Training Programs – The creation of training programs/curricula requires that there be clear learning objectives. When objectives are tied to a common competency model or framework, the expected outcomes are clear and more readily measured. As noted above in Workforce Evaluation, assessment of the workforce against a competency model to identify major gaps is a critical first step. Existing training curricula then need to be compared against the model to determine where training already exists, where training can be modified, and where true gaps in training exist that do not currently address major challenges in a competency. This work is intended to compare existing Defense Acquisition University (DAU) training curricula against the DECF to identify any major gaps or areas where modifications of existing programs may help to address DE.

Career Planning – It is a common practice to utilize competency models or frameworks to drive career planning for individuals. In these instances, an individual's current competencies are assessed, and a future 'target' or 'desired' competency profile is created. Areas requiring major growth are identified and the individual, often in conjunction with the organization, generates an approach to improving competencies in these areas. Approaches to growth can include targeted work experiences, mentoring or coaching, apprenticeship, or education and training.

Identifying Critical Roles – When developing a competency model or framework, it is common to identify critical roles – related sets of activities – that tend to be associated with the discipline or example, in systems engineering roles such as 'system architect,' 'requirements engineer,' or 'technical manager'. (Hutchison et al., 2018). Each role may require a specific competency profile – in other words, some KSABs will be more important for certain roles and less important for others. In the context of digital engineering, everyone working in the environment will require a baseline level of modeling competencies – but additional interaction with models, from simply being able to find information to manipulating models or building them from scratch, will be dependent on the role of the individual. One example of a role specific to digital engineering is 'model curator' – this role has the responsibility of ensuring models are current and correct. Where possible, competencies that are particularly critical to specific roles will be highlighted.

2.3 Validation

In Phase 1 of the WRT-1006 research task, the team conducted several iterative workshops with key stakeholders to revise and refine the DECF. This resulted in the release of DECF v. 1.0 in the final technical report (Hutchison et al., 2020). The team engaged with a Subject Matter Expert (SME) panel throughout the development of the DECF. This panel, consisting of Troy Petersen and Sanford Friedenthal, provided guidance, support, and feedback on the approach and content of the DECF. Workshops with critical stakeholders and the public review periods were two primary mechanisms for validating the DECF. A third review was conducted by the team internally. The team took use cases not for the DECF itself but for engineering in a digital environment – for example, ‘digital sign off’ or ‘model curation’ and walked through the steps required to perform these functions and mapped these steps to their required competencies. This additional approach is hoped to identify and provide opportunities to fill gaps in the current DECF. In addition, the team did a holistic review of the DECF and created additional updates and recommendations based on the detailed review.

In Phase 2 of this research task, the team onboarded a new team member who provided an independent review of DECF v. 1.0 and worked together with the team to provide valuable feedback to enhance the DECF. As a result, DECF v. 1.1 is the final product of this technical report. The team maintained close communication with the sponsors of this task to gather feedback and validate the work throughout Phase 2.

2.4 Modeling the DECF

The team utilized a Model-Based Systems Engineering (MBSE) approach to create a SysML model of the DECF, its context, and its use cases. This approach both leverages the capabilities of DE and demonstrates the benefit proposition of their adoption. The primary focus of the model was to capture the structure and content of the DECF. Block definition diagrams (BDD) such as Figure 2 is both a functional and visual representations of the structure of the DECF. The actual content of the model – the multitude of groups, competency areas and KSABs – is fulfilled by specified instants of each of these blocks.

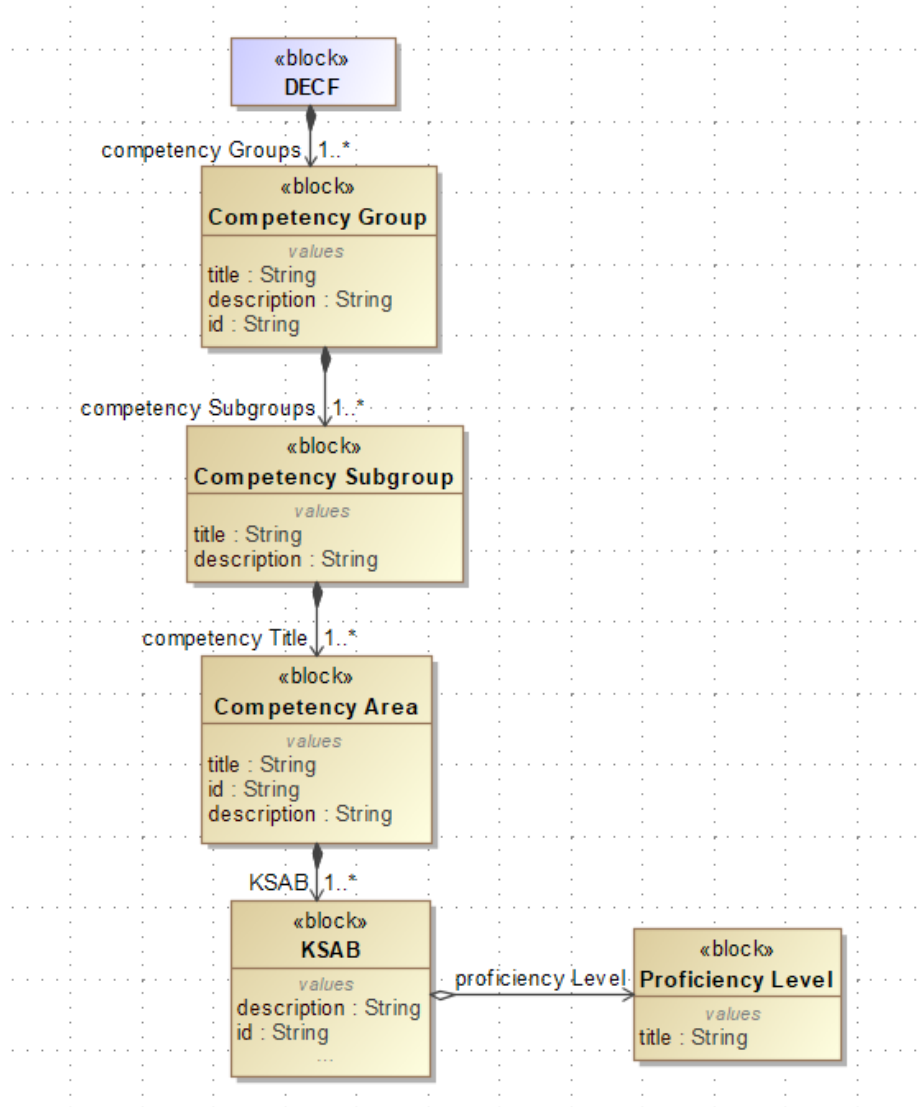


Figure 2. BDD of the DECF Structure.

The primary purpose of the model is to capture the DECF structure and content, but initial efforts were made into exploring the use cases of the DECF. First the context of the relationship of the DECF to a defense organization was modeled as shown in Figure 3. Since this is only a perfunctory pass at modeling the context and use cases, only directly relevant aspects of a defense organization were modeled. With this context the use cases of the model for a defense organization were also modelled, as shown in Figure 4. This graphical representation can be further detailed by elucidating each of the behaviors and activities into their own diagrams. In the future there could be an entirely separate model that fully captured the structure and behavior of a defense organization and would include all the ways in which the organization would use the DECF.

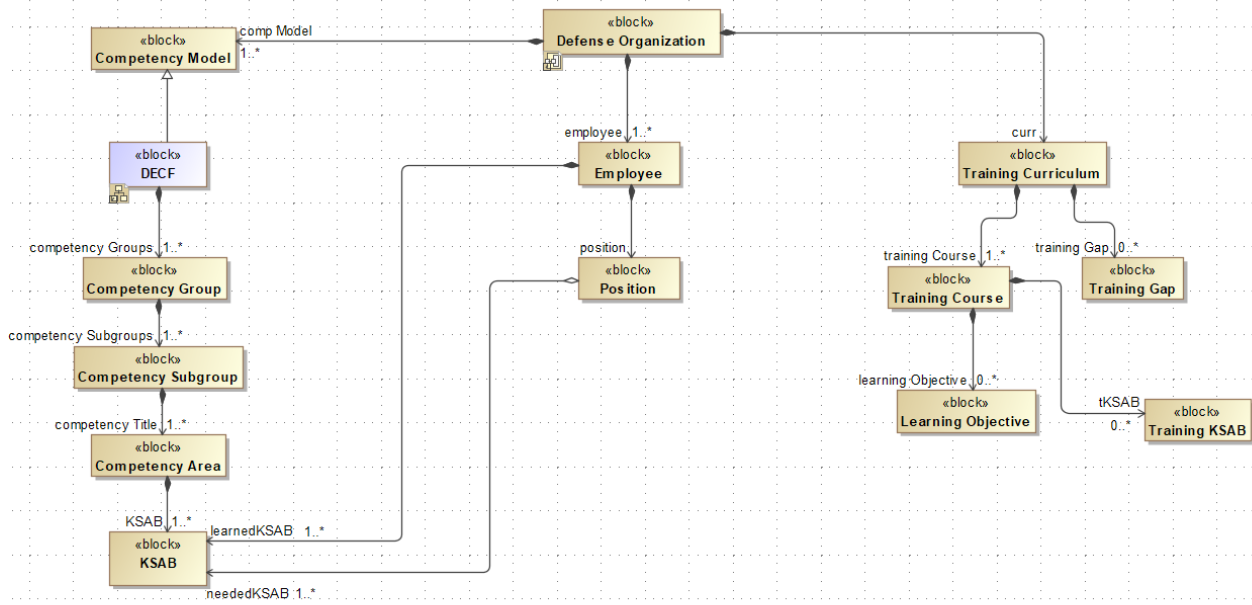


Figure 3. BDD of the DECF Context within a Defense Organization.

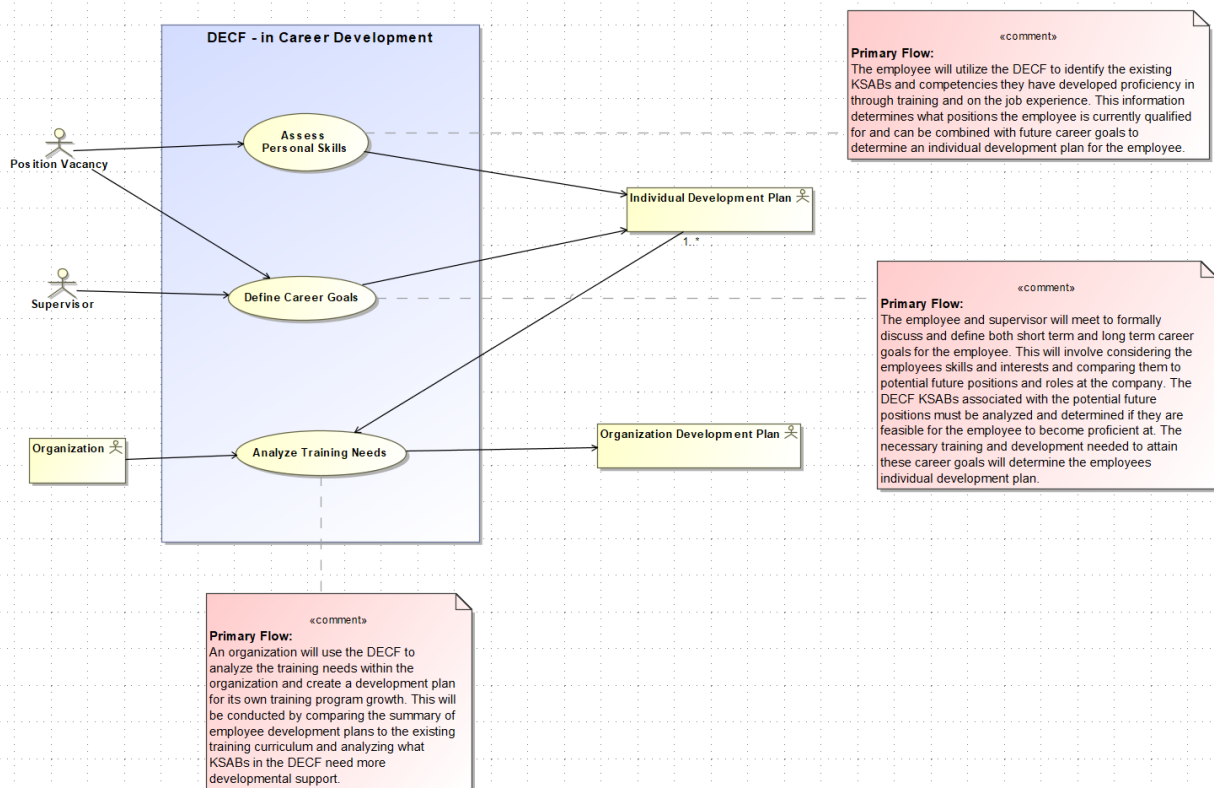


Figure 4. Example Use Case Diagram for the use of the DECF in Career Development.

Although these images captured from the SysML model may yield some insights to any person, attempting to browse model information natively is often inefficient and infeasible for many stakeholders. Instead, an open-source tool called OpenMBEE was incorporated to generate text-based documents directly from model elements. (OpenMBEE, 2020). These documents are generated in, and can be

accessed through, a web-based interface called View Editor. The View Editor interface not only allows for easier sharing of the model documents, but it also allows for direct commenting and even modification of model elements for users given the correct credentials. The intent of this modeling approach is two-fold. First, it allows reviews to take place in a DE environment using the online View Editor interface – giving potential users real-life experience using the required competencies. Second, it improves the visibility and collection of review feedback and facilitates its implementation. Third, it establishes an authoritative source for the DECF and follows digital engineering practices for model management. The team encouraged digital feedback during the review process through this web-based interface, but the model documents were also provided in more traditional PDF and spreadsheet forms.

The digital structure employed in the review process and enabled by OpenMBEE also demonstrates some best practices in DE (see Figure 5 below). The underlying SysML model functions as an authoritative source of truth with limited external access. Information extracted from the model is used to generate model documents in the View Editor interface in which reviewers could potentially make changes and comments. The model management system functions as an intermediary between these two interface systems. It maintains the integrity of the authoritative source of truth and keeps the publicly available documents current with up-to-date model information.

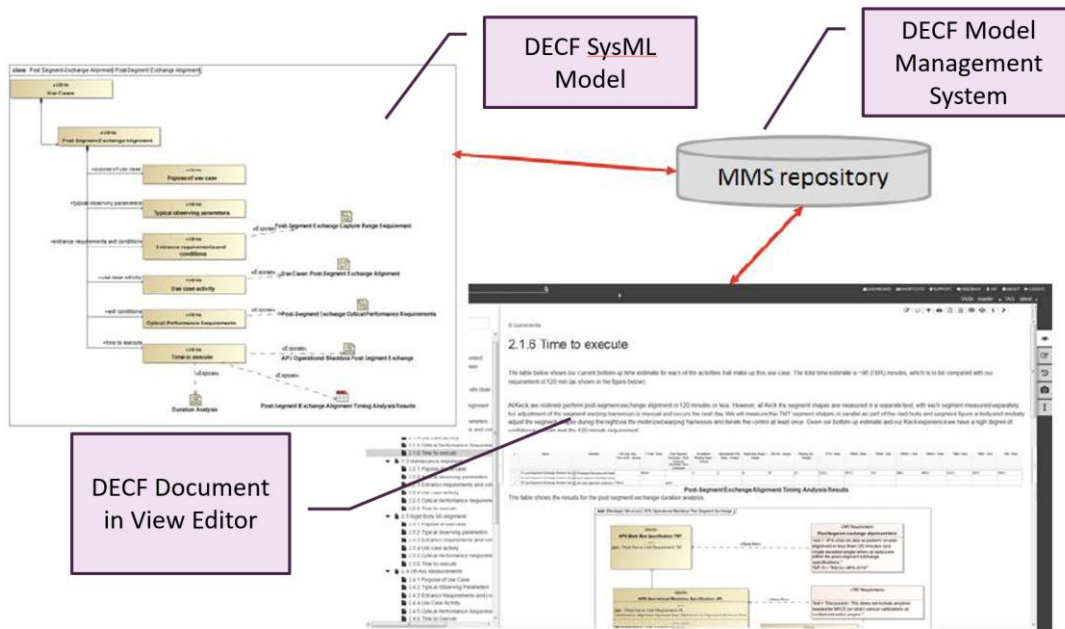


Figure 5. The DECF OpenMBEE Structure.

2.5 Analysis of Existing Curricula

In order to develop the DE skills of the acquisition workforce, the DoD has to have appropriate training resources available to enable individuals to develop the KSABs required to improve their proficiency. There are currently two courses utilized by DAU for DE:

- CLE084: Modeling, Simulation, and Digital Engineering and
- Coursera’s Model-Based Systems Engineering (MBSE) course.

The team obtained materials for both of these courses, as well as took the Coursera course as students. Learning objectives and KSABs were captured from the course materials. Themes were identified from the materials, e.g., “modeling” or “digital engineering value proposition.” The team then analyzed the data from the courses against the DECF and determined:

- Which DECF KSABs were covered;
- Any critical gaps (DECF KSABs not covered in the materials);
- KSABs from curriculum materials that should be added to the DECF; and
- KSABs from curriculum materials that are not in the DECF and are *out of scope*, i.e., should not be added to the DECF.

In addition to the above, the team identified the Massachusetts Institute of Technology (MIT) Architecture and Systems Engineering Program, which is currently being utilized by NAVAIR. The team contacted the MIT faculty for this program and used the publicly available materials to conduct an initial assessment following the same approach as outlined above. In Phase 3 of the research, the team will coordinate with MIT faculty to further refine the assessment based on additional course materials/faculty insights.

These analyses can be found in Section 4.

2.6 Synergies with Additional SERC Research Task

In 2020, DAU funded a related task through the SERC (WRT-1018). The task was created to support “micro-credentialing” for individuals in the ENG discipline across three Areas of Strategic Importance (ASIs):

- Digital Engineering (DE)
- Artificial Intelligence and Machine Learning (AI/ML) and
- Data Analytics (DA).

The DECF provides the foundation for the DE competencies described in the DAU micro-credentialing task. Likewise, learning from that task fed into updates in the DECF. This was accomplished through:

- Research team members who participated in both tasks (Drs. Nicole Hutchison and Jon Wade);
- Regular weekly reviews of the WRT-1006 findings and progress with the WRT-1018 team;
- Reviews of the WRT-1018 framework with the WRT-1006 team; and
- Discussions of alignment with sponsors and SMEs.

The notional overlap between DECF v. 1.1 and the DAU frameworks for the ASIs (DE, DA, and AI/ML) is illustrated in Figure 6, below. (Giffin et al., 2021)

Relationship between DECF and DAU ASI Competency Frameworks

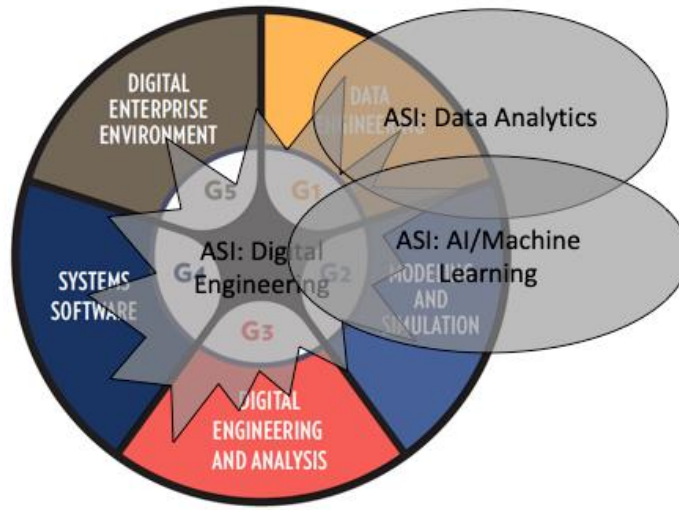


Figure 6. Relationship between DECF v. 1.1 and DAU ASI Competency Frameworks.

Each of the competencies/KSABs in the ASI: Digital Engineering framework are contained within the DECF, i.e., the DAU competency model is a subset of the DECF model specifically relevant and within the scope of DAU curriculum. Generally, the DAU framework covers the lower proficiency levels (Awareness through Intermediate) as opposed to the higher proficiency levels (Advanced and Expert). The competency frameworks for both Data Analytics and AI/Machine Learning are related to digital engineering and some of them overlap with the DECF, most specifically in the “Data Engineering” and “Modeling and Simulation” competency groups. However, the purpose of the DECF is different than the competency frameworks to support the ASI micro-credentials. While there is overlap with the DECF, there are also many KSABs in the DAU DA and AI/ML frameworks that go into more depth than anything contained within the DECF.

2.7 Mapping of the DECF to Commercial Job Titles, Job Descriptions, and Requirements of DE

The team gathered a list of DE-related roles from the Engineering and Technical Management (ETM) task force. Typical roles include Engineer (e.g., Systems, Mission, Security, Software, Safety, Infrastructure, Test, DevSecOps, Site Reliability, Data), Developer (e.g., Digital Environment, Software), Architect (e.g., System, Digital, Software, Cloud, Data), Manager (e.g., Digital Environment, Test), Scientist/Data Scientist, Specialist (e.g., Quality Assurance, Industrial, Business and Industry), Production Controller, Engineering Technician, Modeling and Simulation SME, Model Curator (Model Maker), Researcher/AI Researcher, Technical Product Owner, Administration and Program Staff, Management and Program Analyst.

The team also queried a few jobs from relevant keywords based on the typical roles mentioned above using Indeed.com and USAJobs, a U.S. Office of Personnel Management website. The job availability varies daily, and the data shown in Table 1 was collected on 20 March 2021. Overall, there were more than 354,000 jobs available for these selected job titles on both websites.

Table 1. Example List of DE-Related Jobs Available on the Indeed.com and USAJobs.gov Websites.

Job Title Search	Jobs on Indeed.com	Jobs on USAJobs.gov
Artificial Intelligence	12,239	23
Contracting Officer	9,448	416
Engineering Technician	5,678	264
IT Specialist	19,476	2,323
Model Maker (Model Curator)	84	33
Model-Based Systems Engineering	18,136	12
Program Manager	34,694	1,636
Software Engineer	84,969	147
Systems Architect	39,412	80
Systems Engineer	125,096	477
Total	349,232	5,411

Based on a few selected job openings, DECF v. 1.1 was mapped to the associated job openings, job descriptions and responsibilities, as well as the requirements from USAJobs, as shown in Table 2. The relevant DECF competencies were identified based on the job descriptions, responsibilities, and DE requirements (see the last column in Table 2).

Table 2. Mapping of DECF v. 1.1 to the Sample Job Openings, Job Descriptions, Responsibilities and DE Requirements from the USAJobs website.

Job Titles	Job Descriptions and Responsibilities	DE Requirements	Relevant DECF Competencies
Contracting Officer	<ul style="list-style-type: none"> In this organization, only the Contracting Officer is legally authorized to financially obligate the US Government to acquire its products and services. Working in a team environment, you will learn and utilize innovative business practices to streamline the acquisition process and maximize resources. You will also negotiate and manage a wide variety of unique and complex contract types, such as fixed-price and cost-reimbursement contracts, to obtain the best value on behalf of the Government. Working alongside Agency and other Intelligence Community colleagues, you will apply your business skills to diverse programs for technical collection systems, construction projects, information technology initiatives and more. Contracting Officers are hired at various experience levels, from entry to full performance positions. This organization is committed to you and your development and provides progressively more complex on-the-job experiences and related training and development 	<ul style="list-style-type: none"> Demonstrated experience with and knowledge of the Federal Acquisition Regulation (FAR) guidelines and US Government contracting. Experience conducting a wide range of acquisition lifecycle activities. reimbursement. Exceptional customer service skills. Strong analytic and critical thinking skills. Ability to multi-task in a fast-paced environment. Attention to administrative detail. 	<p>C7 Data Analytics</p> <p>C13 Project and Program Management</p> <p>C21 Communication</p>

Job Titles	Job Descriptions and Responsibilities	DE Requirements	Relevant DECF Competencies
	<p>programs, enabling you to achieve your career goals while supporting mission needs.</p>		
<p>IT Specialist (Enterprise Architecture-INFOSEC)</p>	<ul style="list-style-type: none"> Performs work involving identification and incorporation of new concepts and ideas for optimized business architectures in a cloud environment leveraging both Commercial off the Shelf (COTS) Software as a Service (SaaS) and custom developed applications in achieving particular missions and goals, technological trends, and significant advancements in operational and mission analysis. Plans, develops, schedules, and tests architectural constructs that enable more efficient, effective, and secure use of artificial intelligence (AI)/machine learning (ML)/natural language processing (NLP) in support of DCSA and other stakeholder missions using established standards to include Agile and Rapid Prototyping methodologies. Provides management and technical expertise to the agency in managing the development, validation, and synchronization of the organization. Reviews and evaluates proposals affecting business architecture. Researches emerging standards, tools, and techniques for both assessing and performing software and systems engineering processes. 	<ul style="list-style-type: none"> Specialized experience required for this position is: Business Architecture and/or Enterprise Architecture in a cloud domain or cloud-based system of networks and information systems; Agile software development methodologies; and information management systems development life cycle (i.e., system requirements, design, test, and implementation). 	<p>C7 Data Analytics</p> <p>C8 Digital Architecting</p> <p>C10 Digital Validation and Verification</p> <p>C11 Model-Based Systems Engineering Processes</p> <p>C16 Configuration Management</p> <p>C18 Software Engineering</p> <p>C20 Management</p> <p>C21 Communication</p> <p>C25 Digital Environment Security</p>
<p>Lead Systems Engineer (Digital), NH-4 Position</p>	<ul style="list-style-type: none"> Foster and promote the strategic vision of the Office of Chief Systems Engineer through innovative approaches to digital engineering practices across the ASA(ALT) portfolio. As the OCSE lead digital engineer, advise the Chief Systems Engineer on all engineering matters that will promote the digital transformation and modernization of the ASA(ALT) Data Domain. Provide professional, creditable, valuable, and consistent communications for efforts that span across the Office of Chief Systems Engineer efforts to multiple Army and DoD organizations. Monitors projects, programs, products, and acquisition documentation related to digital engineering. 	<ul style="list-style-type: none"> Selectees must meet position requirements for certification at Level 3 in the Acquisition Career Field S - ENGINEERING within 24 months of entrance on duty. 	<p>C2 Data Management</p> <p>C7 Data Analytics</p> <p>C13 Project and Program Management</p> <p>C15 Digital Engineering Policy and Guidance</p> <p>C16 Configuration Management</p> <p>C20</p>

Job Titles	Job Descriptions and Responsibilities	DE Requirements	Relevant DECF Competencies
	<ul style="list-style-type: none"> Responsible for contract management by developing performance work requirements, overseeing contractor technical performance, and identifying areas of risk. 		Management C21 Communication F4 Coaching and Mentoring
Program Manager	<ul style="list-style-type: none"> Responsible for the cost, schedule, performance reporting, contract activities, logistics, budget, personnel management for assigned activities in all phases of the acquisition life cycle for a ship, sub, carrier, ship, or weapon system. Responsible for organizational personnel management, organizational structure, and resource loading. Communicate program activities in a variety of written and oral forums, at all levels, internally and externally to the organization. Establish work assignments, set priorities, prepare schedules, and ensure timely performance of satisfactory work. Design acquisition strategy and program baselines, direct acquisition life cycle activities and all efforts associated with the program office or functional area through subordinate managers and teams. Oversee the identification and resource requirements and the developments of strategies for program planning, budgeting, and execution. Provide goals, objects, program, and general guidance for operations consistent with higher level guidance. Provide the overall direction and guidance for acquisition life cycle program, its administration, and civilian personnel. Forecast and manage workload for the program office or functional area. Responsible for direct supervisory management for civilians assigned to your division. 	<ul style="list-style-type: none"> This position is covered under the Defense Acquisition Workforce Improvement Act (DAWIA). You must be certified as a Career Field A-Program Management Level III. Certification is required within 24 months of appointment. Specialized experience must demonstrate the following: leading the development or implementation of acquisition strategies (e.g., financial, programmatic, technical, contractual) in support of ship construction or weapons systems. 	C13 Project and Program Management C14 Organizational Development C15 Digital Engineering Policy and Guidance C20 Management C21 Communication C22 Planning C23 Digital Environment Operations F3 DoD Policy/Guidance F4 Coaching and Mentoring
Systems Engineer, NH-0801-04 position	<ul style="list-style-type: none"> Develops System Engineering Plans, policies, and procedures in accordance with DoD, Army, industry, and academia best practices. Integrates all systems engineering tasks to effectively implement disciplined systems engineering process and procedures throughout all acquisition phases of the 	<ul style="list-style-type: none"> This position requires Acquisition Certification level III in the career field - Engineering. 	C2 Data Management C3 Modeling C4 Simulation

Job Titles	Job Descriptions and Responsibilities	DE Requirements	Relevant DECF Competencies
	<p>assigned subsystem, system, or system of systems acquisition.</p> <ul style="list-style-type: none"> • Interfaces with contractor counterparts to ensure constant and current flow of information to all parties for systems engineering and integration. • Provides life cycle architecture assistance to the Project Executive Office (PEO), Project Manager, or Product Manager associated with acquisition of subsystems, systems, and system of systems. • Serves as the Product, Project, or PEO expert on systems engineering and architecture modeling tools and standards. • Serves as advisor to all Project Leaders, Product Managers, and Project Management personnel on matters related to systems engineering and associated processes. 		<p>C8 Digital Architecting</p> <p>C11 Model-Based Systems Engineering Processes</p> <p>C13 Project and Program Management</p> <p>C15 Digital Engineering Policy and Guidance</p> <p>C21 Communication</p> <p>C23 Digital Environment Operations</p> <p>F3 DoD Policy/Guidance</p> <p>F4 Coaching and Mentoring</p>

Data from the sample jobs in Table 2 shows most of the jobs had matching competencies with each other such as data analytics, project and program management, communication, and coaching and mentoring. In some instances, the team was able to clearly align the job descriptions and requirements from the sample jobs with the competency descriptions in the DECF, which can make it easy for HR to identify, create, modify, or improve the job creation process. HR could also utilize the associated competencies’ KSABs with the various proficiency levels to provide further details on what KSABs are required for the positions in the digital environment.

3. The Digital Engineering Competency Framework

3.1 DECF Organization

The overall structure of DECF v. 1.1 is in compliance with the DoD Instruction 1400.25. vol. 250. It includes competencies, competency descriptions, proficiency levels, and KSABs within those levels. To improve ease of understanding and use, the team has also organized the DECF into competency groups and subgroups. These are collections of related competencies and should help the user grasp the aspects of digital engineering addressed by their constituent competencies.

3.2 Foundational Digital Competencies

A holistic DE approach incorporates multiple disciplines into a rich model-based environment. The initial focus of the DECF was primarily around acquisition engineers (“ENG” career field). However, many disciplines must come together if digital engineering is to become the way the DoD does business in accordance with the DoD Digital Engineering Strategy. DECF v. 1.1 incorporates additional competencies to better address the skills required of a broader set of professionals who will work in the digital environment.

The DECF covers aspects central to accomplishing DE. There are many other digital competencies that could be considered core to developing a digital workforce that also underpin the DECF. These kinds of digital competencies should be included in a holistic development of a DE workforce.⁴

In terms of coverage of the systems lifecycle, the many systems engineering competency models that were used as inputs into the DECF included the full systems lifecycle, from mission engineering through to traditional systems engineering, operation, and disposal. Lifecycle-focused competencies relevant for the ENG career field are incorporated into the DECF, though some are updated to specifically reflect a digital versus document-based approach. Table 3 outlines the foundations.

Table 3. Foundational Digital Competencies in DECF v. 1.1.

ID		Foundational Digital Competencies
F1	Digital Literacy	Digital literacy means having the skills you need to live, learn, and work in a society where communication and access to information is increasingly through digital technologies. Digital literacy looks beyond functional IT skills to describe a richer set of digital behaviors, practices, and identities. It is common for individuals to struggle with trusting the digital environment; areas that arise include understanding how ‘versioning’ works in a model versus a traditional document and how cloud computing works. When these are not understood, the modeling environment is not trusted, and individuals are likely to find ways to work around the digital engineering process. This includes the ability to communicate, locate, protect, and preserve information on digital platforms.
F2	Digital Engineering Value Proposition	The body of the DECF assumes that individuals understand why digital engineering is important. However, as the team has worked with government and industry personnel over the last 18 months, this cannot be assumed. One of the foundational pieces of knowledge is the understanding of why digital engineering provides value and what specific values digital engineering is expected to provide.
F3	DoD Policy/Guidance	Individuals need to be aware of the DoD policies around DE and how individuals are expected to operate in a digital environment.
F4	Coaching and Mentoring	Coaching and mentoring competencies within the digital enterprise domain focus on senior or more experienced individuals acting as advisors or counselors to junior level incumbents, on systems modeling and analysis.

⁴ In DECF v. 0.5 and v. 0.75, which were publicly reviewed, these competencies were called “digital literacy” and were incorporated into the DECF. KSABs related to “Digital Literacy” have been incorporated into the new structure for v. 1.1 as shown in Section 4.3.

F5	Decision Making	This group encompasses competencies related to using data of all sorts to perform analysis and make decisions in a digital environment. This includes the abilities to correctly leverage digital resources to make and effectively relate decisions. This includes the abilities to use analysis tools and techniques to make appropriate decisions.
F6	Software Literacy	Technical expertise in various software or coding languages will be necessary for many roles in a digital engineering environment. This ability may range from simply opening documents within specific software to creating, supporting, and maintaining applications. This includes the abilities to understand, apply, problem solve, create, and critique software in pursuit of particular learning and professional goals.

It should also be noted that individual disciplines have assumed foundations that are *not* incorporated into the DECF. For example, current systems engineers who are transitioning into DE should already have basic systems engineering foundations. They should understand the concepts of “systems,” “systems engineering,” and “lifecycle” from their own discipline. Likewise, program and project managers or contracting officers should already be familiar with the basic terminology and approaches of their fields. These discipline-specific foundations are assumed in the DECF, as these fields already have their own distinct competency models that account for these types of KSABs. A notional representation of this concept can be seen in Figure 7.

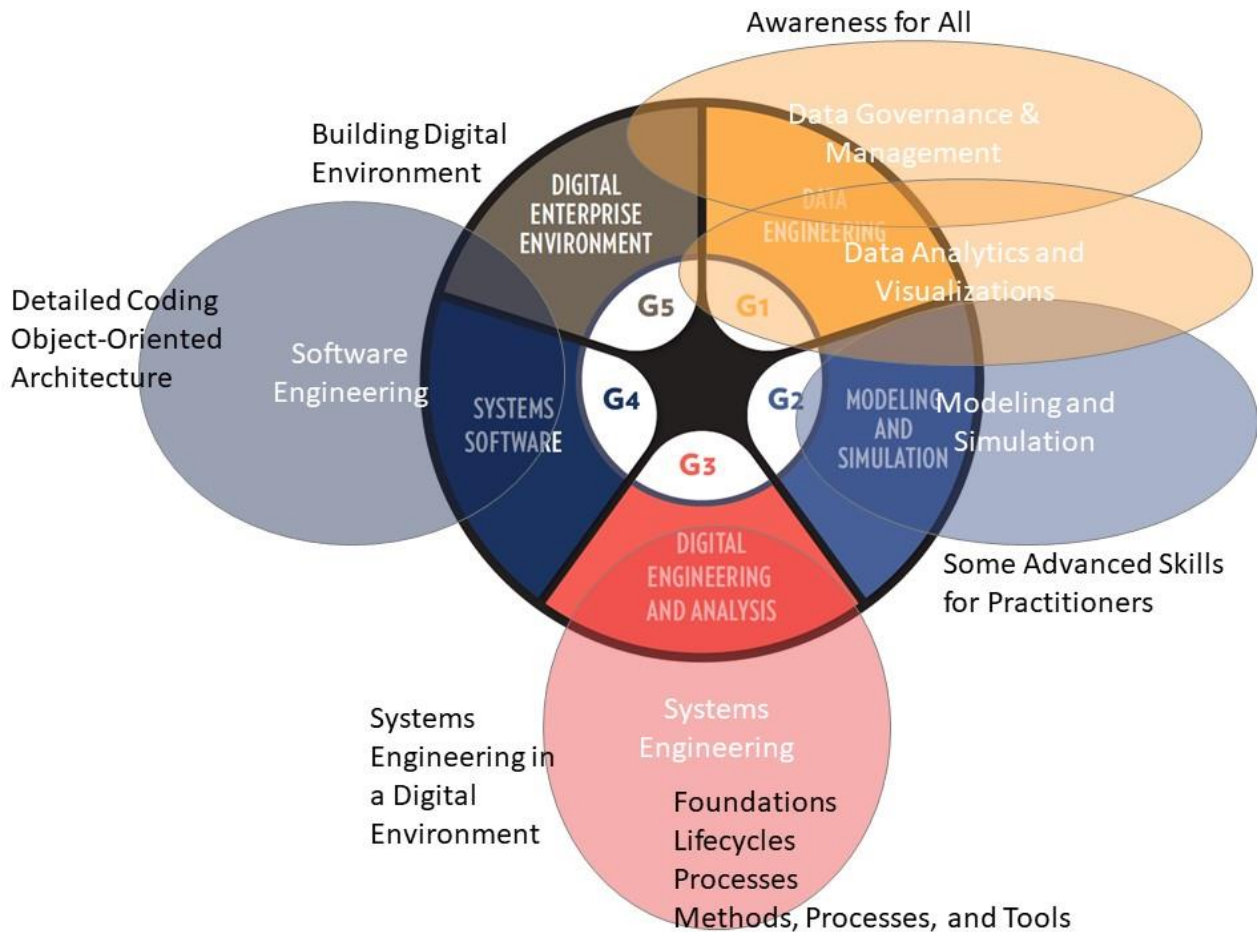


Figure 7. Notional Model of the Overlap between Discipline-Specific Knowledge and the DECF.

3.3 DECF v. 1.1 Overview

In Phase 2, the DECF was updated as DECF v. 1.1, as shown in Figure 10. The updated DECF v. 1.1 includes new competencies that were found from the gaps identified when comparing the DECF with the DoD training resources. The DECF competency groups were also updated to reflect a cohesive categorization of the competencies.

Data is the foundation on which DE is built. Data is required to support and build models and simulations. These models are used to develop systems and support programs, creating a set of digital artifacts that support a variety of engineering, programmatic, and contractual uses. This all occurs in a digital environment, a carefully structured collection of data and supporting software. Ideally, successful DE approaches should lead to more consistently to the development of successful systems. Finally, there is a feedback loop in that successful systems create more data. This logic provides the structure for the DECF and is illustrated in Figure 8.

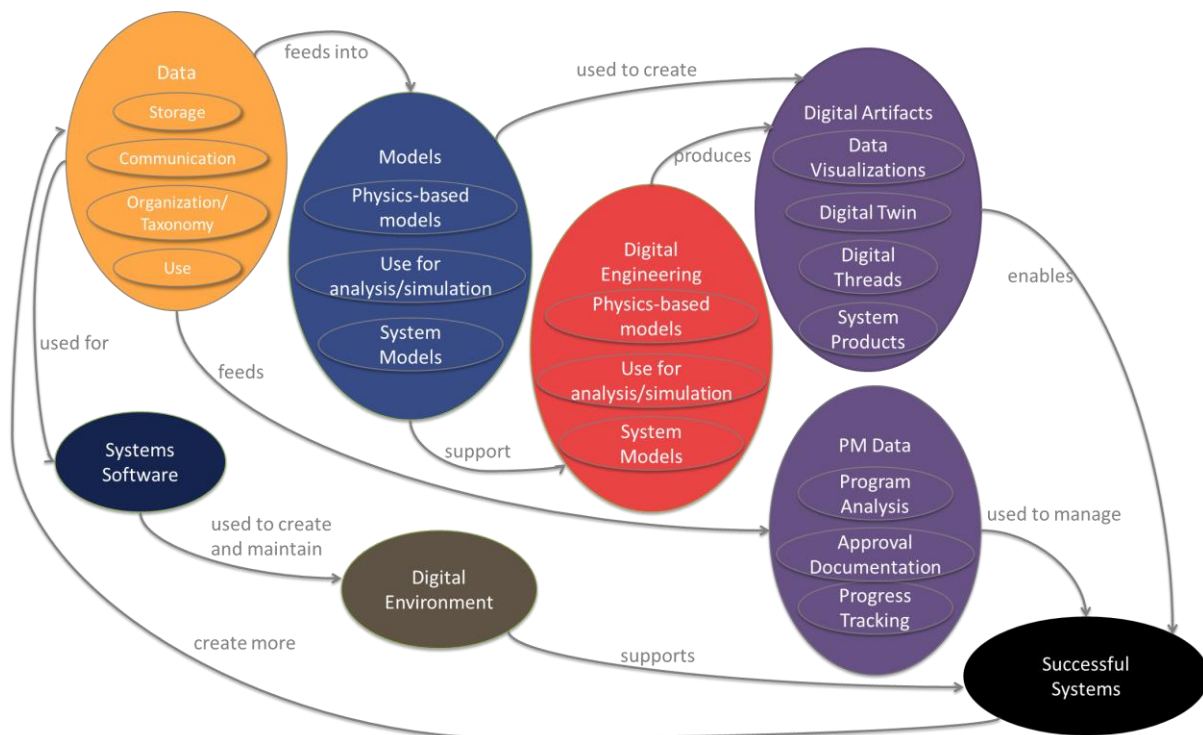


Figure 8. Context for the DECF.

The DECF begins with the data foundations that are required for an effective digital environment (“Data Engineering”). The competency groups constitute how DE takes full advantage of the digital power of computation, visualization, and communication to take better, faster actions throughout the life cycle. These competency groups can be seen as supporting the four elements of John Boyd’s OODA loop: Observe, Orient, Decide, and Act. Data Engineering guides how to observe, ensuring that data is acquired, curated, compressed, secured, and prepared. Next, Modeling and Simulation provide the ability to orient this data to describe and understand a phenomenon of interest. Decision Making utilizes analysis tools and techniques to make appropriate decisions. Finally, Engineering Methods are used to transform these decisions into engineering actions.

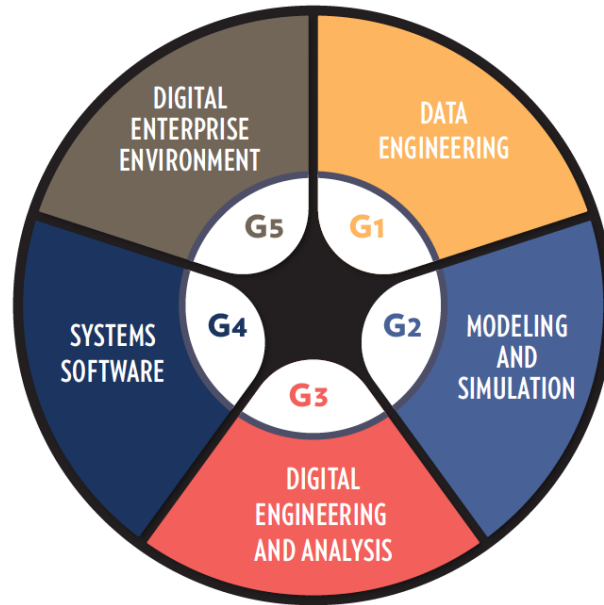


Figure 9. DECF Competency Groups.

There are five (5) competency groups identified for the DECF, as shown in Figure 9, along with a foundation of general digital competencies. Competency groups provide a logical structure for the individual competencies, making the DECF easier for users to understand and utilize. The groups in Figure 9 are intended to provide a holistic perspective of all the skills required to provide value in a digital environment. The five (5) competency groups are defined in Table 4.

Table 4. Descriptions of DECF v. 1.1 Competency Groups.

ID	Competency Title	Competency Description
G1	Data Engineering	Apply knowledge on how to acquire, curate, compress, secure, and prepare data resulting from a DE environment. Create or support data-focused processes. Data could originate from modeling and simulation, or from sensors in the physical world.
G2	Modeling and Simulation	Use of digital models to describe and understand phenomena of interest from initiation of the effort through the entire life cycle maturation. Model literacy—understanding what models are and how they work—is required to move into more advanced skills, from the ability to build a model using appropriate tools, standards, and ontology to creating a modeling environment.
G3	Digital Engineering and Analysis	Apply traditional engineering methods and processes in a digital environment. Create new engineering processes and methods for a digital environment. Create digital artifacts throughout the project or system lifecycle. Use engineering methods, processes, and tools to support the engineering and system lifecycle.
G4	Systems Software	Apply technical knowledge in various software or coding languages to create, support, and maintain applications. This includes the abilities to understand, apply, problem solve, create, and critique software in pursuit of particular learning and professional goals.
G5	Digital Enterprise Environment	Use the foundations of data, modeling, and software to create and maintain the digital enterprise. This requires creating the

	environment in which digital engineers, discipline and domain engineers, program managers, and decision-makers work.
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As shown previously in Figure 9, in DECF v. 1.1, there are five (5) competency groups. Figure 10 further breaks these into nine (9) competency subgroups, and 31 competencies (including six (6) foundational digital competencies). The competency hierarchy includes competency groups (G#), subgroups (S#), and individual competencies (C#). Where appropriate, the competency groups are divided into subgroups. Subgroups contain related like competencies. The competency hierarchy provides a logical structure for the individual competencies, making the DECF easier for users to understand and utilize. The hierarchy structure provides an overview of all the skills required to provide value in a DE environment regardless of specific roles.

DIGITAL ENGINEERING COMPETENCY FRAMEWORK (DECF) VERSION 1.1

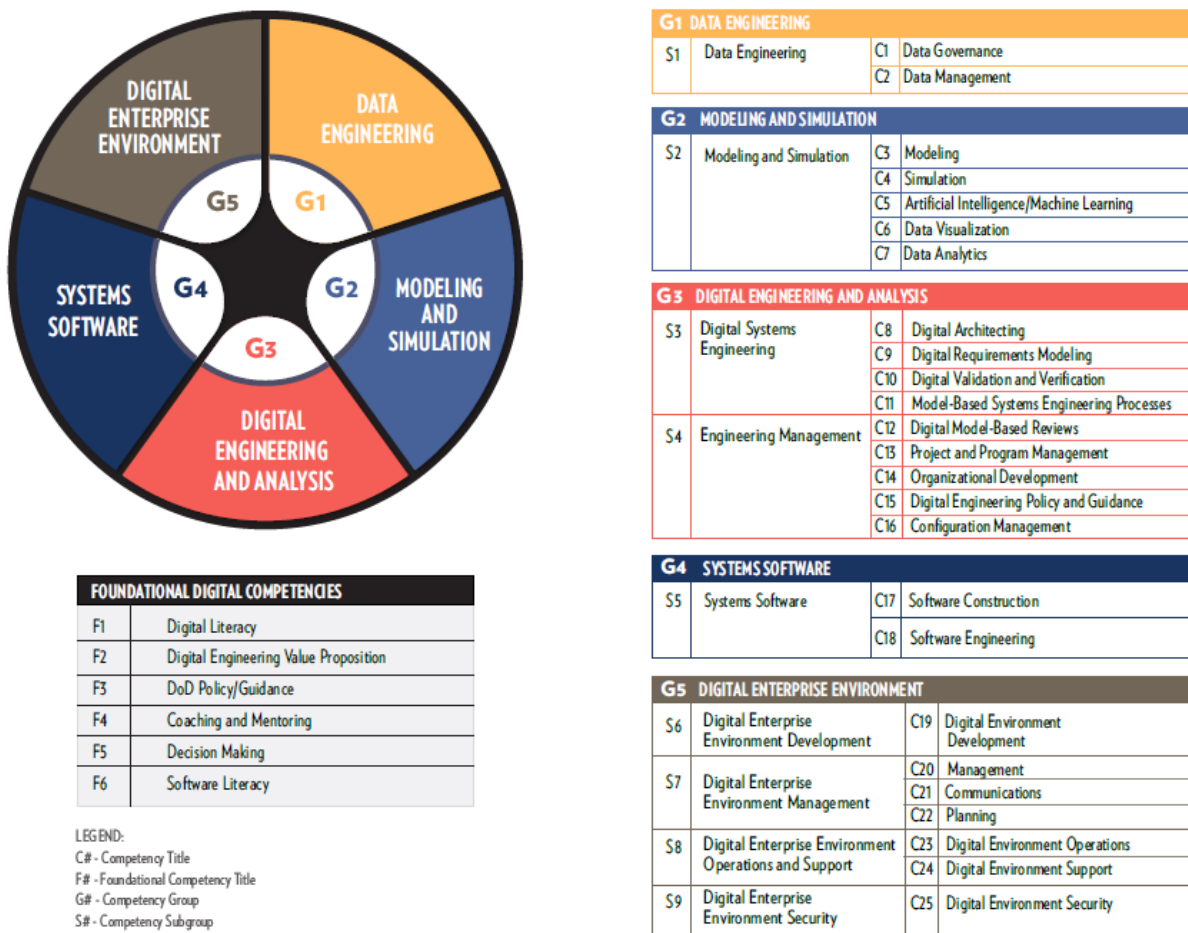


Figure 10. Overview of DECF v. 1.1.

While every role is likely to require some skills from each of these competencies, no role should require all the skills in all of the competencies in each group at top proficiency level. The specific competency, proficiency levels, and KSABs required for an individual are dependent upon the role(s) being played.

3.4 Competencies and Proficiency Levels

In compliance with DoD Instruction 1400.25, each competency is broken down into KSABs relevant to proficiency levels within each competency. Not every individual will fully obtain all the competencies. Each individual’s proficiency level must be assessed to understand the true status of the workforce with respect to DE. Proficiency is the level to which an individual attains a competency, as illustrated in Table 5.

Table 5. Proficiency Levels of DECF v. 1.1.

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.

DECF v. 1.1 contains 962 KSABs divided among these competency areas. Each represent a unique and important aspect of what will enable a successful digital transformation and productive DE practices. The distribution of these KSABs in terms of both their competency area and respective proficiency level is shown in Table 6.

Table 6. Distribution of the KSABs in DECF v. 1.1.

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	C4 Modeling	122	11	25	36	35	15
	C5 Simulation	56	8	8	16	16	8
	C6 Artificial Intelligence/Machine Learning	32	2	19	8	3	0
	C7 Data Visualization	22	2	4	12	2	2
	C3 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	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	28	2	2	1	10	13
	C21 Communications	12	1	2	1	3	5
	C22 Planning	11	1	2	2	3	3
	C23 Digital Environment Operations	27	3	4	8	10	2
	C24 Digital Environment Security	42	6	2	7	16	11
	C25 Digital Environment Support	56	2	5	12	22	15
		962	74	203	216	300	169

The KSABs within each competency are specifically targeted to DE. Therefore, a broader competency area like Communications has a relatively low number of KSABs related to DE, while a specific area like Model-Based Systems Engineering Processes, that is intrinsically linked with DE, has many KSABs.

It is also interesting to note the distribution of the KSABs across the five (5) proficiency levels. KSABs at the Awareness and Basic levels represent broad fundamentals within a competency area, while KSABs at the Advanced and Expert levels include the practice of specific techniques that make up the various applications of the competency area. The DECF is established to be a general framework that can be used to create specific competency models that will be tailored based on component implementation of the Digital Engineering Strategy. As a result, the KSABs must cover the breadth of potential DE practices, even if all these practices are not utilized within every organization.

It is important to note that the DECF is established as a competency framework instead of a competency model and as such will be implemented differently for each respective organization. This distinction is made to enable the DECF to flexibly serve as a standard for various shareholder organizations that have wholly different functions and workforce needs. These organizations can tailor their specific competency model by selecting KSABs out of the DECF that are deemed necessary for their business or workflow. This subset of KSABs will still be traceable to the DECF standard while ensuring that each organization’s competency model is streamlined to suit their needs and aid in the use cases described in Section 2.2.

Tables 7-11 display the specific competencies contained within the competency hierarch shown in Figure 10. These KSABs and proficiency levels can be found in the DECF model. For convenience, they are also provided as appendices to this report (Appendices A-AE).

Table 7. Competencies in the Data Engineering Group in DECF v. 1.1.

Subgroup	#	Competency	Description
S1-Data Engineering	C1	Data Governance	Data governance is a collection of practices and processes that help to ensure the formal management of data assets within a digital enterprise. Data governance practices help an enterprise gain better control over its data assets, including methods, technologies, and behaviors around the proper management of data. Data governance also entails security and privacy, integrity, usability, integration, compliance, availability, roles and responsibilities, and overall management of the internal and external data flows within an organization.
	C2	Data Management	Data management is applying policies, procedures, and information technology to plan for, acquire, access, manage, protect, and use data of a technical nature to support the total life cycle of the system. Data management includes verifying that all the data are secure, collected, documented, and archived along with descriptions of data to ensure completeness of data collected. Data management also ensures the distribution of data is in accordance with the data management plan for analysis.

Table 8. Competencies in the Modeling and Simulation Group in DECF v. 1.1.

Subgroup	#	Competency	Description
S2 Modeling and Simulation	C3	Modeling	Modeling is essential to aid in understanding complex systems and system interdependencies, and to communicate among team members and stakeholders.
	C4	Simulation	Simulation provides a means to explore concepts, system characteristics, and alternatives; open the trade space; facilitate informed decisions and assess overall system performance.
	C5	Artificial Intelligence/ Machine Learning	Artificial intelligence (AI) is the ability of machines to perform tasks that normally require human intelligence. Machine Learning (ML) is the application of AI that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it to learn for themselves.
	C6	Data Visualization	Data visualization is the creation of graphic representations of data, particularly to improve communication about that data. Data visualization is also the ability to identify patterns, trends, and correlations in the data and place them in a visual context to describe their importance. This entails building and managing data visuals, models, and artifacts.

Subgroup	#	Competency	Description
	C7	Data Analytics	This is the process of inspecting, cleansing, transforming, modeling, and simulating data with the goal of discovering useful information, informing conclusions, and supporting decision making.

Table 9. Competencies in the Digital Engineering and Analysis Group in DECF v. 1.1.

Subgroup	#	Competency	Description
S3 Digital Systems Engineering	C8	Digital Architecting	Digital architecture activities use digital models to define a comprehensive digital system model based on principles, concepts, and properties logically related to and consistent with each other. Digital architecture has features, properties, and characteristics that satisfy, as far as possible, the problem or opportunity expressed by a set of system requirements (traceable to mission/business and stakeholder requirements) and life cycle concepts (e.g., operational, support) and which are implementable through digital enterprise related technologies. Digital architecture competencies relate to the ability to create system digital models and required architectural products and digital artifacts for a system or system-of-systems in accordance with applicable standards and policies.
	C9	Digital Requirements Modeling	Digital requirements modeling refers to being able to capture stakeholder high-level requirements by documenting stated needs in the form of a model, assist in the clarification and translation of need statements into a more digital engineering-oriented basis, create and derive system requirements, that are related to the system architecture definition. It is also used to establish requirements traceability throughout the digital model architecture; examine the relationships of requirements to digital artifacts, and trace design solutions to requirements; and ensure designs can be traced to the system capabilities and requirement sets within digital enterprise environment.
	C10	Digital Validation and Verification	Digital verification is the process for determining whether or not a product fulfills the requirements or specifications established for it, by using digital models and artifacts for testing and verification. Enabling this practice is important to ensure that digital practices correlate well with their real-world projects.
	C11	Model-Based Systems Engineering Processes	Model-based systems engineering is 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 life cycle phases.
S4 Engineering Management	C12	Digital Model-Based	Digital model-based reviews define the series and sequence of model-based systems engineering activities

Subgroup	#	Competency	Description
		Reviews	that bring stakeholders to the required level of commitment, prior to formal reviews. It utilizes system models, artifacts, and products for analysis of design and technical reviews to execute trade-off and design analyses, prototyping, manufacturing, testing, and sustainment of the system.
	C13	Project and Program Management	Project management is the planning, coordinating, and monitoring of the work activities needed to deliver a product, service, or enterprise endeavor within the constraints of schedule, budget, resources, infrastructure, and available staffing and technology.
	C14	Organizational Development	Organizational development focuses on developing organizational policies, standards, and guidelines for model-based systems engineering methods and artifacts.
	C15	Digital Engineering Policy and Guidance	Digital engineering policy and guidance focuses on identifying process improvements to model-based engineering methods and contributing to organization of system lifecycle development standards and definition of best practices. It includes defining strategy and approach to be used for modeling and analysis of complex systems.
	C16	Configuration Management	Configuration management refers to the development of configuration management strategies, policies, standards, and guidelines for digital engineering related artifacts in accordance with model-based systems engineering methods

Table 10. Competencies in the System Software Group in DECF v. 1.1.

Subgroup	#	Competency	Description
S5 Systems Software	C17	Software Construction	Software Construction refers to the detailed creation of working software through a combination of coding, verification, unit testing, integration testing, and debugging.
	C18	Software Engineering	Software Engineering is the systematic application of digital engineering approaches to the development of software.

Table 11. Competencies in the Digital Enterprise Environment Group in DECF v. 1.1.

Subgroup	C#	Competency	Description
S6 Digital Enterprise Environment Development	C19	Digital Environment Development	A digital enterprise environment is an integrated digital development framework in which digital models and representations are interconnected such that the content and activities within it are managed to accomplish the organizational objectives of the enterprise.
S7 Digital Enterprise Environment	C20	Management	Management in the digital enterprise environment aims to deliver a framework that ensures transformational processes in enterprises occur with pace, high-quality

Subgroup	C#	Competency	Description
Management			and security. This is achieved through a set of IT solutions that are designed to make digital businesses fast, seamless, and optimized at every level.
	C21	Communications	Communications include using digital model artifacts from the digital enterprise environment to investigate and manage the adoption of appropriate model-based tools, techniques, and processes for the operation of digital enterprise environment systems and services. Communications also establishes the appropriate guidance to enable transparent decision-making to be accomplished, allowing senior leaders to ensure the needs of principal stakeholders are understood, the value proposition offered by digital enterprise environment is accepted by stakeholders and the evolving needs of the stakeholders and their need for balancing benefits, opportunities, costs, and risks is embedded into strategic and operational plans.
	C22	Planning	Planning in the digital enterprise environment includes establishing strategies to monitor and manage the performance of digital artifacts and services, in respect to their contribution towards enterprise performance goals. Planning ensures 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.
S8 Digital Enterprise Environment Operations and Support	C23	Digital Environment Operations	Operations within the digital enterprise environment include creating digital models and simulation artifacts and technology roadmaps, and sharing knowledge and insights from processes and results, with others. It encourages adoption to changes in the digital enterprise environment process or technology. It includes setting parameters for the prioritization of digital resources and the changes to be implemented and the configuration of digital engineering methods and tools to address the project needs.
	C24	Digital Environment Support	Support within a digital enterprise environment includes abilities to develop, mature, and implement methods and processes to support digital enterprise environment activities across the enterprise and lifecycle.
S9 Digital Enterprise Environment Security	C25	Digital Environment Security	Digital Environment Security includes developing policies, standards, processes, and guidelines to ensure the physical and electronic security of digital environments and automated systems. This includes performing security risk and vulnerability assessments, and business impact analyses related to security and information assurance in the digital enterprise environment. It is intended to provide advice and guidance on the application and operation of digital

Subgroup	C#	Competency	Description
			environment physical, procedural, and technical security controls.

The KSABs related to each of these competencies can be found in Appendices A-AE.

3.5 Cross-Cutting Elements in the DECF

Because there is not a specific competency surrounding them, it could be perceived that some relevant key elements in DE are not included in the DECF. The DECF is structured in a manner that concisely captures the breadth of DE enabling skills with a minimal number of competencies. Most technologies are inherently multidisciplinary in practice, and so creating distinct competencies for each potentially relevant technology would create significant overlaps in the framework. To demonstrate this potential overlap, three noteworthy cross-cutting DE elements were identified and analyzed:

- **Digital Twin:** An integrated multiphysics, multiscale, probabilistic simulation of an as-built system, enabled by Digital Thread, that uses the best available models, sensor information, and input data to mirror and predict activities/performance over the life of its corresponding physical twin.
- **Digital Thread:** An extensible, configurable, and component enterprise-level analytical framework that seamlessly expedites the controlled interplay of authoritative technical data, software, information, and knowledge in the enterprise data-information-knowledge systems, based on the Digital System Model template, to inform decision makers throughout a system's life cycle by providing the capability to access, integrate and transform disparate data into actionable information.
- **Digital Artifact:** An artifact produced within, or generated from, the digital engineering ecosystem. These artifacts provide data for alternative views to visualize, communicate, and deliver data, information, and knowledge to stakeholders.

These elements are all enablers of the digital transformation of the DECF. An analysis of the DECF showed that each of these technologies had several dozen corresponding KSABs across various competencies. There were 55 KSABs related to Digital Artifacts spread across ten (10) different competencies, 32 KSABs related to Digital Twin found in seven (7) competencies, and another 32 KSABs related to Digital Thread in eleven different competencies. Each of these elements has more associated KSABs than several of the individual competencies included in the DECF. However as shown in Figure 11, the spread of these KSABs across the variety of competencies demonstrates the inherent interdisciplinary nature of these elements and how much overlap would occur if they were uniformly included as their own competencies. The exception to this rule is the competency for AI/ML, which was deemed both vital for inclusion and unique in its content. In the future there may be some additional unique, self-contained elements that may also warrant their own competencies in future iterations of the DECF.

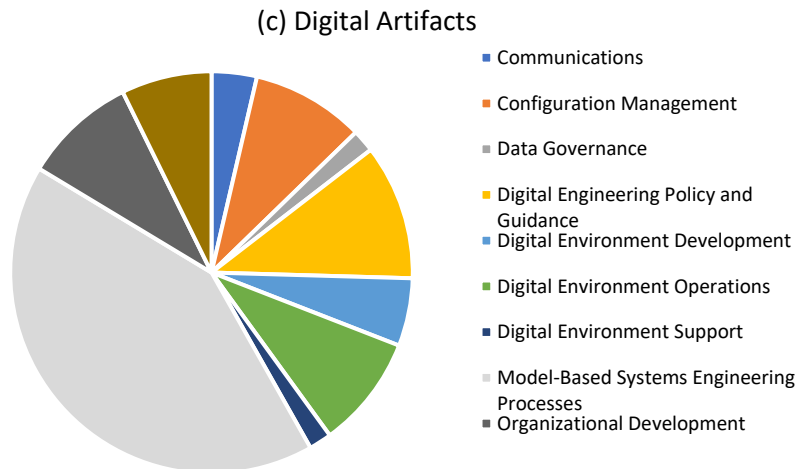
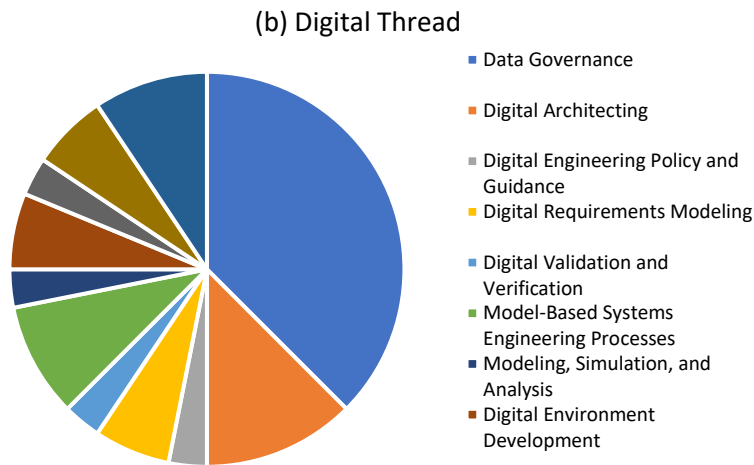
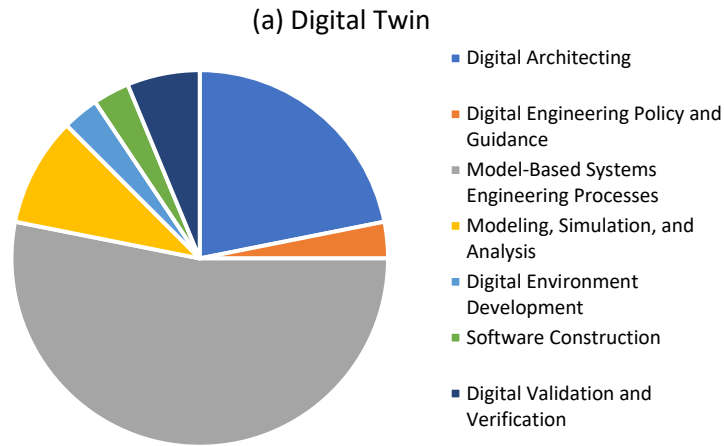


Figure 11. Distributions of Cross-Cutting Elements in the DECF: (a) Digital Twin; (b) Digital Thread; and (c) Digital Artifacts.

4. Digital Engineering Competencies in Existing DoD Training Resources

Using the DECF as a baseline, the team has been conducting a gap analysis using existing curriculum for digital engineering training in the DoD. Specifically, the team has investigated three courses:

- Defense Acquisition University (DAU) CLE084: Models, Simulations, and Digital Engineering;
- Coursera MBSE: Model Based Systems Engineering (currently utilized by the DAU); and
- MIT Architecture and Systems Engineering Program (utilized by NAVAIR), which includes relevant courses such as Models in Engineering and MBSE Documentation and Analysis.

The method used was to review course materials and attend the course as appropriate. Researchers captured the knowledge, skills, and abilities (KSAs) illustrated in the curriculum as well as the stated learning objectives. These were then compared against the KSABs in the DECF to determine the level of coverage and any major gaps. In addition, materials covered in the courses but not reflected in the DECF were flagged by the team for consideration and, where appropriate, incorporated into the DECF.

Sections 4.1-4.3 provide summaries of these analyses. The detailed KSAB tables and their mapping to the DECF can be found in the OpenMBEE model.

4.1 Defense Acquisition University Course (CLE084)

From the DAU CLE084, 27 learning objectives were identified along with 184 KSAs that support those objectives. All the KSAs were in the lower proficiency levels of “awareness” or “basic”, meaning individuals after completing the course would be expected to understand the concepts and possibly apply them on the job with heavy supervision. The course as currently structured provides a foundation for beginning work in digital engineering but would not enable individuals without other experiences or training to function as practitioners. Figure 12 displays the DAU course content in comparison to DECF v.1.1.1.

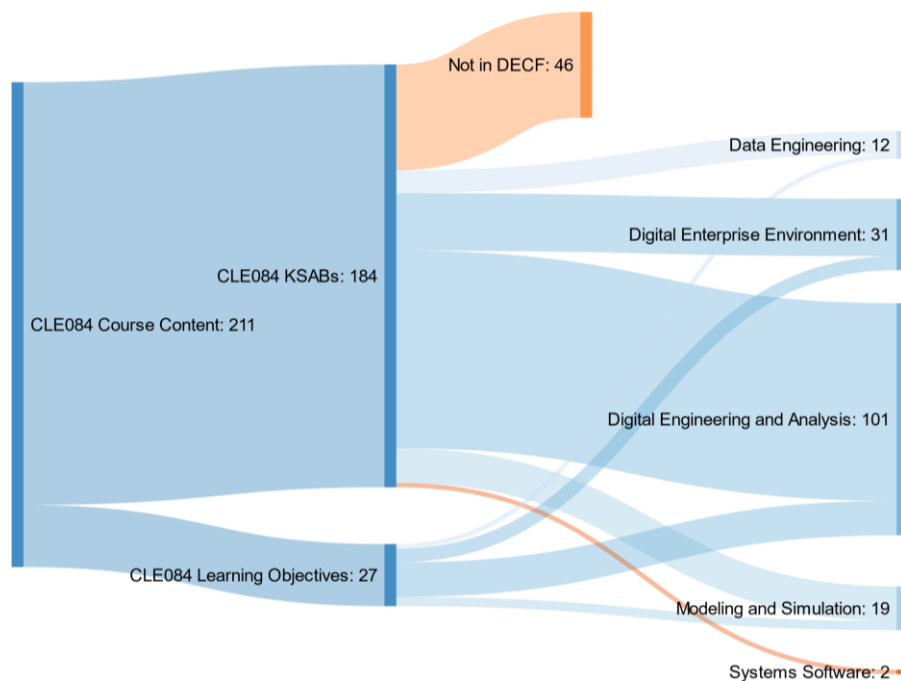


Figure 12. Visualization of DAU Course Content Comparison to DECF v. 1.1.1.

In addition, there were some items that are covered – again at the “basic” and “awareness” levels – in curriculum that are not contained wholly within a single area of the DECF, such as:

- Digital twin
- Digital thread
- Digital artifacts
- Technical coherency

As outlined in Section 3, these concepts are spread throughout the DECF, so there was no one-to-one alignment with a single competency or even competency group. However, these concepts are contained within the DECF.

There were KSABs in the curriculum that were not contained in the DECF, including:

- “Workforce Skillset” – awareness around developing the skillset of the workforce as a whole; and
- “Contracting for DE”

After reviewing these, the team agreed that “Workforce Skillset” KSABs are out of scope for the DECF, though of course should remain in training materials around DE. The DECF itself is a method for examining workforce skillset; this is a use case of the DECF, not a competency within it. But, as managers will take these courses on DE, it is reasonable that they have awareness of the expectations of the workforce and digital engineers will benefit from understanding the overarching expectations for their growth and development.

After SME review of “Contracting for DE,” the team identified a small set of KSABs around contracting that were incorporated into the DECF. As with other disciplines identified in the DECF, not all contracting skills are reflected here, but specifics around the requirement to understand how contracting language and approaches must change to enable digital acquisition are appropriate. (Refer back to Figure 2 for examples of overlaps with other disciplines.) These KSABs are contained in the “Program and Project management” competency (C13).

Finally, there were some KSABs contained in the curriculum that were added to the DECF foundations – not part of the DECF itself but considered important for functioning in a DoD digital environment. These included the value proposition for DE and the specific DoD policies and guidance around DE. Table 12 provides an overview of the mapping of KSABs with DECF v. 1.1. Table 13 provides the mapping with DECF v. 1.0, giving insight into the updates to the DECF that incorporated KSABs from the coursework.

Table 12. Distribution of CLE084 KSABs in DECF v. 1.1.

CLE084 KSABs in DECF v.1.1	Awareness	Basic	Intermediate	Advanced	Expert	Total
G1 Data Engineering	4	3	3	0	0	10
G2 Modeling and Simulation	1	9	5	0	0	86
G3 Digital Engineering and Analysis	18	42	22	4	0	25
G4 Systems Software	0	2	0	0	0	15
G5 Digital Enterprise Environment	7	15	3	0	0	2
Total	30	71	33	4	0	138

Total not in DECF	46
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Table 13. Distribution of CLE084 KSABs in DECF v. 1.0.

CLE084 KSABs in DECF v.1.0	Awareness	Basic	Intermediate	Advanced	Expert	Total
G1 Data Engineering	2	0	0	0	0	2
G2 Modeling and Simulation	1	2	0	0	0	3
G3 Digital Engineering and Analysis	3	2	0	0	0	5
G4 Systems Software	0	0	0	0	0	0
G5 Digital Enterprise Environment	1	1	1	0	0	3
Total	7	5	1	4	0	13

Total not in DECF	173
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4.2 Coursera MBSE: Model-Based Systems Engineering (MBSE) Course

DAU uses the Coursera course “MBSE: Model-Based-Systems Engineering” for DE training. The course was created by Ken English⁵ and is structured into a four-week program. Weeks 1-3 contain four modules each, while Week 4 contains six modules. The course is intended to provide an overview of MBSE, but also introduces basic concepts in systems engineering.

From this course, 34 KSABs were identified, all of which were at the Awareness or Basic proficiency level. As with CLE084, several of the KSABs identified are not part of the DECF. For example, one KSAB is “Discuss how systems engineering fits into the project lifecycle.” This is foundational knowledge for systems engineering. However, the DECF is structured not to include all relevant skills for any systems engineering, but to include the KSABs required for systems engineers to work in a digital environment. (Refer to Figure 4 for conceptual illustration.)

Table 14. Distribution of Coursera KSABs in DECF v. 1.1.

Coursera KSABs in DECF v.1.1	Awareness	Basic	Intermediate	Advanced	Expert	Total
G1 Data Engineering	3	1	0	0	0	4
G2 Modeling and Simulation	3	1	0	0	0	4
G3 Digital Engineering and Analysis	7	1	0	0	0	8
G4 Systems Software	0	0	0	0	0	0
G5 Digital Enterprise Environment	0	0	0	0	0	0
Foundational Digital Competencies	1	3	0	0	0	4
Total	14	6	0	0	0	20

Total not in DECF	12
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This course can provide a valuable foundation for individuals who have no awareness of systems engineering or what models are and how they can be used. For example, contractors working in a DE environment may benefit from this kind of orientation to the purpose behind DE. However, systems engineering practitioners or engineers used to working in a digital space would likely not gain appreciable improvements in their DE competencies from attending this course.

⁵ The course is available at <https://www.coursera.org/learn/mbse/home/welcome>.

4.3 MIT Architecture and Systems Engineering Program

The team explored the MIT Architecture and Systems Engineering Program that focuses on models and methods to manage complex systems. According to MIT, more than 8,500 professionals have joined this program from global companies such as BAE Systems, Boeing, Ford, GM, the U.S. Navy, Raytheon, and Shell, and is considered as an important part of the MBSE training and transformation efforts in these organizations (MIT, 2021). This MIT program requires about 20 weeks for completion and the online courses are a combination of videos, reading material, assessments, and course work. The online courses in this program are:

- Architecture of Complex Systems
- Models in Engineering
- Model-Based Systems Engineering
- Quantitative Methods in Systems Engineering

As an example, The U.S. Naval Air Systems Command (NAVAIR) has been committed to transforming their engineering acquisition capabilities to a model-based design with a goal of reducing the timeline from start to delivery while maintaining quality and precision. Since 2017, NAVAIR has participated in this MIT Architecture and Systems Engineering program that focuses on MBSE. According to a white paper by NAVAIR, the MIT program is appropriate for their use because of its intentional involvement of a wide range of people across the organization rather than silos in specific groups or departments. NAVAIR stated that the course introduced the participants to the depth and breadth of what model-based engineering is, its applications, and how it is used. They also found that while the transition to MBSE is complicated, the courses have helped their workforce understand the overarching goal and establish a common language amongst them. NAVAIR recommends this program for individuals in higher levels of an organization who are facilitating engineering change (MIT, 2021).

In the team’s independent assessment, 67 KSABs were identified after reviewing them from the publicly available weekly schedules of the four courses in the MIT Architecture and Systems Engineering Program. There are five (5) DECF competencies (digital architecting, modeling, simulation, model-based systems engineering processes, and digital validation and verification) that were aligned with 27 KSABs in this program at the awareness, basic, intermediate, and advanced proficiency levels. The remaining KSABs contained in the program were either foundational systems engineering or fundamental engineering KSABs, which were excluded from the DECF.

Table 15. Distribution of MIT Course KSABs in DECF v. 1.1.

MIT Course KSABs in DECF v.1.1	Awareness	Basic	Intermediate	Advanced	Expert	Total
G1 Data Engineering	0	0	0	0	0	0
G2 Modeling and Simulation	1	1	1	2	0	5
G3 Digital Engineering and Analysis	15	6	1	0	0	22
G4 Systems Software	0	0	0	0	0	0
G5 Digital Enterprise Environment	0	0	0	0	0	0
Total	16	7	2	2	0	27

Total not in DECF	40
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It is important to note that this independent assessment is solely based on limited, publicly available materials and the team has not reviewed this assessment with faculty at MIT. The team plans to coordinate with the MIT faculty teaching these courses to refine the assessment based on their input or additional course materials in Phase 3 of this research project.

4.4 Overarching Recommendations from the Comparison of the DECF with the DoD Training Resources

The current courses in use by DAU (CLE084 and Coursera's MBSE) are useful for providing a common foundation and orientation to the terminology and benefits of MBSE and DE. They would help individuals attain "Awareness" or "Basic" proficiencies – understanding of the concepts and in some instance the ability to apply them with heavy guidance or supervision. They are particularly helpful for individuals who have no background in systems engineering or modeling or who are firmly entrenched in a document-based acquisition approach. However, seasoned systems engineers and engineers would require substantially deeper training to become practitioners of digital engineering.

Based on mapping of the DECF to the limited course materials available online for the MIT Architecture and Systems Engineering Program, the team found that the courses provided a solid fundamental understanding of models in engineering, MBSE, systems engineering, and digital architecting. In some cases, individuals can obtain proficiencies as high as the "Advanced" level. This program is recommended by NAVAIR for individuals who are facilitating change in their departments or organizations as they transition towards digital transformation.

Overall, the Department needs to:

- **Screen for foundational skills.** The DECF assumes a foundation of skills on which to build digital engineering competency. However, when it comes to training, this foundation cannot be assumed. The DoD needs to implement some basic screening approaches to ensure that individuals who do not have this foundation are offered opportunities to build it. Courses like DAU's CLE084 and Coursera's MBSE are already in use by the department and provide some of the necessary foundations. But it is important that only individuals who need these foundations utilize the resources, while individuals who will not gain proficiency through these courses be directed to other courses.
- **Introduce courses using modeling and simulation projects and problems as part of the curriculum.** As currently structured, CLE084 and Coursera MBSE training focus on the lowest levels of proficiency. While Awareness level skills are a critical foundation on which to build skills for practical application of DE, they are not sufficient in and of themselves. Because up to 70% of learning is gained through experience (rather than classroom instruction), creating models and simulations that students can use to practice the skills of the task is paramount.

Ideally, implementation of modeling and simulation projects would impact not only DE-focused curriculum but could help enable a variety of disciplines for digital transformation. A modeling environment that spans, for example, the ENG and PM training courses at DAU would enable systems engineers and program managers to improve their familiarity with working in a digital environment before they are exposed to DE-specific training.

Note that the SERC will begin a task (WRT-1043) for DAU in 2021. This task is intended to develop a modeling and simulation environment to be used for DAU curriculum along with the associated simulations and course materials.

- **Include coaching and mentoring as part of the longer-term curriculum.** While coaching and mentoring can be applied within a single course, it would be most beneficial if longer-term coaching relationships were established specifically around the transition to DE in the DoD. The

DAU may be in a unique position to broker such coaching opportunities, allowing individuals the opportunities to apply their DE knowledge on the job with expert guidance.

5. Conclusion and Future Work

5.1 Work Completed

From 2020-2021, the DECF team has created:

- DECF v. 1.1, an iterative improvement of DECF v. 1.0 released in spring 2020. The purpose of the DECF is to provide clear guidance for the DoD acquisition workforce, in particular the ENG acquisition workforce, through clearly defined competencies that illuminate the KSABs required for DE professionals. Though the DECF includes considerations specific to the Defense acquisition workforce, data was gathered from outside the defense community and the structure of the DECF provides a useful model for any individual or organization that needs to understand the skills required to successfully implement DE.
- Analysis of current DE-related courses/curriculum against the DECF. In particular, the team has reviewed and mapped:
 - DAU’s CLE084: Models, Simulations, and Digital Engineering;
 - Coursera’s Model-Based Systems Engineering course; and
 - MIT’s Online Program: Architecture and Systems Engineering: Models and Methods to Manage Complex Systems.

The DECF exists in a modeling environment, which allows users to explore the competency groups, competencies, and knowledge, skills, abilities, and behaviors (KSABs) contained within. The model also includes data on the courses, providing both visual and tabular information about the alignment between courses currently being used within the DoD for DE training and how well these courses cover the DECF, as illustrated in Figure 13.

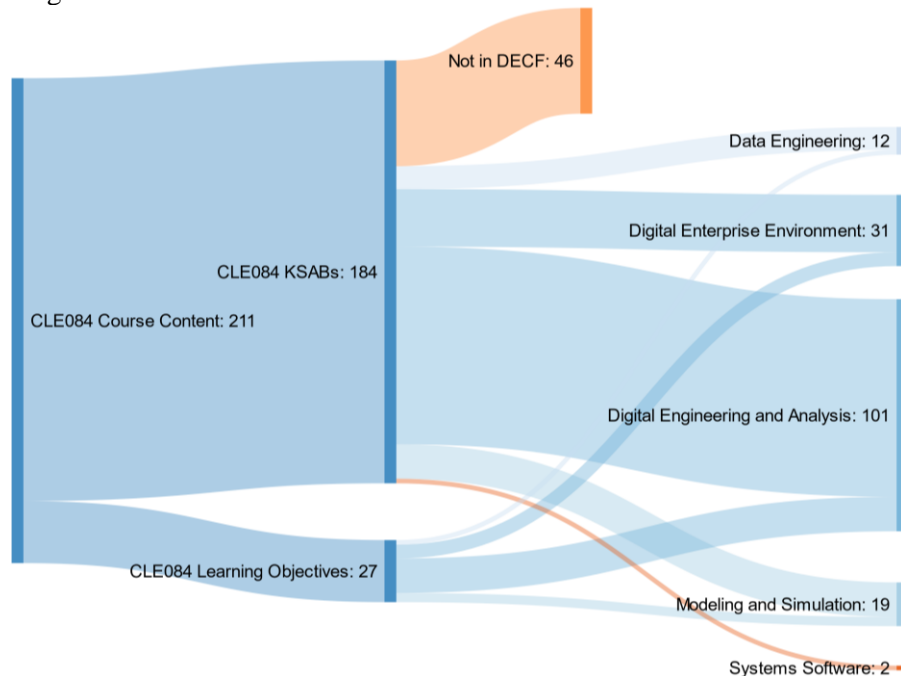


Figure 13. Visualization of DAU Course Content Comparison to DECF v. 1.1.

5.2 Growth of the DECF Modeling Environment

Going forward, the DECF team proposes to continue to advance the capabilities of the DECF modeling environment to improve capabilities with respect to specific users/use cases. In particular:

1. Work with the DE training community to compare additional training to the DECF, gather data on the ease of use for importing course data, complete the comparisons, and decide how data can best be exported for use.
2. Work with appropriate personnel to utilize the DECF for workforce assessment. This may include individual assessment, collective assessment, or identification of gaps.
3. Work with appropriate personnel to use the data created in item #2 above to support workforce planning and identify how the data can best be provided to enable planning. This may also include determining how workforce plans can be contained within the DECF environment, with appropriate metrics that can be tracked in the model over time.
4. Gather feedback from early users to identify additional capabilities that will enable exploration and understanding of the DECF (e.g., additional model views, new visualizations, etc.).

The approach for these improvements in the DECF is to hold a series of pilots with several organizations and gather lessons learned on real world use of the DECF. Periodically (notionally once a quarter), the team will hold workshops to bring individuals from multiple organizations together to review and provide feedback on updates to the DECF capabilities. The team would start with the OUSD (R&E) ETM Task Force team. Potential organizations include NAVAIR, NAVSEA, DAU, and others. Our outreach through the NAVAIR Systems Engineering Transformation brought industry participation to support early DECF reviews, such as the acquisition systems reference model. The team believes in engage industry to support these efforts again.

The learning from these activities would be used to continuously improve the DECF, with the research task culminating in DECF v. 2.0. The proposed research task (Phase 3) is a continuation of Phase 2 and focuses on improving the modeling environment for the DECF to support more users and use cases and exploring the expansion of this environment to support the ETM and workforce planning with respect to DE. Figure 14 provides an outline of the proposed workflow for Phase 3.

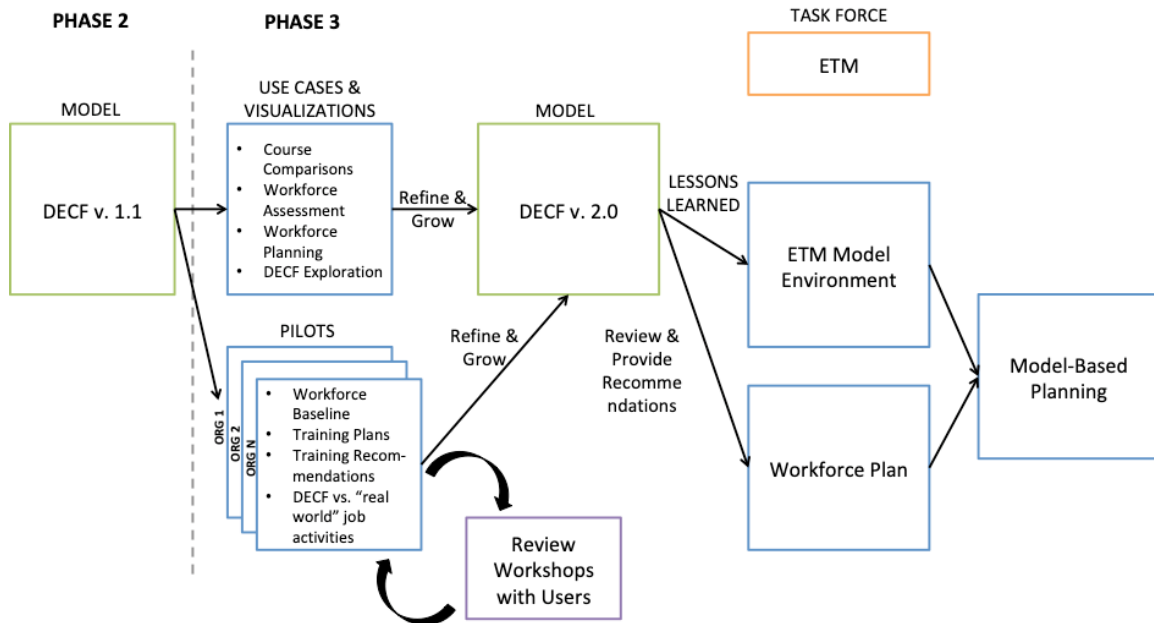


Figure 14. Potential Future Work for WRT-1006 Research Task.

5.3 Modeling Environment Development for the Engineering and Technical Management (ETM) Task Force

The ETM task force proposes a comprehensive competency model that includes competencies in Tiers 1-3. The DECF will feed into this competency model, and the lessons learned from the DECF work provide a unique opportunity to assist the Department in developing the ETM in a modeling environment to better enable the use cases outlined for the DECF.

The team proposes to:

- Work with the ETM task force team to create a modeling environment to support and capture the ETM competency model. This would iteratively incorporate the capabilities further developed for the DECF, e.g., visualizations, forms, model views, etc.; and
- Work with the ETM task force to determine whether and how the workforce development plan can be captured in the modeling environment, with linkages to the ETM and metrics that are linked to ETM model elements. This would give the Department a unique opportunity to utilize a model-based environment from the ground up.

The result would be a working model to support ETM, assessments against the ETM, and an understanding and first iteration of what is possible for planning using a model-based environment.

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Appendix A: KSABs for Data Governance (C1) in DECF v. 1.1

Competency Group: G1 Data Engineering				
Competency Title: C1 Data Governance				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Aware of the data required to inform program and technical decisions • Explain the importance of a data model • Understand the definition of schema. 	<ul style="list-style-type: none"> • 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 principles underlying the relationship among facts and apply this understanding when solving problems • Understand the definition of data model. 	<ul style="list-style-type: none"> • Apply ethical and robust techniques in the transformation of data from one format/medium to another, in line with organizational policies and procedures and being sensitive to risks around the use of information • 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 for the government • Assess the implications of information, both internal and external, that can be mined from business systems and elsewhere • Identify the considerations for data quality. • Assess the impact of data quality on data 	<ul style="list-style-type: none"> • Ensure that operational problems are identified, recorded, monitored and resolved, using relevant data and data analyses • Assess and document the impacts, threats and opportunities to the organization, using relevant data and data analyses • Assess and manages risks around the use of information • 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 	<ul style="list-style-type: none"> • Identify and manage resources needed for the planning, development and delivery of specified information and communications systems services (including storage, modification 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

Competency Group: G1 Data Engineering

Competency Title: C1 Data Governance

Awareness	Basic	Intermediate	Advanced	Expert
	<ul style="list-style-type: none"> • Understand the integration of process and data models to create business models. • Understand the concept of Data Exchange Layer • Understand the definitions of data governance; data storage; data integration; and monitoring. 	<p>credibility.</p> <ul style="list-style-type: none"> • Assess the implications of low-quality data. 	<p>management</p> <ul style="list-style-type: none"> • Identify the implications of copyright, data protection and other legal issues associated with publishing data • Monitor the external environment to gather information on emerging technologies • Provide advice and guidance to database designers and other application development team members using the data structures and associated components • Provide advice on the transformation of data/information from one format or medium to another • Provide expert guidance in the selection, provision and use of database and data warehouse architectures, software, and facilities • Provide specialist advice to those accountable for information governance to correct digital media related compliance issues • Recommend remediation actions on information 	<p>guidelines for information and records management ensuring that uniformly recognized and accepted data definitions are developed and applied throughout the organization</p> <ul style="list-style-type: none"> • Ensure that the information required to support the organization is defined, and devise appropriate processes and data architectures to support enterprise digital engineering implementation • Ensure that there is a business perspective based on data analyses, of how any new technical capabilities will be integrated into the enterprise, including planning around key business cycles, selecting appropriate customers for migration, etc. • Establish and communicate the organization's information management strategy. • Identify issues with portfolio structure, cost,

Competency Group: G1 Data Engineering

Competency Title: C1 Data Governance

Awareness	Basic	Intermediate	Advanced	Expert
			and documentation, records management, information assurance and data protection, as required <ul style="list-style-type: none"> • Sets standards for data modelling and design tools and techniques, advise on their application, and ensure compliance 	risk, inter-dependencies, impact upon on current business activities and the strategic benefits to be realized, using relevant data and data analyses <ul style="list-style-type: none"> • Identify and establish the veracity of the external sources of information which are relevant to the operational needs of the enterprise • Identify the impact of any relevant statutory, internal, or external regulations on the organization's use of information and develop strategies for compliance • Direct the creation and review of an enterprise information assurance strategy to support the strategic requirements of the business • Establish processes for regular and consistent access to, and independent verification of, external information from multiple sources • Specify at a strategic level the business functions and data subjects needed to

Competency Group: G1 Data Engineering				
Competency Title: C1 Data Governance				
Awareness	Basic	Intermediate	Advanced	Expert
				support future business, thereby enabling the development of an information architecture

Appendix B: KSABs for Data Management (C2) in DECF v. 1.1

Competency Group: G1 Data Engineering				
Competency Title: C2 Data Management				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Understand the benefits of data management. • Understand the definition of data management. 	<ul style="list-style-type: none"> • Understand, orient to, and integrate new information • Understand the definition of data element in the context of metadata, telecommunications, or databases. • Understand how data from the Digital System Model (DSM) is stored, shared, protected, and used. • Understand the benefits of data centralization. • Understand the definition of library filing construct. • Understand how digital thread supports data workflow and analytics. • Understand how digital threads can support information flow. 	<ul style="list-style-type: none"> • Develop appropriate physical database or data warehouse design elements, within set policies, to meet business change or development project data requirements 	<ul style="list-style-type: none"> • Derive data management structures and metadata to support consistency of information retrieval, combination, analysis, pattern recognition and interpretation, throughout the organization • Develop and maintain specialist knowledge of database and data warehouse concepts, design principles, architectures, software, and facilities • Ensure implementation of information and records management policies and standard practice • Ensure that formal information access requests and complaints are dealt with according to approved procedures • Ensure that physical database design policy supports transactional data requirements for performance and availability • Implement physical database designs to support transactional data requirements for performance and availability • Maintain and implement information handling procedures • Manage the investigation of data requirements in order to 	<ul style="list-style-type: none"> • Assess and advise on the practicality of testing process alternatives, including automated testing, using data and data analysis • 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 • Design test cases and test scripts independently and without supervision, mapping back to pre-determined criteria, recording and reporting outcomes • Lead and plan activities to communicate and implement information management strategies • Protect the integrity, availability, authenticity, non-repudiation and confidentiality of information and data in storage and in transit

Competency Group: G1 Data Engineering

Competency Title: C2 Data Management

Awareness	Basic	Intermediate	Advanced	Expert
			establish, modify or maintain data structures <ul style="list-style-type: none"> • Manage the iteration, review and maintenance of data requirements and data models • Report on system quality and collects metrics on test cases • Take responsibility for the accessibility, retrievability, security, quality, retention, and ethical handling of specific subsets of data • Validate external information from multiple sources, independently • Enable the availability, integrity and searchability of information through the application of formal data and metadata structures and protection measures • Assesses the integrity of data from multiple sources 	<ul style="list-style-type: none"> • 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

Appendix C: KSABs for Modeling (C3) in DECF v. 1.1

Competency Group: G2 Modeling and Simulation				
Competency Title: C3 Modeling				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Capture and maintain model provenance and pedigree in order to establish trust, credibility, accuracy and a basis for judging model reuse • Describe a variety of system analysis techniques which can be used to derive information about a system • Describe different types of modeling and provide examples • Explain why system 	<ul style="list-style-type: none"> • Construct models to be traceable from concept to disposal, so that they can become the authoritative source of truth • Know where to find model descriptions • Understand the purpose and benefits of modelling • Use appropriate system analysis techniques to derive information about the real system • Use models to communicate, collaborate, and perform model-driven lifecycle activities by exchanging information between technical disciplines or organizations • Use models to support analysis • Use various modeling toolsets • Apply concepts to start creating system models and architecture products (less complex architecture with fewer coordinating activities) with direct supervision • Apply modelling techniques to establish, modify or maintain a data structure and its associated components (entity 	<ul style="list-style-type: none"> • Create system models for system development efforts in accordance with applicable standards and policies • Define the inter-relationships among model elements and diagrams • Explain why models are developed for a specific purpose or use and provides examples • Have a well-developed understanding of modeling tools and how to implement them in both classified and unclassified environments • Model current and desired scenarios, as directed • Review the system model created by others • Select appropriate tools and techniques for system modeling and analysis • Use model formalisms to aid in the development, integration, and curation of models • Use modeling language, concepts, diagrams, data 	<ul style="list-style-type: none"> • Advise on selection of appropriate modeling or analysis approach, based on understanding the strengths and weaknesses of various modeling techniques • Develop approaches to integrating modeling tools with other types of engineering tools such as requirements management tools and configuration management tools • Prepare instructions in support of collaboration of model development, to ensure accurate use and operation between technical disciplines and organizations • Adapt approach to accommodate the specifics of a given situation or system of interest being modeled • Advise across the enterprise, on systems modeling • Analyze system models • Apply a range of mathematical, statistical, or predictive modelling techniques in consultation with experts if appropriate, and with sensitivity to the limitations of the 	<ul style="list-style-type: none"> • Review and judge the suitability of systems modeling and analysis approaches and results • Advise and arbitrate on complex or sensitive issues relating to systems modeling • 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 • Coach lead practitioners in systems modeling • Contribute to

Competency Group: G2 Modeling and Simulation

Competency Title: C3 Modeling

Awareness	Basic	Intermediate	Advanced	Expert
<p>representations are required and the benefits they can bring to developments</p> <ul style="list-style-type: none"> • Understand that system models are created for system development efforts in accordance with applicable standards and policies • Understand the various modeling toolsets • Describe the scope and limitations of models, including definition, implementation and analysis • Explain how the purpose of modeling affect the 	<p>descriptions, relationship descriptions, attribute definitions)</p> <ul style="list-style-type: none"> • Apply published modeling methodologies, i.e., OOSEM, JPL-SA, RUP-SE, etc. • 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 • 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 • Assist in more complex modelling activities • Build models in a collaborative modeling environment • Comply with style guides to properly develop system models • 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 	<p>attributes</p> <ul style="list-style-type: none"> • Ability to design models based on data • Analyze the system model • Apply design, modelling, 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) • Assess aspects of model quality to ensure conformance to language and method constraints • Contribute to model development and interpretation activities • Conversant with techniques covering full range of modelling situations • Develop accurate, complete, trusted and reusable models • Develop Digital Artifacts, according to intent • Develop models with input from subject matter experts and communicates the results back to them for review and confirmation 	<p>techniques</p> <ul style="list-style-type: none"> • Coach new and experienced practitioners in systems modeling and analysis • Conduct advanced modelling activities for significant change programs and across multiple business functions • Conduct analyses (e.g., gap, impact, interoperability) of the system model and architectural products • Contribute to capacity modelling and planning • Contribute to discussions about the choice of the modelling approach to be used • Define and document enterprise-level policies, procedures, guidance and best practice for systems modeling and analysis, including associated tools • Determine how to integrate or federate models • Develop framework for system model • Ensure that DE activities and digital artifacts development are performed according to intent • Establish a data model framework • Evaluate system models created and maintained by others • Identify and maintain an approach that integrates models 	<p>system modeling best practices</p> <ul style="list-style-type: none"> • Defines strategy and approach to be used for modeling and analysis of complex or novel system or system elements • Establish policy and strategy for the selection of solution architecture components, and coordinate design activities, promoting the discipline to ensure consistency • Evaluate multiple system models at the mission or system-of-system level • Has continuing responsibility for the maintenance of models for a designated function • Influence key stakeholders

Competency Group: G2 Modeling and Simulation

Competency Title: C3 Modeling

Awareness	Basic	Intermediate	Advanced	Expert
<p>approach taken</p> <ul style="list-style-type: none"> • Re-state terms and definitions about models and Digital Engineering in Systems Engineering • Understand “model” in the context of Digital Engineering • Understand the basic modeling concepts, diagrams, data attributes, and the relationship(s) between the modeling language diagrams 	<ul style="list-style-type: none"> • 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, and the integration of work products and multidisciplinary teams to result in the digital representation of the SOI • Explain policy and guidance about models, simulations, and Digital Engineering • Explain the use of models in Digital Engineering (DE) • Utilize modeling language tools to create or maintain architectural products based on data provided • Utilize Unified Modeling Language (UML) based tools to create or maintain architectural products based on data provided • Understand the types of data models (conceptual, logical, physical) • Identify key considerations for implementing a digital system model successfully. • Understand the steps of the model-test-model approach: long-term planning, pre-test modeling, field test, post-test modeling, model 	<ul style="list-style-type: none"> • Explain why models have a limit of valid use, and the risks of using models outside those limits • Gain agreement from subject matter experts to models produced • Generate system models • Implement system model and architecture • Implement the strategy and approach to be adopted for the modeling on a system or system element • Integrate and curate models across disciplines to support cohesive model driven lifecycle activities • Integrate modeling language components with other product and analytical models including physics-based models • Interpret and use outcomes of modeling, with guidance • Lead and determine appropriate representation of a system or system element • Maintain the system model for a system or system-of-systems in accordance with applicable standards and policies with minimal or no supervision 	<p>generated by all stakeholders to digitally represent the SOI throughout the lifecycle</p> <ul style="list-style-type: none"> • Investigate corporate data requirements, and apply data analysis, design, modelling, and quality assurance techniques, to establish, modify or maintain data structures and their associated components (entity descriptions, relationship descriptions, attribute definitions) • Knowledge of a broad range of industry-wide modelling techniques • Lead and determine appropriate representations of complex system or system elements • Manage capacity modelling and forecasting activities • Manage complex system model development and analysis efforts • Manage the investigation of corporate data requirements, and co-ordinate the application of data analysis, design and modelling techniques, based upon a detailed understanding of the corporate information requirements, in order to establish, modify or maintain data structures and their associated components (entity descriptions, relationship 	<p>within and beyond the enterprise boundary in systems modeling and analysis</p> <ul style="list-style-type: none"> • Introduce novel practices and techniques in systems modeling and analysis, producing measurable improvements • Lead capacity modelling and forecasting over the organization’s planning or budgeting cycle • Lead the development of architectures for complex solutions, ensuring consistency with specified requirements agreed with both external, and internal customers • Set strategy for management of technology resources,

Competency Group: G2 Modeling and Simulation

Competency Title: C3 Modeling

Awareness	Basic	Intermediate	Advanced	Expert
	<p>validation/accreditation.</p> <ul style="list-style-type: none"> • Understand the benefits and potential risks in the model-test-model approach. 	<ul style="list-style-type: none"> • Manage framework for system model • Organize complex models • Review how the system model is aligned with the framework • Review system model to identify system components or capabilities based on the application • Review the creation of system models (e.g., Interface Control Document, SysML diagrams) produced by other systems engineers to ensure proper format and content • Select appropriate modelling techniques for meeting assigned objectives • Use modeling and simulation tools and techniques to represent a system or system element • 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 	<p>descriptions, attribute definitions)</p> <ul style="list-style-type: none"> • Plan own modelling activities, selecting appropriate techniques and the correct level of detail for meeting assigned objectives • Prioritize the creation of system models to meet larger program milestones and events • Prioritize the maintenance of system models to meet larger program milestones and Systems Engineering Technical Review (SETR) events • Produce models in support of business strategy • Responsible for planning and coordinating team modelling activities and for ensuring the quality of their work • Review and judge the outputs of systems modeling, ensuring the results can be used for the intended purpose • Review complex modeling work • Set standards for data modelling and design tools and techniques, advise on their application, and ensure compliance • Support the technical authority expert in approving standard modeling techniques and submitting waivers and deviations for approval • Verify the creation of system 	<p>including corporate telecommunications functions, and promotes the opportunities that technology presents to the employing organization, including the feasibility of change and its likely impact upon the business</p> <ul style="list-style-type: none"> • 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

Competency Group: G2 Modeling and Simulation

Competency Title: C3 Modeling

Awareness	Basic	Intermediate	Advanced	Expert
			models and architectural products (e.g., Interface Control Document, DoDAF viewpoints, SysML diagrams) produced by other systems engineers to ensure proper format and content	

Appendix D: KSABs for Simulation (C4) in DECF v. 1.1

Competency Group: G2 Modeling and Simulation				
Competency Title: C4 Simulation				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Describe the scope and limitations of model simulations, including definition, implementation, and analysis Explain how the purpose of modeling and simulation affect the approach taken Explain the relevance of outputs from systems modeling analysis, and how these relate to overall system development Describe different types of simulation and provide examples Describe the scope and limitations of simulations, including definition, implementation, and analysis Explain how the 	<ul style="list-style-type: none"> Explain the use of models and simulations within a digital engineering environment Explain why models and simulations have a limit of valid use, and the risks of using models and simulations outside those limits Use established techniques as directed, to model simple subject areas with clearly-defined boundaries Understand definitions of modeling and simulation. Understand the definition of models and simulation. Understand the definition of business model. Explain the use of simulations in Digital Engineering (DE) Use various 	<ul style="list-style-type: none"> Assist in complex modelling activities Applies modeling and simulation applications and tools, to cover a full range of modeling situations Integrate modeling capabilities with other product and analytical models including physics-based models Apply maintenance and calibration for an engineering tool Use system analysis techniques to derive information about the real system, with guidance Use tools and techniques to conduct analysis of models, with guidance Understand different types of models (mathematical, process, text vs graphics-based, low- vs high-level models, flat vs. hierarchical models Understand considerations for implementing a Digital System Model (DSM). Understand how models and digital artifacts can be 	<ul style="list-style-type: none"> Apply modeling and simulation techniques to forecast the demand upon a particular resource or service Advise on the choice of modeling techniques and approach, to communicate with customers accordingly 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 Apply a range of mathematical, statistical, predictive modelling or machine-learning techniques in consultation with experts if appropriate, and with sensitivity to the limitations of the techniques Understand that various modeling and simulation applications and tools are required to cover a full range of modeling and simulation situations Coordinate complex modeling work Develop and implement clearly defined digital modeling plans and method statements Ensure staff use the model to support their analysis Ensure that appropriate modeling and simulation tools and methods are available, understood and employed in architecture development 	<ul style="list-style-type: none"> Conduct mission-level analyses across multiple systems or services Advise on the suitability and limitations of models and analysis techniques used 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 Develop the capabilities and the requirement sets within digital modeling and simulation environment Ensure the

Competency Group: G2 Modeling and Simulation

Competency Title: C4 Simulation

Awareness	Basic	Intermediate	Advanced	Expert
<p>purpose of simulation affects the approach taken</p> <ul style="list-style-type: none"> • Re-state terms and definitions about simulations in Systems Engineering • Understand the various simulation toolsets 	<p>simulation toolsets</p>	<p>used to represent technical coherency using DE concepts.</p> <ul style="list-style-type: none"> • Understand the importance and acceptance of models, simulations, and digital engineering artifacts. • Understand the process for peer review of models, simulations, and digital artifacts. • 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) • Explain why simulations have a limit of valid use, and the risks of using simulations outside those limits • Interpret and use outcomes of simulation with guidance • Select appropriate tools and techniques for system modeling simulation • Use simulation tools and techniques to represent a system or system element 	<ul style="list-style-type: none"> • Use models to identify and evaluate alternative architectures and the trade-offs in cost, performance, and scalability • Implement the strategy and approach to be adopted for the modeling and analysis on a system or system element • Support a modeling and simulation program through the preparation of technical plans and the application of digital thread principles • Understand the need to include modeling, simulation, and Digital Engineering tasks in the request for proposal (RFP) • Understand the need to obtain the appropriate model, simulation, and digital engineering artifact deliverables using the proper contractual mechanism. • Advise on selection of appropriate modeling or analysis approach, based on understanding the strengths and weaknesses of various simulation techniques • Review and judge the outputs of systems simulation, ensuring the results can be used for the intended purpose 	<p>maintenance of models for a designated function</p> <ul style="list-style-type: none"> • Serve as a modeling expert in industry initiatives • Advise and arbitrate on complex issues relating to systems simulation • Review and judge the suitability of systems simulation approaches and results

Appendix E: KSABs for Artificial Intelligence/Machine Learning (C5) in DECF v. 1.1

Competency Group: G2 Modeling and Simulation				
Competency Title: C5 Artificial Intelligence/Machine Learning				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Ability to describe text classification, information retrieval, information extraction • Describe the advantages of an Integrated Development Environment (IDE) for coding 	<ul style="list-style-type: none"> • Ability to audit and test the dynamic function allocation between humans and the machine • Ability to conduct User experience testing to evaluate the usability of the AI • Ability to do text classification/categorization • Ability to measure degree of comprehensibility of the AI/ML inferencing • Ability to retrieve data from one version of a SQL and NoSQL database • Able to design and implement a prescriptive support system • Able to design and implement a Decision Support System • Demonstrate familiarity with ROS-M • Describe an ontology, and state situations where it would be useful • Describe and provide examples of the 6 levels of autonomous systems defined by the Society of Automotive engineers. • Describe reinforcement learning, and indicate the class of problems it addresses • Describe the difference between a 	<ul style="list-style-type: none"> • Ability to design and execute a supervised learning task • Ability to design and execute an unsupervised learning task • Ability to do Information retrieval on a corpus of documents • Demonstrate that affective computing systems do not cause harm by amplifying or damping human emotional experience • Design and construct an ontology supporting a semantic web application • Design, construct and execute information extraction • Evaluate adaptive and learning systems for the ability to explain their reasoning and decisions in a transparent and understandable way • Evaluate mixed reality systems (virtual, augmented, diminished) and their effects on task performance and human 	<ul style="list-style-type: none"> • Apply a range of machine-learning techniques in consultation with experts if appropriate, and with sensitivity to the limitations of the techniques • Evaluate whether the system demonstrates: accountability, value alignment, explainability, fairness and user data rights • Supervise the construction of an end to end learning system from data collection to data analytics 	

Competency Group: G2 Modeling and Simulation

Competency Title: C5 Artificial Intelligence/Machine Learning

Awareness	Basic	Intermediate	Advanced	Expert
	Decision Support System and a Prescriptive support system <ul style="list-style-type: none"> • Describe the major differences between Supervised and Unsupervised learning • Determine the degree of explainability of the AI/ML inferencing • Determine whether the behavior of autonomous functions is predictable to their operators • Explain the concept of Human in the loop • Explain the concept of User Centered Design • Explain the value of ML platforms (e.g., TensorFlow, WatsonStudio) • Understand the importance of SLAM (simultaneous localization and mapping) for real and virtual robotic systems 	welfare		

Appendix F: KSABs for Data Visualization (C6) in DECF v. 1.1

Competency Group: G2 Modeling and Simulation				
Competency Title: C6 Data Visualization				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Understand the benefits of data visualization • Understand the definition of data visualization 	<ul style="list-style-type: none"> • Ability to extract semantic metrics from text under supervision • Ability to extract statistical metrics from text under supervision • Describe the benefits of data visualization across a variety of stakeholders • Knowledge of the basic principles of applied logic and knowledge representation 	<ul style="list-style-type: none"> • Ability to determine the most appropriate visual representation for the specific need • Ability to do Information retrieval on a corpus of documents • Ability to implement methods and tools to represent patterns of what happened in the past providing predictive behaviors • Ability to implement processes to explore data • Ability to implement the most appropriate visual representation for the specific need • Ability to perform text preparation • Ability to represent patterns of what happened in the past • Ability to represent semantic structures in text • Ability to understand and interact with algorithm and modeling for knowledge representation and extraction • Ability to use and implement algorithm and modeling for knowledge representation and extraction • Ability to use different forms of text vectorization for NLP • Identify, evaluate, select, and apply hardware or software tools or technological solutions appropriate to support data visualization 	<ul style="list-style-type: none"> • Ability to determine the most representative metrics for the specific need • Ability to evaluate results of knowledge representation and extraction 	<ul style="list-style-type: none"> • Ability to design process to explore data • Ability to design the most appropriate visual representation for the specific need

Appendix G: KSABs for Data Analytics (C7) in DECF v. 1.1

Competency Group: G2 Modeling and Simulation				
Competency Title: C7 Data Analytics				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Explain the difference between structured and unstructured data • Understand the difference between SQL and NoSQL databases 	<ul style="list-style-type: none"> • Apply data analysis, design, and modelling techniques to establish, modify or maintain a data structure and its associated components (entity descriptions, relationship descriptions, attribute definitions) • Leverage data and analytics to enable insights and achieve faster and better data-driven decisions • Understand definition of data, metadata, telecommunication, databases. • Ability to determine the elements required to describe what happened in the past • Ability to interact with data engineering procedures and methods 	<ul style="list-style-type: none"> • Apply data analysis, design, modelling, 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) • 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) • Interpret and use outcomes of data analysis, with guidance • Undertake data analysis activities and deliver analysis outputs, in accordance with customer needs and conforming to agreed standards • Ability to determine patterns in what happened in the past 	<ul style="list-style-type: none"> • Contribute to the data engineering of digital information systems with the creation of reports, technology road mapping, and the sharing of knowledge and insights • Ensure that digital data warehouse design policy supports demands for business intelligence and data analytics • Develop data hypotheses and methods, evaluate analytics models, share insights and findings, and continue to iterate with additional data • Establish and manage methods, techniques, and capabilities to enable the organization to analyze data, to generate insights, create value, and drive decision-making. • Evaluate the need for analytics, assess the problems to be solved and what internal or external data sources to use or acquire • Implement data warehouse 	<ul style="list-style-type: none"> • Develop analytics policy, standards, and guidelines • Direct the creation and review of a cross-functional, enterprise-wide approach and culture for analytics • Lead the organization's commitment to efficient and effective analysis of textual, numerical, visual, or audio information • Lead the provision of the organization's analytics capabilities • Set direction and lead the introduction and use of analytics to meet overall business requirements, ensuring consistency across all user groups • Ability to design insights to understand why something happened in the past • Ability to design methods and tools to understand what happened in the past • Advise and arbitrate on complex or sensitive issues relating to systems analysis • Apply a wide-ranging

Competency Group: G2 Modeling and Simulation

Competency Title: C7 Data Analytics

Awareness	Basic	Intermediate	Advanced	Expert
		<ul style="list-style-type: none"> • Ability to implement methods and tools to understand what happened in the past • Ability to implement methods and tools to understand why something happened in the past • Ability to represent what happened in the past and why it happened • Apply data analysis 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) • 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 • Implement the strategy and approach to be adopted for analysis on a system or system element 	<p>designs that support demands for business intelligence and data analytics</p> <ul style="list-style-type: none"> • Investigate corporate data requirements, and apply data analysis, design, modelling, and quality assurance techniques, to establish data structures • Know the data required to inform program and technical decisions • Manage reviews of the benefits and value of analytics techniques and tools and recommends improvements • Manipulate specific data from information services, to satisfy defined information needs • Specify and apply appropriate mathematical, statistical, predictive modelling or machine-learning techniques to analyse data, generate insights, create value and support decision-making • Adapt approach to accommodate the specifics of a given situation or system of interest being 	<p>knowledge of the strengths and weaknesses of available analysis techniques, to advise on the appropriateness of selected approaches in any given level of complexity and novelty</p> <ul style="list-style-type: none"> • Coach lead practitioners in systems analysis • Contribute to system analysis best practices

Competency Group: G2 Modeling and Simulation

Competency Title: C7 Data Analytics

Awareness	Basic	Intermediate	Advanced	Expert
		<ul style="list-style-type: none"> • Lead and determine appropriate analysis of a system or system element 	<p>analyzed</p> <ul style="list-style-type: none"> • Advise across the enterprise, on systems analysis • Coach new and experienced practitioners in systems analysis • Lead and determine appropriate analyses of complex system or system elements • Lead the integration and combination of different analyses for a system or system element • Review and judge the outputs of systems analysis, ensuring the results can be used for the intended purpose 	

Appendix H: KSABs for Digital Architecting (C8) in DECF v. 1.1

Competency Group: G3 Digital Engineering and Analysis				
Competency Title: C8 Digital Architecting				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Understand how a model-based systems engineering approach can enable architecture design • Understand system model and architectural concepts, including the DODAF framework • Understand how architecture enables a model-based systems engineering approach 	<ul style="list-style-type: none"> • Create system digital models and basic architecture products, under direct supervision • 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 • Describe what it means for a digital model to be accurate, complete, trusted, and reusable • Identify and locate data necessary to create system model and architectural products when using architecting tools • Identify the relationship(s) between defense architecture frameworks and system models • Interact with relevant stakeholders to create digital engineering oriented architecture for a system's design • Utilize modeling languages to create or maintain system 	<ul style="list-style-type: none"> • Provide architecture assessment to make decisions based on the architecture to ensure requirements are met for the system development throughout the life-cycle • Apply system model and architectural concepts based on different stakeholder views and how they relate • Collaborate with disciplinary subject matter experts to create system models and architectural products • Collaborate with disciplinary subject matter experts to maintain system models and architectural products • Create required architectural products for a system or system-of-systems in accordance with applicable standards and policies with minimal or no supervision • Demonstrate a full understanding of system model and architectural techniques 	<ul style="list-style-type: none"> • Contribute to the development of solution architectures in specific business, infrastructure or functional areas, using model-based engineering methods and digital artifacts • Utilize architectural products to assist with analysis of alternatives to make a recommendation for the best solution • Analyze systems architecture models • Apply architecture to the remaining system disciplines and specification development • Develop framework for system architecture • Ensure that appropriate tools and methods are available, understood and employed in architecture development • Evaluate digital architectural products created and maintained by others • Identify and evaluate alternative architectures 	<ul style="list-style-type: none"> • Evaluate multiple system architectures at the mission or system-of-system level • Lead and oversee the framework for system digital model and architecture

Competency Group: G3 Digital Engineering and Analysis

Competency Title: C8 Digital Architecting

Awareness	Basic	Intermediate	Advanced	Expert
	<p>architectural products based on data provided</p> <ul style="list-style-type: none"> • Comply with style guides to properly develop architectural products • Identify the relationship(s) between defense architecture frameworks and modeling language diagrams • Understand the concept of digital thread. • Understand how digital threads work in the acquisition lifecycle. • Understand how digital artifacts support system of systems approaches, program interoperability, and modularity. • Understand how the use of digital artifacts can be used to effectively support interoperability. • Understand how the use of digital artifacts can be used to effectively support Modular Open System Approach (MOSA). 	<ul style="list-style-type: none"> • Review architecture diagrams • Review how the system model and architecture are aligned with the framework • Review system architectural products (e.g., structural diagram, behavior diagram, requirements diagram, parametric diagram) to identify system components or capabilities based on the application • Review the architectural products created by others, including digital twins and digital assets • Understand the ways digital artifacts can be used to support a MOSA. • Analyze architectural products using system models • Contribute to the system model for a system-of-systems architecture effort to establish the framework by which systems are designed • Maintain the required architectural products for a system or system-of-systems in accordance with 	<p>and the trade-offs in cost, performance and scalability</p> <ul style="list-style-type: none"> • Lead the development of solution architectures in specific business, infrastructure or functional areas • Manage complex system architectural development and analysis efforts • Prioritize the creation of architectural products to meet larger program milestones and events • Prioritize the maintenance of architectural products to meet Systems Engineering Technical Review (SETR) events • Review program integrated architectures for release outside of the system command • Support the technical authority expert in approving architectural products and submitting waivers and deviations for approval • Utilize architectural products to assist with analysis of alternatives to provide a set of technically acceptable solutions 	

Competency Group: G3 Digital Engineering and Analysis

Competency Title: C8 Digital Architecting

Awareness	Basic	Intermediate	Advanced	Expert
		applicable standards and policies with minimal or no supervision <ul style="list-style-type: none"> • Manage framework for architecture • Review how the architecture is aligned with the framework • Review the creation of architectural products (e.g., DoDAF viewpoints) produced by other systems engineers to ensure proper format and content • Identify digital interfaces and integration approaches with the contractor. 	<ul style="list-style-type: none"> • Verify architecture products for the technical authority • Verify the creation of architectural products (e.g., DoDAF viewpoints) produced by other systems engineers to ensure proper format and content • Verify the maintenance of architectural products (e.g., DoDAF viewpoints) produced by other systems engineers to ensure proper format and content 	

Appendix I: KSABs for Digital Requirements Modeling (C9) in DECF v. 1.1

Competency Group: G3 Digital Engineering and Analysis				
Competency Title: C9 Digital Requirements Modeling				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Explain the importance of digital requirements modeling 	<ul style="list-style-type: none"> • Use requirements traceability when modeling system-of-interest • Contribute to requirements management using digital modeling • Use requirements traceability matrix 	<ul style="list-style-type: none"> • 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 • Create requirements traceability in the digital model architecture • Ensure traceability between requirements and specifications • Generate a system specification in a digital enterprise environment model where all requirements and RDs are generated from the modeled system • Generate models using requirements and use case diagrams to include requirements elicitation, generation, analysis, verification and validation • Generate system models with functional allocation to operational requirements to determine system functions to include capability, operational, functional & physical architecture to establish the allocated, functional, and product baselines based on sound, proven standards • Perform requirements engineering using 	<ul style="list-style-type: none"> • Ascertain needs requirements of project to ensure proper modeling tools and technology are selected for the current project • Examine engineering artifacts and trace designs to requirements • Develop the capabilities and the requirement sets within digital enterprise environment • Ensure staff are involved with configuration or requirements management 	<ul style="list-style-type: none"> • Lead the modeling development of digital models for complex solutions, ensuring consistency with specified requirements agreed with both external, and internal customers

Competency Group: G3 Digital Engineering and Analysis

Competency Title: C9 Digital Requirements Modeling

Awareness	Basic	Intermediate	Advanced	Expert
		<p>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</p> <ul style="list-style-type: none"> • Query the model for how reliability requirements are addressed • Translate requirements into system specifications using digital modeling products • Understand relationships between system requirements and the system being developed • Create requirements traceability building on architectural products • 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 • 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 • Provide system model to make decisions based on the architecture to ensure requirements are met for the system development throughout the lifecycle • Translate requirements into system specifications using architecture products 		

Appendix J: KSABs for Digital Validation and Verification (C10) in DECF v. 1.1

Competency Group: G3 Digital Engineering and Analysis				
Competency Title: C10 Digital Validation and Verification				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Develop an understanding of the role of testing within system development, as a tool for design improvement as well as a verification process • Understand the importance of validating the digital twin. 	<ul style="list-style-type: none"> • Explain the validation and verification process of the digital model • Understand how digital twins can be used for T&E/V&V. 	<ul style="list-style-type: none"> • 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) • Analyze and report test activities and results using model-based engineering methods and tools • Understand the specific definition of verification with regards to DE. • Understand the specific definition of validation with regards to DE. • Understand the use of a digital ecosystem for VV&A of the system. • Verify that products developed are aligned with the review and/or analysis 	<ul style="list-style-type: none"> • Extend the digital enterprise environment model to define test strategies or cases • Verify digital model using digital thread • Verify system model for the technical authority 	

Appendix K: KSABs for Model-Based Systems Engineering Processes (C11) in DECF v. 1.1

Competency Group: G3 Digital Engineering and Analysis				
Competency Title: C11 Model-Based Systems Engineering Processes				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Knowledgeable about digital model project lifecycle • Understand the use of models in the context of digital engineering • Understand need to assess aspects of model quality including conformance to modeling language and application method constraints • Understand published modeling methodologies, i.e., OOSEM, JPL-SA, RUP-SE, etc. • Understand the basic fundamentals of Model-Based Systems Engineering (MBSE), Model-Based Engineering (MBE), and the broader Model-Centric Engineering (MCE) concepts 	<ul style="list-style-type: none"> • Assist with the evaluation of system-of-interest change requests using MBSE processes • Contribute to modeling tasks employing a model-based systems engineering approach • Describe digital artifacts contribution to the following engineering concepts: Systems of Systems (SoS), program interoperability, and modularity • Describe how digital system model artifacts advance the state-of-the-practice of digital engineering • Develop digital model artifacts, according to intent • Analyze and interpret the results obtained using model-based engineering methods and tools 	<ul style="list-style-type: none"> • Analyze the system model and architectural products • Build models in a digital enterprise environment collaborative modeling environment • Develop knowledge and skills with a new or updated tool, and apply the tool in the solution of an engineering problem • Ensure digital artifacts are up-to-date, consistent, interoperable, accessible, uncorrupted, and properly and safely stored • Generate digital enterprise environment system models • Integrate all other model domains and physics-based models with the system model 	<ul style="list-style-type: none"> • Apply advanced concepts, principles, and practices of model-based system engineering process • 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 • Integrate supporting engineering disciplines and specification development into system architecture • Integrate MBSE processes for complex system development efforts to appropriately represent the system requirements and design within the digital enterprise environment 	<ul style="list-style-type: none"> • Act as the technical authority for system model and architecture • Advise across the enterprise, on systems modeling and analysis • Develop advanced concepts, principles and practices of model-based system engineering process, requirements, and products • Evaluate multiple system models and architectures at the mission or system-of-system level • 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 life cycle phases

Competency Group: G3 Digital Engineering and Analysis

Competency Title: C11 Model-Based Systems Engineering Processes

Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Understand the uses of system models for system development efforts in accordance with applicable standards and policies • Understand the value that modeling concepts bring to complex system development efforts throughout the system lifecycle • Understand the importance of model traceability from concept to disposal in maintaining an authoritative source of truth • Understand the workforce needs for the development and use of digital artifacts during the acquisition life cycle. • Understand the definition of digital artifact. Understand how digital artifacts can be used across the acquisition lifecycle (DoD 5000.02) 	<ul style="list-style-type: none"> • Understands model-based engineering methods, tools and technologies that may assist in streamlining work and improving productivity • Evaluate the system model and architectural products created and maintained by others • Explain the difference in digital enterprise environment stakeholder views • Use appropriate representations of a system or system element in order to derive information about the real system • Use model formalisms to aid in the development, integration, and curation of models • Use modeling toolsets to generate diagrams, to establish system model data attributes • Use models as the basis for defining, evaluating, comparing, and optimizing alternatives and making decisions 	<ul style="list-style-type: none"> • Maintain system models for system development efforts in accordance with applicable standards and policies to reduce acquisition lifecycle timeline • Review system models to identify system components or capabilities based on the application • Select and define appropriate representations of a system or system element • Understand need to organize complex models, define the inter-relationships among model elements and diagrams • Understand the capabilities and the requirement sets within the digital enterprise environment • Use digital enterprise environment tools and techniques to represent a system or system element 	<ul style="list-style-type: none"> • Coordinate the planning, designing, and testing of maintenance procedures in accordance with model-based engineering methods AND Produce digital artifacts to support planning, designing, and testing of maintenance procedures • Identify sources of error in model-based engineering methods and take appropriate corrective action • Conduct analysis to ensure interoperability with external programs, systems, or capabilities • Evaluate and select appropriate model-based engineering methods and tools in line with agreed policies and standards • Design MBSE solutions for complex systems including operational, architectural, and requirements research, analysis, and documentation of assigned programs 	<ul style="list-style-type: none"> • Define and manage the model-based engineering activities to ensure achievement of the projected business benefits after delivery • 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 • Engage with senior managers to ensure the business portfolio will deliver the agreed upon digital artifact objectives • Incorporate technological innovation to improve the engineering practice of model-based engineering methods and digitization • Provide advice to support the design of service components including designing in flexible and scalable capacity, using model-based engineering methods and digital artifacts

Competency Group: G3 Digital Engineering and Analysis

Competency Title: C11 Model-Based Systems Engineering Processes

Awareness	Basic	Intermediate	Advanced	Expert
	<ul style="list-style-type: none"> • Use system models for design analysis • Contribute to the system model development and interpretation activities • Apply digital modeling tools to the solution of an engineering problem Understand digital artifacts and their use. • Understand how to represent systems and systems of systems (SoS) technical data in the digital engineering environment. • Understand the concept of digital twin and how it can be used in an acquisition environment. • Understand elements that can make up the digital twin. • Understand how digital twin can be used for understanding operation and maintenance. • Understand how the use of models and digital artifacts contributes to technical coherency. 	<ul style="list-style-type: none"> • Use models to support engineering activities and decision making across the lifecycle • Use system models for system development efforts in accordance with applicable standards and polices to reduce acquisition lifecycle timeline • Conduct operational, architectural, and requirements research, analysis, and documentation of assigned programs • Understand the definition of model-based systems engineering (MBSE) and the differences/similarities between this and DE. • Use the risk management process to manage the risk of using digital artifacts. 	<ul style="list-style-type: none"> • Review and improve usage and application of digital engineering methods and tools • Support monitoring of the external environment and assessment of emerging technologies to evaluate the potential impacts, threats and opportunities to the organization, using model-based engineering methods and digital artifacts • Ensure that digital engineering activities and digital artifacts development are performed according to intent • Evaluate supervision of the system model and architectural products created and maintained by others • Identify and maintain an approach that integrates models generated by all stakeholders to digitally represent the system of interest throughout the lifecycle • Implement MBSE solutions for complex systems 	<ul style="list-style-type: none"> • Recommend and implement corrective action by engaging and influencing senior management, using results from model-based engineering methods and tools • 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

Competency Group: G3 Digital Engineering and Analysis

Competency Title: C11 Model-Based Systems Engineering Processes

Awareness	Basic	Intermediate	Advanced	Expert
	<ul style="list-style-type: none"> • Understand the definitions of models, digital artifacts, and information sharing and how these are related. • Understand why digital artifacts are used and common examples of digital artifacts. • Understand the characteristics of digital artifacts, as well as potential benefits, including: accessibility, alignment, consistency, comprehensiveness, precision, data limitations, relevancy, accuracy, and ownership. • Identify key stakeholder groups that will produce and consume digital artifacts • Understand how strategic leadership may create or consume digital artifacts. • Understand how program managers may create or consume digital artifacts. • Understand how developers may create or consume digital artifacts. • Understand how systems engineers may create or consume digital artifacts. 		<p>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</p> <ul style="list-style-type: none"> • Determine appropriate representation or analysis of the digital model • Determine appropriate representations or analysis of complex system or system elements • Lead complex system model and architectural development and analysis efforts • Lead the development of digital models in specific business, infrastructure or functional area • Lead the integration and combination of different models and analyses for a system or system element 	

Competency Group: G3 Digital Engineering and Analysis

Competency Title: C11 Model-Based Systems Engineering Processes

Awareness	Basic	Intermediate	Advanced	Expert
	<ul style="list-style-type: none"> • Understand the risk of using digital artifacts with respect to workforce, change, data accuracy, the DE ecosystem, and data consistency. • Understand how digital artifacts can be used to effectively support SoS. • Understand how Digital Artifacts can be used to support interoperability. 		<ul style="list-style-type: none"> • 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 • Plan modelling activities, selecting appropriate techniques and the correct level of detail for meeting assigned objectives • Plan and coordinate team modelling activities and for ensuring the quality of their work • Review the creation of system models and architectural products and artifacts produced by other systems engineers to ensure proper format and content • Review the maintenance of system models and architectural products produced by other systems engineers to ensure proper format and content 	

Competency Group: G3 Digital Engineering and Analysis

Competency Title: C11 Model-Based Systems Engineering Processes

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none">• Support the technical authority expert in approving standard modeling and architectural products and submitting waivers and deviations for approval• 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• Utilize digital model artifacts to assist with analysis of alternatives to provide a set of technically acceptable solutions• Utilize system model and architectural products to conduct gap analysis• Apply integration using the integrated modeling environment to execute the MBSE process for complex system development efforts to represent the system requirements and design	

Competency Group: G3 Digital Engineering and Analysis				
Competency Title: C11 Model-Based Systems Engineering Processes				
Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • 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 • 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 • Implement MBSE operational, architectural, and requirements research, analysis, and documentation of assigned programs 	

Competency Group: G3 Digital Engineering and Analysis				
Competency Title: C11 Model-Based Systems Engineering Processes				
Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> 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 	

Appendix L: KSABs for Digital Model-Based Reviews (C12) in DECF v. 1.1

Competency Group: G3 Digital Engineering and Analysis				
Competency Title: C12 Digital Model-Based Reviews				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Aware of the digital model-based review process • Understand the importance of peer reviews. 	<ul style="list-style-type: none"> • Coordinate with subject matter experts to review and confirm information and results from models 	<ul style="list-style-type: none"> • Conduct model-based reviews and audits, to ensure effective collaboration for system-of-interest evolution • Confer with subject matter experts on models produced to gain concurrence on results • Review resulting models with stakeholders and gain resolution to resultant issues • 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 • 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 • Verify that system model products developed are aligned with the review and/or analysis 	<ul style="list-style-type: none"> • Define the series and sequence of model-based engineering activities to bring stakeholders to the required level of commitment, prior to formal reviews • Conduct technical reviews to evaluate digital products on a continuous basis as the technical baseline matures, and inform decisions • Communicate modeling results to managers and obtain feedback for agreement • 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 • Utilize system model and architectural products to conduct reviews 	<ul style="list-style-type: none"> • Approve system model as the technical authority

Appendix M: KSABs for Project and Program Management (C13) in DECF v. 1.1

Competency Group: G3 Digital Engineering and Analysis				
Competency Title: C13 Project and Program Management				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Understand that modeling and simulation provide insight into program cost, schedule, performance, and associated risks Understand the challenges and benefits for planning and execution of projects in digital engineering ecosystem. 	<ul style="list-style-type: none"> Understand the importance of including DE consideration in contracts: Build, extend, and maintain the DSM 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.) Understand how DE tasks and products are incorporated into a contract Understand the differences in contracting for document-based versus model-based acquisition Understand the role and importance models, simulations, and data in improving project management Understand the process for digital engineering as it relates to acquisition. Identify the DE tasks and products that need to be accomplished. Identify the tasks that should be completed by the contractor/developer Understand the importance of the Program and Contract WBSs. Identify how digital engineering tasks and artifacts can be included in WBS structures. Understand how to reflect DE tasks and products in the SOW, SOO, and PWS. 	<ul style="list-style-type: none"> 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 Advise on program cost, schedule, performance, and supportability risk assessments, using knowledge gleaned from digital engineering methods and tools Lead system modeling for a project Manage models that are produced within a project Understand the importance of including DE consideration in contracts: use DE practices during acquisition Understand the importance of including DE consideration in contracts: 	<ul style="list-style-type: none"> Able to formalize the development, integration, and use of models to inform enterprise and program decision making 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 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 Define new projects and support them through their lifecycle Implement model-based engineering methods and tools at program, project and team level including selection and tailoring in 	<ul style="list-style-type: none"> Maintain an overview of the contribution of programs to organizational success Implement processes which support cost-effective technology development and selection decisions Plan, schedule, monitor and report on model-based engineering activities related to the portfolio to ensure that each part of the portfolio contributes to the overall achievement of the portfolio

Competency Group: G3 Digital Engineering and Analysis				
Competency Title: C13 Project and Program Management				
Awareness	Basic	Intermediate	Advanced	Expert
	<ul style="list-style-type: none"> • Understand the importance of including DE consideration in contracts: develop and maintain the digital twin. • Understand the importance of including DE consideration in contracts: use digital artifacts for analysis in place of briefing charts. • Understand the importance of including DE consideration in contracts: design and integrate architecture for the DE infrastructure. • Understand how to include DE-related tasks and artifacts into the RFP, specifically sections B, C, L, and M. • 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. • Understand the interaction between digital engineering and program risk (i.e., how digital engineering can mitigate some risks and introduces others). • Understand how cohesively using digital artifacts throughout the acquisition life cycle is critical to program success. • Understand the ways that stakeholders can use digital artifacts in a SoS context (describe, distinguish, determine, communicate, draw, and allow). 	<ul style="list-style-type: none"> • leverage the DSM for developing training systems. • Understand how to properly reflect IP and Data Rights considerations in a contract. • Understand the importance of develop and maintain the digital artifacts for consideration in contracts • Understand the importance of develop and maintain the digital twin for consideration in contracts • Include the tasks, interfaces, and integration approaches in the RFP and final contract. • Identify the mechanisms and artifacts for reflecting DE tasks and deliverables in a contract (e.g., WBS, CDRL, DID, SOW, SOO, PWS). • Use digital artifacts to mitigate risks in schedule, cost, requirements, and design. 	<ul style="list-style-type: none"> • line with agreed standards • Take action to ensure targets are met within established safety and quality procedures, including, where appropriate, handover of digital artifacts to the client • Prioritize the creation of system model and architectural products to meet larger program milestones and events 	

Appendix N: KSABs for Organizational Development (C14) in DECF v. 1.1

Competency Group: G3 Digital Engineering and Analysis				
Competency Title: C14 Organizational Development				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Aware of the organizational plans in the organization 	<ul style="list-style-type: none"> Understanding of the organizational plans in the organization Understand the workforce needs in terms of: specific skills and abilities required; competency standards; and training and development needs. 	<ul style="list-style-type: none"> Create technology roadmaps using model-based engineering methods, to align organizational plans with emerging technology solutions 	<ul style="list-style-type: none"> 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 Monitor environmental and market trends and pro-actively assesses impact on organization strategies, benefits and risks, using model-based engineering methods and digital artifacts Provide advice, guidance and expertise to support adoption of model-based methods and tools, and adherence to policies and standards Play a leading role in establishing modeling language-based MBSE at an enterprise 	<ul style="list-style-type: none"> Establish a systems modeling culture and environment, leveraging the capabilities of the organization Initiate organization-wide modelling improvement activities and obtain customer buy-in to general changes Develop organizational policies, standards, and guidelines for model-based engineering methods and artifacts Lead the establishment of MBSE at an enterprise level Leverage the capabilities of MBSE across the organization Establish and share best practices, for re-use or adaptation of model-based engineering methods and digital artifacts, to the broader community

Competency Group: G3 Digital Engineering and Analysis

Competency Title: C14 Organizational Development

Awareness	Basic	Intermediate	Advanced	Expert
				<ul style="list-style-type: none"> • 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 • Lead the establishment of a MBSE enterprise with the use of formalized modeling language and ontology • Plan and lead the identification and assessment of new and emerging technologies and the evaluation of the potential impacts, threats and opportunities by using model-based engineering methods and digital artifacts • Set direction and lead in the introduction and use of model-based engineering techniques, methodologies and tools, to match overall business requirements, ensure consistency across all user groups

Appendix O: KSABs for Digital Engineering Policy and Guidance (C15) in DECF v. 1.1

Competency Group: G3 Digital Engineering and Analysis				
Competency Title: C15 Digital Engineering Policy and Guidance				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Understand the maintenance of system models for system development efforts are accomplished in accordance with applicable standards and policies 	<ul style="list-style-type: none"> Define plans, processes, and appropriate tools for model governance and analysis on a project Understand the role of digital engineering with respect to existing DoD acquisition practices Understand the specific definition of accreditation with respect to digital engineering. 	<ul style="list-style-type: none"> Create and update the documentation of digital engineering methods and tools Update engineering processes, manuals, and instructions to achieve desired digital engineering benefits 	<ul style="list-style-type: none"> Contribute to organizational policies, standards, and guidelines for methods and tools Identify process improvements to model-based engineering methods, and contribute to organization system testing standards and definition of best practice Tailor processes in line with agreed standards and evaluation of digital engineering methods and tools Develop policy and guidance about models, simulations, and digital engineering Maintain standards or guidance for the execution of model-based system engineering and architectural design Manage the system model and architecture products for policy compliance and framework alignment 	<ul style="list-style-type: none"> Create standards or guidance for the execution of model-based system engineering and architectural design Define modeling standards and quality targets for an organization Define strategy and approach to be used for modeling and analysis of complex or novel system or system elements Establish modeling policy and strategy for the selection of solution architecture components, and coordinate design activities, promoting the modeling and simulation discipline to ensure consistency Extend MBSE at an enterprise level by penetrating the concept into new departments or product areas

Competency Group: G3 Digital Engineering and Analysis

Competency Title: C15 Digital Engineering Policy and Guidance

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> Review and judge the adequacy of tailoring of enterprise-level systems modeling and analysis processes for specific projects 	<ul style="list-style-type: none"> Drive adoption of and adherence to model-based engineering methods and policies and standards through the provision of expert advice and guidance in order to ensure architectural principles are applied, requirements are defined and rigorous security testing is applied Ensure that appropriate model-based engineering methods and standards (corporate, industry, national and international) are adhered to Identify and monitor environmental and market trends using modeling-based engineering methods and pro-actively assess impact on business strategies, benefits and risks 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

Competency Group: G3 Digital Engineering and Analysis

Competency Title: C15 Digital Engineering Policy and Guidance

Awareness	Basic	Intermediate	Advanced	Expert
				corporate governance requirements • Establish formal guidance for the system model within a command (e.g., Command Style Guide, command policy, handbooks)

Appendix P: KSABs for Configuration Management (C16) in DECF v. 1.1

Competency Group: G3 Digital Engineering and Analysis				
Competency Title: C16 Configuration Management				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Aware of the configuration management policies, standards, and guidelines 	<ul style="list-style-type: none"> Apply tools, techniques and processes to administer, track, log, report on, and correct configuration items, components and changes Assist with audits to check the accuracy of information and undertakes any necessary corrective action under direction Contribute to configuration management using digital modeling 	<ul style="list-style-type: none"> Create traceability records, from test cases back to requirements Ensure that users comply with identification standards for object types, environments, processes, lifecycles, documentation, versions, formats, baselines, releases and templates Perform audits to check the accuracy of information and undertake any necessary corrective action under direction Asses the details of digital enterprise environment hardware/software items that have been installed and removed so that configuration management records can be updated Verify and approve changes ensuring protection of assets and components from unauthorized change, diversion and inappropriate use 	<ul style="list-style-type: none"> Contribute to development of configuration management strategies, policies, standards, and guidelines in accordance with model-based engineering methods and digital artifacts Agree to the scope of configuration management processes and the configuration items and related information to be controlled Develop, configure and maintain tools (including automation) to identify, track, log and record accurate, complete and current information 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 Identify, evaluate and manage the adoption of appropriate tools, 	<ul style="list-style-type: none"> Develop configuration management strategies, policies, standards, and guidelines for digital engineering related artifacts Develop new methods such as automation and organizational capabilities for the configuration management of digital artifacts

Competency Group: G3 Digital Engineering and Analysis

Competency Title: C16 Configuration Management

Awareness	Basic	Intermediate	Advanced	Expert
			techniques and processes (including automation) for configuration management of digitally-based artifacts and systems <ul style="list-style-type: none"> • Plan the capture and management of configuration items and related information • Propose and agree on the configuration items to be uniquely identified with naming conventions • Asses 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 	

Appendix Q: KSABs for Software Construction (C17) in DECF v. 1.1

Competency Group: G4 Systems Software				
Competency Title: C17 Software Construction				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Aware of the available software tools and basic coding knowledge 	<ul style="list-style-type: none"> Construct software for verification by following coding standards, which support code reviews and unit testing Construct software for verification by organizing code which supports automated testing Understand algorithms and of coding practices Minimize software complexity by emphasizing code creation that is simple and readable, using software construction standards, modular design and other specific coding techniques Minimize software complexity by restricting the use of complex or hard-to-understand language structures 	<ul style="list-style-type: none"> Build extensible software to assist in managing future changes and updates Create working software through a combination of coding, verification, unit testing, integration testing, and debugging Encapsulate reusable code fragments into well-structured libraries or components, to avoid the problem of code clones 	<ul style="list-style-type: none"> Ensure that system software is tailored to facilitate the achievement of service objectives Apply knowledge of algorithms and coding practices Specify user/system interfaces, including validation and error correction procedures, processing rules, access, security and audit controls Tailor system software to maximize hardware functionality Translate logical designs into physical designs 	<ul style="list-style-type: none"> Ensure adherence to agreed software development standards and good practice

Competency Group: G4 Systems Software
Competency Title: C17 Software Construction

Awareness	Basic	Intermediate	Advanced	Expert
	<ul style="list-style-type: none"> • Perform variability encapsulation to make the software assets easy to configure and customize • Perform software variability implementation with mechanisms such as parameterization, conditional compilation, design patterns, and so forth • Use existing software construction assets such as libraries, modules, components, source code, and commercial off-the-shelf (COTS), to solve different problems 			

Appendix R: KSABs for Software Engineering (C18) in DECF v. 1.1

Competency Group: G4 Systems Software				
Competency Title: C18 Software Engineering				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Execute given software test scripts under supervision Understand that the disciplinary engineer is a productive contributor to modeling tasks performed by a systems engineering team employing a model-based systems engineering approach Aware of the software development processes and software implementation plans 	<ul style="list-style-type: none"> Identify and report testing software issues and risks, associated with own work Interpret, execute and record software test cases in accordance with project test plans Perform software unit tests and integration tests throughout system lifecycle Receive and respond to routine requests for software security support Test the variability provided by reusable software assets 	<ul style="list-style-type: none"> Assist in the configuration of software and equipment and the systems testing of platform-specific versions of one or more software products Carry out agreed system software maintenance tasks Correct malfunctions on system installations Document software faults, implement resolutions and retest to agreed standards Use system management software and tools to collect agreed performance statistics 	<ul style="list-style-type: none"> Advise on the correct and effective use of system software Assess software-associated risk and specify recovery routines and contingency procedures Assist the user community in the provision of software transition support and change planning Conduct tests of hardware and/or software using supplied test procedures and diagnostic tools Configure software and equipment and test platform-specific versions of one or more software products Contribute to the development of software information assurance policies, standards and guidelines Coordinate and manage planning of the system software and/or acceptance tests, including software security testing, within a development or integration project or program 	<ul style="list-style-type: none"> Assess supplier's software development and testing capabilities Define software configurations required for testing with reference to agreed testing standards Determine software testing policy, and supports the software development processes including software security testing Ensure sites deliver site software implementation plans that align with the overall plan Lead complex software security investigations engaging additional specialists if required Manage all risks associated with software testing and take preventative action when any risks become unacceptable Ensure compliance between business strategies and software information security

Competency Group: G4 Systems Software
Competency Title: C18 Software Engineering

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • Ensure that operational documentation for system software is fit for purpose and current • Interpret, execute and document complex software test scripts using agreed methods and standards • Investigate and coordinate the resolution of potential and actual software service problems • Investigate software security breaches in accordance with established procedures and recommend required actions and support/ follow up to ensure these are implemented • Lead a team, by providing expert technical knowledge in the systems testing of platform-specific versions of the software products, on varying platforms • Plan the installation and testing of new versions of system software • Prepare and maintain operational documentation for system software 	<ul style="list-style-type: none"> • Manage complex software security investigations engaging additional specialists if required • Review new software application proposals and provide specialist advice on security issues and implications • Set policies, standards and guidelines for how an organization conducts software digital forensic investigations

Competency Group: G4 Systems Software
Competency Title: C18 Software Engineering

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • Process and analyze software security evidence in line with policy, standards and guidelines and support production of forensics findings and reports • Produce test scripts, materials and regression test packs to test new and amended software or services • Provide authoritative advice and guidance on any aspect of software test planning and execution tools • Provide reports on progress, anomalies, risks and issues associated with the overall software project • Provide software specialist advice to support others • Provide specialist guidance information to support systems software testing and quality assurance functions, to assist in improving procedures • Provide technical expertise to enable the correct application of software operational procedures 	

Competency Group: G4 Systems Software
Competency Title: C18 Software Engineering

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • Report the outcome of testing and identify potential improvements to the process and to the software products according to agreed designs and standards • Review system software updates and identify those that merit action • Specify requirements for software digital, data, resources and tools 	

Appendix S: KSABs for Digital Environment Development (C19) in DECF v. 1.1

Competency Group: G5 Digital Enterprise Environment				
Competency Title: C19 Digital Environment Development				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Describe the basic concept of digital engineering within a digital enterprise environment 	<ul style="list-style-type: none"> Contribute to setting digital application service level agreements Streamline contracting, procurement, legal, and business practices by transitioning to a model-based approach Relate the importance of a methodology to achieving digital engineering within a digital enterprise environment Utilize and provide feedback on the digital engineering methodologies Understand the definition of technical coherency. Understand the characteristics of technical coherency. Understand the challenges and benefits of developing a digital engineering ecosystem. Understand the components of the digital engineering ecosystem. 	<ul style="list-style-type: none"> Leverage technologies currently available in the marketplace, while finding high-payoff solutions for decision making in acquiring, deploying and maintaining the enterprise digital environment Review digital enterprise environment requirements and specifications, and define test conditions Ensure the digital enterprise environment supports evaluating concepts, engaging the user, and identifying tradeoffs using a digital representation of a system of interest 	<ul style="list-style-type: none"> 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 Assess supplier's digital environment development and testing capabilities Develop, mature, and implement digital enterprise environment tools 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 Contribute to the development of digital environment installation procedures and standards Develop, mature, and use digital engineering methodologies in place of document-based approaches 	<ul style="list-style-type: none"> Align the contribution of systems and services to clearly stated business and performance targets Create the business readiness plan, taking into consideration digital enterprise environment deployment, data migration, capability deployment (training and engagement activities) and any business activities required to integrate new digital processes or jobs into the business as usual environment Contribute to the development of digital enterprise environment organizational strategies that address the evolving business risk and information control requirements Create and maintain overall digital enterprise environment network plans to support the ...

Competency Group: G5 Digital Enterprise Environment

Competency Title: C19 Digital Environment Development

Awareness	Basic	Intermediate	Advanced	Expert
	<ul style="list-style-type: none"> • 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. • Understand how digital thread and digital twin work within the DE Ecosystem. • Understand the relationship between DE Ecosystem and data quality. • Understand the role of peer review and VV&A in the DE ecosystem. • Understand the VV&A applications for the DE Ecosystem. • Understand the authorities and recommended practices around VV&A in a DE Ecosystem. • Understand the MOSA and the implications for defining interfaces in a digital ecosystem. 		<ul style="list-style-type: none"> • Evaluate and identify digital engineering tools for stakeholders based on current and future needs • Determine the readiness levels of users with regard to upcoming changes in decision making for acquiring, deploying, and maintaining digital enterprise environment • 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 • Identify information and communication systems that support the digital enterprise environment processes and manage the relationship with specialists with authority for those systems • Lead multi-organizational level digital artifacts and digital enterprise environment infrastructure development efforts 	<ul style="list-style-type: none"> • (cont) organization's business strategy and service level agreements with customers • Establish a digital enterprise environment supporting infrastructure and environment to perform activities, collaborate, and communicate across stakeholders • Lead efforts to extending modeling penetration into new departments or product areas • Monitor emerging technologies which can be used to innovate and manage creativity in support of projects • Establish an end-to-end digital engineering enterprise by focusing on production, delivery and sustainment of the end item • Lead the development of digital enterprise environment organizational capabilities for methods and tools (including automation) to ensure adoption and adherence to policies and standards

Competency Group: G5 Digital Enterprise Environment

Competency Title: C19 Digital Environment Development

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • 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 • Produce specifications of cloud-based or on-premises components, tiers and interfaces, for translation into digital enterprise environment using selected services and products • Review digital enterprise environment related requirements and specifications, and define digital enterprise environment test conditions • Develop digital enterprise environment application installation procedures and standards 	<ul style="list-style-type: none"> • Provide hardware and software recommendations to perform digital enterprise environment activities • Review new digital enterprise environment-related software application procurement proposals and provide specialist advice on digital enterprise environment security issues and implications • Specify requirements for digital enterprise environment, data, resources and tools • Take responsibility for major aspects of digital enterprise environment network specification and design within the organization

Appendix T: KSABs for Management (C20) in DECF v. 1.1

Competency Group: G5 Digital Enterprise Environment				
Competency Title: C20 Management				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Describe how digital engineering tasks and products are incorporated into a contract Describe the risks and opportunities of using digital engineering 	<ul style="list-style-type: none"> Manage risks associated with digital enterprise environment testing and take preventative action when risks become unacceptable Explain the concept of authoritative source of truth 	<ul style="list-style-type: none"> Produce routine reports to assist in digital environment management activities and decision making 	<ul style="list-style-type: none"> Produce reports as appropriate for digital enterprise environment portfolio governance, including making recommendations for changes to the portfolio 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 Ensure the workforce has proper digital engineering qualifications Control digital enterprise environment assets in one or more significant areas, ensuring that administration of the acquisition, storage, distribution, movement and disposal of assets is carried out Coordinate information and media resources to meet specific digital thread ... 	<ul style="list-style-type: none"> Identify leadership teams (e.g., champions, sponsors, etc.) that are accountable to actively participate in managing and implementing the digital transformation efforts Lead the definition, implementation and review of the organization portfolio management for its digital engineering related framework Lead the on-going monitoring and review of digital engineering related portfolios for impact on current business activities and the strategic benefits to be realized 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 Implement effective digital enterprise environment portfolio governance ...

Competency Group: G5 Digital Enterprise Environment

Competency Title: C20 Management

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • (cont.) related objectives, while maintaining the professional standards and clarity of purpose throughout a project • Maintain and update content management processes to meet the needs of users including those with disabilities • Make decisions for changes to enterprise and project level digital enterprise environment relevant information • Support a model based culture and environment, leveraging capabilities of the digital enterprise environment infrastructure of the organization • Take responsibility for organization's digital engineering projects, providing effective team leadership, including information flow to and from team members during project work • Take responsibility for the design, procurement, installation, upgrading, operation, control, maintenance (including storage, modification and communication of data, ... 	<ul style="list-style-type: none"> • (cont.) arrangements supported by effective reporting, using results from model-based engineering methods and tools • Transform the culture by encouraging the workforce to develop and implement enterprise-wide digital enterprise environment strategies • Take full responsibility for decision making for acquiring, deploying, and maintaining the enterprise digital environment • Undertake and/or direct reviews as necessary to ensure management decision-making is transparent for acquiring, deploying, and maintaining enterprise digital environment, and that an appropriate balance between benefits, opportunities, costs and risks can be demonstrated to principal stakeholders

Competency Group: G5 Digital Enterprise Environment

Competency Title: C20 Management

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none">• voice, text, audio and images) and effective use of digital enterprise environment infrastructure components and monitors their performance	

Appendix U: KSABs for Communications (C21) in DECF v. 1.1

Competency Group: G5 Digital Enterprise Environment				
Competency Title: C21 Communications				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Describe the motivation for change within a digital engineering environment Communicate using digital model artifacts from the digital enterprise environment 	<ul style="list-style-type: none"> Communicate and share the digital modeling strategy for a specific project 	<ul style="list-style-type: none"> 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 Collate digital enterprise environment usage conclusions and recommendations and present lessons learned to stakeholders Define and communicate the digital modeling strategy for any given project 	<ul style="list-style-type: none"> Engage with and influence senior level stakeholders and project teams through digital enterprise environment management processes, ensuring that the infrastructure is managed to provide agreed levels of service and data integrity Inspire creativity and flexibility in the management and application of digital engineering related artifacts and projects 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

Competency Group: G5 Digital Enterprise Environment

Competency Title: C21 Communications

Awareness	Basic	Intermediate	Advanced	Expert
				<ul style="list-style-type: none"> • 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 • Evaluate new developments in the organization and the industry and advise senior management on digital enterprise environment potential growth, problem areas and resourcing needs

Appendix V: KSABs for Planning (C22) in DECF v. 1.1

Competency Group: G5 Digital Enterprise Environment				
Competency Title: C22 Planning				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Aware of the digital enterprise environment continuity management plan 	<ul style="list-style-type: none"> Participate in the coordination of the digital enterprise environment content management Understand the stakeholders that will be impacted by the switch to a digital ecosystem and the roles and responsibilities of these stakeholders. 	<ul style="list-style-type: none"> Coordinate digital enterprise environment content management processes to meet the needs of users, including those with disabilities Plan the digital enterprise environment infrastructure necessary to provide the digital application services to meet service level agreements 	<ul style="list-style-type: none"> Implement and contribute to the development of a digital enterprise environment continuity management plan Lead the development and implementation of a digital enterprise environment continuity management plan 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 	<ul style="list-style-type: none"> Authorize the structure of digital enterprise environment portfolios, and align digital enterprise environment with business strategy/objectives and emerging digital opportunities 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 Set strategy for monitoring and managing the performance of digital enterprise environment systems and services, in respect of their contribution to business performance and benefits to the business

Appendix W: KSABs for Digital Environment Operations (C23) in DECF v. 1.1

Competency Group: G5 Digital Enterprise Environment				
Competency Title: C23 Digital Environment Operations				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Follow digital enterprise environment procedures, including performing simple installations, replacing consumable items, checking correct working of installations, and documenting/reporting on work done Understand that as a model repository, the digital enterprise environment can be used as a single authoritative source of technical truth Understand established digital engineering publishing processes and dashboards used to distribute digital content (formally or informally) to interested stakeholders 	<ul style="list-style-type: none"> Adapt to changes in digital enterprise environment process or technology Identify digital environment related operational problems and contribute to their resolution, checking that they are managed in accordance with agreed standards and procedures Understand digital enterprise environment technical publication concepts, tools and methods and the way in which these are used Use organization's agreed to digital enterprise environment procedures to publish content, and create and maintain data records 	<ul style="list-style-type: none"> Carry out agreed upon operational procedures, including infrastructure configuration, installation, and maintenance Contribute to digital enterprise environment capacity modelling and planning Provide technical expertise to enable the correct application of digital enterprise environment operational procedures Configure digital engineering methods and tools to address the project needs Implement systems and controls for digital enterprise environment to measure performance and manage risk Use digital enterprise environment content publishing systems to manage published content across different channels 	<ul style="list-style-type: none"> Configure modeling tools to automate the provisioning, testing and deployment of new and changed digital enterprise environment infrastructure Ensure advanced modelling activities are used to create significant change in digital enterprise environment adoption across multiple organization functions Create digital modeling and simulation artifacts and technology roadmaps, and share knowledge and insights from processes and results, with others Define digital environment configurations required for testing with reference to agreed upon testing standards Ensure that digital information is presented effectively 	<ul style="list-style-type: none"> 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 Set parameters for the prioritization of digital resources and the changes to be implemented

Competency Group: G5 Digital Enterprise Environment

Competency Title: C23 Digital Environment Operations

Awareness	Basic	Intermediate	Advanced	Expert
		<ul style="list-style-type: none"> • Use standard procedures and tools to carry out defined digital enterprise environment system backups, restoring data where necessary • Provide support on the use of existing model-based engineering methods and tools 	<ul style="list-style-type: none"> • Provide expert technical knowledge in the systems testing of platform-specific versions of the digital enterprise environment products, on varying platforms • Perform digital enterprise environment activities related to administration of assets • 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 • 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 	

Appendix X: KSABs for Digital Environment Support (C24) in DECF v. 1.1

Competency Group: G5 Digital Enterprise Environment				
Competency Title: C24 Digital Environment Support				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Aware of the maintenance and support plans of the digital enterprise environment • Understand the tools, techniques, and processes to log, track, and report on configuration items, components, and changes. • Develop an understanding of the role of testing within system development, as a tool for design improvement as well as a verification process 	<ul style="list-style-type: none"> • Contribute to digital enterprise environment maintenance, installation and problem resolution • Initiate improvements to digital enterprise environment test processes and direct their implementation • Obtain and analyze digital enterprise environment usage data, and present it effectively • Ensure that project-specific needs are supported in the digital enterprise environment • Conduct tests on digital enterprise environment installations with guidance • Explain the validation and verification process of the digital model 	<ul style="list-style-type: none"> • Apply tools, techniques and processes to create and maintain an accurate digital enterprise environment register • Assess digital environment associated risks, and specify recovery routines and contingency procedures • Contribute to the planning and implementation of maintenance and installation of infrastructure components for virtualized environments • Contribute to the planning and implementation of maintenance and installation work, including building and configuration of infrastructure components in digital environments 	<ul style="list-style-type: none"> • Use appropriate digital enterprise environment tools, techniques, and proprietary guidelines to conform to application programming interface definitions for new or existing platforms and applications • Schedule and supervise all digital enterprise environment maintenance and installation work • Act to highlight and resolve potential instances of digital enterprise environment unauthorized usage such as unlicensed copies of software • Develop, mature, and implement methods and processes to support digital enterprise environment activities across the enterprise and lifecycle • Understand basic approaches for maintenance, installation, and problem resolution for digital environments • Create and maintain an inventory of information • ... 	<ul style="list-style-type: none"> • Extract information from digital enterprise environment as input to regulatory authorities • Contribute to the creation and maintenance of digital environment policy, standards, procedures and documentation for security • Determine digital environment testing policies, including processes related to security • Evaluate new digital environment developments in the organization, and the industry and advise senior management on potential growth, problem areas and resourcing needs • Investigate and coordinate the resolution of potential and actual digital enterprise environment service problems • Lead and manage investigations into complex digital enterprise environment issues, engaging additional specialists if required

Competency Group: G5 Digital Enterprise Environment

Competency Title: C24 Digital Environment Support

Awareness	Basic	Intermediate	Advanced	Expert
		<ul style="list-style-type: none"> • 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 • Correct digital environment malfunctions, calling on other experienced colleagues and external resources if required • Identify potential hazards or risks related to the use of digital enterprise environment tools and equipment • 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 • Maintain accurate records of various metrics related to digital artifacts and digital enterprise environment infrastructure 	<ul style="list-style-type: none"> • (cont.) assets, which are subject to relevant external oversight • Analyze and implement technological innovations in digital environment to enable end-to-end digital enterprise • Develop digital enterprise environment installation procedures and standards, and schedule installation work • Document digital environment related faults, implement resolutions and retest to agreed standards • Draft and maintain standards and procedures for digital enterprise environment component capacity management • Identify and analyze problems and issues with decision making for acquiring, deploying, and maintaining enterprise digital environment and recommend corrective actions. • Implement agreed upon digital enterprise environment infrastructure changes and maintenance routines 	<ul style="list-style-type: none"> • Lead the establishment and maintenance of consistent and integrated approach to digital enterprise environment governance in line with the organization's corporate governance requirements • Measure and monitor adherence to standards and ensure consistent execution of the digital enterprise environment processes across the organization • Establish accountability to measure, foster, demonstrate, and improve tangible results of digital engineering across programs and the enterprise • 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 • Provide authoritative advice and guidance on any aspect of digital environment test planning and execution

Competency Group: G5 Digital Enterprise Environment

Competency Title: C24 Digital Environment Support

Awareness	Basic	Intermediate	Advanced	Expert
		<ul style="list-style-type: none"> • Provide assistance to digital enterprise environment users following agreed upon procedures for further help or escalation • Maintain and troubleshoot digital enterprise environment tools and technologies • 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 • 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) • Analyze and report test activities and results using model-based engineering methods and tools • Understand the specific definition of verification regarding DE. 	<ul style="list-style-type: none"> • 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 • Manage digital enterprise environment capacity modelling and forecasting activities • 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 • Produce reports and analysis to support digital enterprise environment asset management activities and aid decision making • Provide reports on progress, anomalies, risks, and issues associated with a digital enterprise environment modeling project 	<ul style="list-style-type: none"> • 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 • Provide reports and proposals for digital enterprise environment improvement, to specialists, users, and managers • Report on digital enterprise environment portfolio status as appropriate • Review information, in conjunction with service level agreements, to identify any digital enterprise environment capacity issues and specify any required changes

Competency Group: G5 Digital Enterprise Environment

Competency Title: C24 Digital Environment Support

Awareness	Basic	Intermediate	Advanced	Expert
		<ul style="list-style-type: none"> • Understand the specific definition of validation with regard to DE. • Understand the use of a digital ecosystem for VV&A of the system. • Verify that products developed are aligned with the review and/or analysis 	<ul style="list-style-type: none"> • Provide specialist guidance information to support digital enterprise environment systems testing and quality assurance functions, to assist in improving procedures • Undertake routine installations and de-installations of digital enterprise environment items of hardware and/or software • Use infrastructure management tools to determine digital enterprise environment load and performance statistics • Oversee maintenance, installation, and problem resolution for digital enterprise environment • Configure digital enterprise environment tools to maintain records of user requests, contact details, and outcomes • Extend the digital enterprise environment model to define test strategies or cases • Verify digital model using digital thread • Verify system model for the technical authority 	

Appendix Y: KSABs for Digital Environment Security (C5) in DECF v. 1.1

Competency Group: G5 Digital Enterprise Environment				
Competency Title: C25 Digital Environment Security				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Understand digital enterprise environment access and controls for the authoritative source of truth in the digital enterprise environment • 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 • Maintain relevant records and documentation on digital enterprise environment security administration tasks • Perform simple digital enterprise environment security administration tasks • Receive and respond to routine digital enterprise environment requests for security support 	<ul style="list-style-type: none"> • Assist in the investigation and resolution of issues relating to access controls and security systems • Develop policies, standards, processes, and guidelines for ensuring the physical and electronic security of digital environments 	<ul style="list-style-type: none"> • Assist users in defining their access rights and privileges • Interpret digital enterprise environment information assurance and security policies and apply these to appropriately manage risks • Perform non-standard digital enterprise environment security administration tasks and resolve security administration issues • Provide advice and guidance to ensure adoption of and adherence to digital enterprise environment information assurance architectures, strategies, policies, standards and guidelines • Apply and maintain specific security controls as required by organizational policy and local risk assessments • Perform basic risk assessments for digital enterprise environment information systems 	<ul style="list-style-type: none"> • Contribute to development of information security policy, standards, and guidelines • Contribute to the creation and maintenance of policy, standards, procedures, and documentation for security • Develop corporate information assurance policy, standards, and guidelines • Obtain and act on vulnerability information and conduct security risk assessments, business impact analysis and accreditation on digital enterprise environment • Perform security risk, vulnerability assessments, and business impact analysis for digital enterprise environment • 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 	<ul style="list-style-type: none"> • Develop and communicate corporate information security policy, standards, and guidelines • Develop policies, standards, processes, and guidelines for ensuring the physical and electronic security of automated systems • 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 • Ensure that all identified breaches in digital environment security are promptly and thoroughly investigated and that any changes required to maintain security are implemented • Ensure that the digital environment policy and standards for security ...

Competency Group: G5 Digital Enterprise Environment

Competency Title: C25 Digital Environment Security

Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Secure digital enterprise environment infrastructure and protect intellectual property 		<ul style="list-style-type: none"> Use digital testing methods to support digital enterprise environment information assurance 	<ul style="list-style-type: none"> Ensure that digital environment security records are accurate and complete and that requests for support are dealt with according to set standards and procedures Ensure that digital enterprise environment security records are accurate and complete and that request for support are dealt with according to set standards and procedures Investigate digital enterprise environment security breaches in accordance with established procedures and recommend required actions and support/follow up to ensure these are implemented Assess impact of suspected cyber-attacks and manage security incidents, supporting digital enterprise environment digital forensics where appropriate Maintain digital enterprise environment security administration processes and check that all requests for support are dealt with according to agreed procedures 	<ul style="list-style-type: none"> (cont.) administration are fit for purpose, current and are correctly implemented Ensure that the policy and standards for digital enterprise environment security administration are fit for purpose, current and are correctly implemented Direct the development, implementation, delivery and support of an digital enterprise environment information security strategy aligned to the strategic requirements of the business 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 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

Competency Group: G5 Digital Enterprise Environment

Competency Title: C25 Digital Environment Security

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • Monitor the application and compliance of digital enterprise environment security administration procedures and review information systems for actual or potential breaches in security • 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 • Provide advice and guidance on digital enterprise environment-based security strategies to manage identified risks and ensure adoption of IT-industry standard processes • Provide guidance in defining digital enterprise environment access rights and privileges • Provide secure connected information network recommendations to perform digital enterprise environment activities 	<ul style="list-style-type: none"> • Set policies, standards and guidelines for how the organization conducts digital enterprise environment digital forensic investigations • Establish digital enterprise environment access and controls for the authoritative source of truth

Appendix Z: KSABs for Digital Literacy (F1) in DECF v. 1.1

Competency Group: Foundational Digital Competencies				
Competency Title: F1 Digital Literacy				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Use established publishing processes according to appropriate guidelines, for example, to release, retire or convert content into a format suitable for publication • Follow digital engineering procedures, including performing simple installations, replacing consumable items, checking correct working of installations, and documenting/reporting on work done • Understand that as a model repository, the digital engineering framework can be used as a single authoritative source of technical truth • Understands that rationale is an important characteristic 	<ul style="list-style-type: none"> • Act as a contributor to modeling tasks on a design engineering team • Apply modeling tasks employing a model-based systems engineering approach • Define test conditions for given requirements • Describe digital artifacts' contribution to the following engineering concepts: Systems of Systems (SoS), program interoperability, and modularity • Describe how digital artifacts advance the state of practice of Digital Engineering • Describe the motivation for change within a DE environment • Describe the purpose of different stakeholder views • Document results in accordance with agreed procedures • Establish access and controls for the authoritative source of truth 	<ul style="list-style-type: none"> • Capture stakeholder high-level requirements • Communicate information security risks and issues to business managers and others • Coordinate content management processes to meet the needs of users, including those with disabilities • Maintain accurate records of user requests, contact details and outcomes • Provide advice and guidance to ensure adoption of and adherence to information assurance architectures, strategies, policies, standards and guidelines • Respond to security breaches in line with security policy and record the incidents and action taken • Review the architectural products created by others • Submit waivers and deviations for approval 	<ul style="list-style-type: none"> • Advise on the choice of techniques and approach and influence customers accordingly • Collate conclusions and recommendations and present forensics findings to stakeholders • Conduct investigations to correctly gather, analyse and present the totality of findings, including digital evidence - to both business and legal audiences • Conduct technical reviews on a continuous basis, especially as the technical baseline matures, to produce digital artifacts and inform decisions • Coordinate information resources to meet specific business objectives whilst maintaining the principles of professional standards, accountability, openness, equality, diversity and clarity of purpose • Create and maintain an inventory of information assets, which are subject to relevant legislation 	<ul style="list-style-type: none"> • 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 • Act as a chief architect for a system-of-systems or mission level analysis across multiple system commands or services • Act as the organization's contact for relevant regulatory authorities • Approve architecture products as the technical authority • Authorize program integrated architectures for release outside of the system command • Communicate and execute the digital engineering vision, strategy, and implementation by providing a mechanism for people to ask questions and provide feedback

Competency Group: Foundational Digital Competencies

Competency Title: F1 Digital Literacy

Awareness	Basic	Intermediate	Advanced	Expert
	<ul style="list-style-type: none"> • Explain the difference in stakeholder views • Maintain records and advise relevant persons of actions taken • Perform digital engineering activities related to administration of assets • Relate the importance of a methodology to achieving Digital Engineering • Understand technical publication concepts, tools and methods and the way in which these are used • Use agreed on procedures to create and maintain an accurate register of assets • Use agreed procedures to publish content 	<ul style="list-style-type: none"> • Take into account any legal issues related to publishing, including that associated copyright concerns are adequately managed • Use content publishing systems to manage published content across different channels • Use digital artifacts to advance the state of practice of Digital Engineering 	<ul style="list-style-type: none"> • Create reports and technology roadmaps, and share knowledge and insights with others • Define and communicate the test strategy for the project • Develop and implement quality plans and method statements • Draft and maintain standards and procedures for service component capacity management • Ensure asset controllers, infrastructure teams and the business coordinate and optimize value, maintain control and maintain appropriate legal compliance • Explain the purpose of and provide advice and guidance on the application and operation of elementary physical, procedural and technical security controls • Identify information and communication systems that support the critical business processes and manage the relationship with specialists with authority for those systems • Identify the implications of copyright, data protection and other legal issues associated with publishing 	<ul style="list-style-type: none"> • 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 • Define metrics and the criteria for success, as a means to create incentives, monitor, reward, take corrective action, and improve results across the digital enterprise • 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 • Develop configuration management strategies, policies, standards, and guidelines • Develop new methods and organizational capabilities (including automation) for configuration management • Develop organizational guidelines for monitoring emerging technologies

Competency Group: Foundational Digital Competencies

Competency Title: F1 Digital Literacy

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • Identify, assess and communicate associated risks related to asset management • Investigate major breaches of security, and recommend appropriate control improvements • Investigate suspected attacks and manage security incidents, using digital forensics where appropriate • Lead a multi-organizational level system model development • Lead multi-organizational level architecture development efforts • Manage client relationships with respect to testing matters • Manage large programs • Monitor the effectiveness of installations and ensure that appropriate recommendations for change are made • Obtain and act on vulnerability information and conduct security risk assessments, business impact analysis and accreditation on complex information systems • Obtain input from, and communicates modelling results to, senior managers for agreement 	<ul style="list-style-type: none"> • Develop organizational policies, standards, and guidelines for data management, aligned with ethical principles • Develop organizational policies, standards, and guidelines for information and records management ensuring that uniformly recognised and accepted data definitions are developed and applied throughout the organization • Develop policy and strategies to ensure all the performance measures of IT services meet the needs of the business and performs to any service requirements or service level agreements which may be in place • 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 • Engage with, and influence, relevant stakeholders to obtain organizational commitment to technology roadmaps

Competency Group: Foundational Digital Competencies

Competency Title: F1 Digital Literacy

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • Perform security risk, vulnerability assessments, and business impact analysis for medium complexity information systems • Plan effective data storage, sharing and publishing within the organization • Plan large programs • Play a leading role in establishing SysML-based MBSE at an enterprise • Produce and analyze registers and histories of authorised 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 • Propose and agree on the configuration items (CIs) to be uniquely identified with naming conventions • Provide advice and guidance on security strategies to manage identified risks and ensure adoption and adherence to standards • Provide specialist advice to those accountable for governance to correct compliance issues 	<ul style="list-style-type: none"> • 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 information and information systems • Ensure that a framework of policies, standards, process 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 • 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 • Ensure that any legal issues related to publishing, including associate copyright concerns, are adequately managed

Competency Group: Foundational Digital Competencies

Competency Title: F1 Digital Literacy

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • Provide specialist expertise in the design characteristics of database management systems (DBMS) or data warehouse products/services • Report on the status of configuration management • 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 • Review the benefits and value of digital engineering methods and tools • Schedule and supervise all IT maintenance and installation work • 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 	<ul style="list-style-type: none"> • Ensure that the business processes and information required to support the organization are defined, and devise appropriate processes and data architectures • Establish a supporting infrastructure and environment to perform activities, collaborate, and communicate across stakeholders • Establish and communicate the organization's information management strategy, developing it as an integral part of the business strategy • 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 • Establish new projects and support them through their lifecycle • Formalize the application of models to support system requirements, design, analysis, ...

Competency Group: Foundational Digital Competencies

Competency Title: F1 Digital Literacy

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • Support a change program or project through the preparation of technical plans and application of design principles that comply with enterprise and solution architecture standards (including security) • Support a systems modeling culture and environment, leveraging the capabilities of the organization • Take responsibility for installation projects, providing effective team leadership, including information flow to and from the customer during project work 	<ul style="list-style-type: none"> • (cont.) verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases • Inspire creativity and flexibility in the management and application of IT • 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 • Lead the establishment of modeling-language-based MBSE at an enterprise level • 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

Competency Group: Foundational Digital Competencies

Competency Title: F1 Digital Literacy

Awareness	Basic	Intermediate	Advanced	Expert
				<ul style="list-style-type: none"> • 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 • Manage client relationships with respect to all testing matters • Measure and monitor adherence to standards and ensure consistent execution of the process across the organization • Outline key business engagement messages that need to be communicated throughout the program/project • Plan, establish and manage processes for regular and consistent access to, and independent validation of external information from multiple sources • Produce network design policies, philosophies and criteria covering connectivity, capacity, interfacing, security, resilience, recovery, access and remote access • Promote awareness of, and commitment to, asset control

Competency Group: Foundational Digital Competencies

Competency Title: F1 Digital Literacy

Awareness	Basic	Intermediate	Advanced	Expert
				<ul style="list-style-type: none"> • Promote the continuing economic and effective provision of services, ensuring that all changes to assets and services are appropriately and accurately controlled and recorded • Provide assurance to principal stakeholders that IT services meet the organization's obligations (including legislation, regulatory, contractual and agreed standards/policies) • Provide guidance in defining access rights and privileges • Provide information and advice on issues such as maintenance of hardware assets, licensing of software, protection of intellectual property, and legal obligations • Provide resources to drive adoption of, and adherence to, policies and standards • Represent own organization as a modelling expert in industry initiatives • Responsible for compliance with regulations, standards and codes of good practice relating to information and ...

Competency Group: Foundational Digital Competencies

Competency Title: F1 Digital Literacy

Awareness	Basic	Intermediate	Advanced	Expert
				<ul style="list-style-type: none"> • (cont.) documentation, records management, information assurance and data protection • Review information, in conjunction with service level agreements, to identify any capacity issues and specify any required changes • Review new business proposals and provide specialist advice on capacity issues • Take overall responsibility for planning effective data storage, security, quality, sharing, availability, retention and publishing within the organization

Appendix AA: KSABs for Digital Engineering Value Proposition (F2) in DECF v. 1.1

Competency Group: Foundational Digital Competencies				
Competency Title: F2 Digital Engineering Value Proposition				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Understand the benefits of working in a digital engineering environment (more efficient and effective). Understand the definition of digital engineering. 	<ul style="list-style-type: none"> 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 Understand digital engineering guidance, capabilities, benefits, roles, responsibilities, and activities. Understand the benefits of digital engineering and the laws that support digital engineering. Understand the benefits of implementing a digital engineering ecosystem: traceability, digital data, 	<ul style="list-style-type: none"> Understand the limitations of current document-based engineering acquisition practices. Understand the challenges of current document-based acquisition system (linear, inefficient). Understand how digital engineering can reduce program risk. 		

Competency Group: Foundational Digital Competencies
Competency Title: F2 Digital Engineering Value Proposition

Awareness	Basic	Intermediate	Advanced	Expert
	<p>MPTs, historical systems information, authoritative source of truth, digital thread, documents generated from environment, not by hand.</p> <ul style="list-style-type: none"> • Understand the "community acceptance" model, which includes review, V&V, and accreditation to create credibility and trust. • Understand the elements of trust in the community acceptance model (context, governance, accuracy, applicability of MPTs, community buy-in). • Understand the role of stakeholder engagement in building trust in the DE ecosystem. 			

Appendix AB: KSABs for DoD Policy/Guidance (F3) in DECF v. 1.1

Competency Group: Foundational Digital Competencies				
Competency Title: F3 DoD Policy/Guidance				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Ensure the correct implementation of standards and procedures in digital enterprise environment projects • Understand DoD policy and guidance about models, simulations, and DE in the context of SE • Understand why the DoD is interested in digital engineering 				<ul style="list-style-type: none"> • Establish formal guidance for the system model and architectural design within a command (e.g., Command Style Guide, command policy, handbooks)

Appendix AC: KSABs for Coaching and Mentoring (F4) in DECF v. 1.1

Competency Group: Foundational Digital Competencies				
Competency Title: F4 Coaching and Mentoring				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> Secure a mentor to seek guidance and advice in the digital engineering environment 	<ul style="list-style-type: none"> Obtain personal coaching and training to improve in systems modeling and analysis 	<ul style="list-style-type: none"> Mentor basic practitioners in systems modeling and analysis Coach basic practitioners in systems modeling and analysis 	<ul style="list-style-type: none"> Coach intermediate practitioners in systems modeling and analysis Guide supervised practitioners in modeling and systems analysis Mentor intermediate practitioners in systems modeling and analysis 	<ul style="list-style-type: none"> Coach advanced practitioners in systems modeling and analysis Mentor advanced practitioners in systems modeling and analysis

Appendix AD: KSABs for Decision Making (F5) in DECF v. 1.1

Competency Group: Foundational Digital Competencies				
Competency Title: F5 Decision Making				
Awareness	Basic	Intermediate	Advanced	Expert
	<ul style="list-style-type: none"> Leverage technologies currently available in the marketplace, while finding high-payoff solutions 	<ul style="list-style-type: none"> Use technological innovations to improve decision making, system capabilities, and performance of computationally intensive engineering activities Identify potential hazards or risks related to the use of tools and equipment Interpret information assurance and security policies and applies these in order to manage risks Interpret installation standards to meet project needs and produce database or data warehouse component specifications Produce routine reports to assist asset management activities and decision making 	<ul style="list-style-type: none"> Provide reports on the consolidated status of information controls to inform effective decision making Contribute to development of policy, standards and procedures for compliance with relevant legislation Contribute to organizational policies, standards, and guidelines for methods and tools Contribute to the development of analytics policy, standards and guidelines Determine the readiness levels of business users with regard to upcoming changes Ensure that operational procedures and working practices are fit for purpose and current Identify problems and issues and recommend corrective actions Make decisions based on that information, including the need to make changes to the systems Manage and maintain the 	<ul style="list-style-type: none"> Authorize allocation of resources for the planning, development and delivery of all information systems services and products Authorize organizational policies governing the conduct of management of change initiatives and standards of professional conduct Authorize the release of formal forensics reports Authorize the structure of portfolios, and be responsible for alignment with business strategy/objectives and with emerging IT and digital opportunities Determine project testing standards for all phases, influencing all parties to conform to those standards Ensure that the policies and standards for capacity management are fit for purpose, current and are correctly implemented Establish the appropriate guidance to enable transparent decision-making to be

Competency Group: Foundational Digital Competencies

Competency Title: F5 Decision Making

Awareness	Basic	Intermediate	Advanced	Expert
			<p>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</p> <ul style="list-style-type: none"> • Produce reports and analysis to support asset management activities and aid decision making 	<p>demonstrated, working with senior leaders to ensure the needs of 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</p> <ul style="list-style-type: none"> • Initiate assessment of consequences and risks arising from decisions to obtain, change or continue the possession or use of an asset, system or service • Maintain an overview of the contribution of programs to organizational success • Monitor performance and take corrective action where necessary and in line with policies • Plan and manage implementation of processes and procedures, tools and techniques for monitoring and managing the performance of

Competency Group: Foundational Digital Competencies

Competency Title: F5 Decision Making

Awareness	Basic	Intermediate	Advanced	Expert
				automated systems and services <ul style="list-style-type: none"> • Take full responsibility for budgeting, estimating, planning and objective setting • 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

Appendix AE: KSABs for Software Literacy (F6) in DECF v. 1.1

Competency Group: Foundational Digital Competencies				
Competency Title: F6 Software Literacy				
Awareness	Basic	Intermediate	Advanced	Expert
<ul style="list-style-type: none"> • Contribute, under supervision, to infrastructure operation • Develop an understanding of the role of testing within system development, as a tool for design improvement as well as a validation process • Execute given test scripts under supervision • Knowledge of algorithms and of coding practices • Maintain relevant records and documentation on security administration tasks • Perform simple security administration tasks • Secure IT infrastructure and protect intellectual property 	<ul style="list-style-type: none"> • Adapt quickly to changes in process or technology • Assist with the evaluation of change requests • Conduct tests and correct malfunctions on system installations • Contribute to maintenance, installation and problem resolution • Contribute, as required, to investigations of problems and faults concerning the installation of hardware and/or software and confirms the correct working of installations • Identify and report testing issues and risks, associated with own work • Interpret, execute and record test cases in accordance with project test plans • Obtain and analyze usage data, and present it effectively • Perform variability implementation with mechanisms such as ... 	<ul style="list-style-type: none"> • Apply tools, techniques and processes to create and maintain an accurate asset register • Apply tools, techniques and processes to track, log and correct information related to configuration items • Construct software for verification by building in such a way that faults can be easily found by software engineers writing the software, and testers and users during their independent testing and operational activities • Contribute to the development of installation procedures and standards • Contribute to the implementation of maintenance and installation work • Contribute to vulnerability assessments • Document faults, implement resolutions and retest to agreed standards 	<ul style="list-style-type: none"> • Act to highlight and resolve potential instances of unauthorized assets such as unlicensed copies of software • Assess associated risks, and specify recovery routines and contingency procedures • Assess proposed changes to object/data structures, in order to evaluate alternative options • Assist the user community in the provision of transition support and change planning, and liaises with the project team • Contribute to digital forensic investigations • Contribute to setting service level agreements, and plan the infrastructure necessary to provide the network services to meet such agreements • Contribute to the development of information assurance policies, standards and guidelines 	<ul style="list-style-type: none"> • Ensure the availability of hardware, software, and resources for the systems testing of platform specific versions of one or more software products • Assess suppliers' development and testing capabilities • Contribute to the development of organizational strategies that address information control requirements • Contribute to the development of organizational strategies that address the evolving business risk and information control requirements • Create and maintain overall network plans to support the organization's business strategy and service level agreements with customers • Define configurations required for testing with reference to agreed testing standards

Competency Group: Foundational Digital Competencies

Competency Title: F6 Software Literacy

Awareness	Basic	Intermediate	Advanced	Expert
	<ul style="list-style-type: none"> • (cont.) parameterization, conditional compilation, and design patterns • Receive and respond to routine requests for security support 	<ul style="list-style-type: none"> • Install or remove hardware and/or software, and associated connections, using supplied installation instructions and tools, and where appropriate, handover to the client • Perform non-standard security administration tasks and resolve security administration issues • Provide assistance to users in a professional manner following agreed upon procedures for further help or escalation • Report details of all hardware/software items that have been installed and removed so that configuration management records can be updated • Review requirements and specifications, and define test conditions • Understand the capabilities and the requirement sets within modeling and simulation software • Use infrastructure management tools to collect and report on load and performance statistics and to automate the provisioning, testing and 	<ul style="list-style-type: none"> • Contribute to the planning and implementation of maintenance and installation work, including building and configuration of infrastructure components in virtualized environments • 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 • Coordinate and manage planning of the system and/or acceptance tests, including software security testing, within a development or integration project or program • Correct malfunctions, calling on other experienced colleagues and external resources if required • Create and maintain network plans for own area of responsibility • Develop installation procedures and standards, and schedule installation work 	<ul style="list-style-type: none"> • Determine testing policy, and owns the supporting processes including software security testing • Ensure sites deliver site implementation plans that align with the overall plan • Ensure that the policy and standards for security administration are fit for purpose, current and are correctly implemented • Evaluate new developments in the organization and the industry and advise senior management on potential growth, problem areas and resourcing needs • Lead complex investigations engaging additional specialists if required • Manage all risks associated with the testing and take preventative action when any risks become unacceptable • Manage complex investigations engaging additional specialists if required • Plan all aspects of the infrastructure necessary to

Competency Group: Foundational Digital Competencies

Competency Title: F6 Software Literacy

Awareness	Basic	Intermediate	Advanced	Expert
		<p>deployment of new and changed infrastructure</p> <ul style="list-style-type: none"> • Use standard procedures and tools to carry out defined system backups, restoring data where necessary 	<ul style="list-style-type: none"> • Develop the capabilities and the requirement sets within modeling and simulation software • Document details of all hardware/software items that have been installed and removed so that configuration management records can be updated • Ensure that all identified breaches in security are promptly and thoroughly investigated and that any system changes required to maintain security are implemented • Ensure that security records are accurate and complete and that request for support are dealt with according to set standards and procedures • Identify operational problems and contribute to their resolution, checking that they are managed in accordance with agreed standards and procedures • Implement agreed on infrastructure changes and maintenance routines • Install and test new versions of system software 	<p>ensure provision of network services to meet organization's business strategy and service level agreements with customers</p> <ul style="list-style-type: none"> • Provide hardware and software to perform digital engineering activities • Provide secure connected information networks to perform digital engineering activities • Provide technical management of an IT operation, ensuring that agreed service levels are met and all relevant policies and procedures are adhered to • Set policies, standards and guidelines for how the organization conducts digital forensic investigations • 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

Competency Group: Foundational Digital Competencies

Competency Title: F6 Software Literacy

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • Interpret, execute and document complex test scripts using agreed methods and standards • Investigate and coordinate the resolution of potential and actual service problems • Investigate security breaches in accordance with established procedures and recommend required actions and support/follow up to ensure these are implemented • Maintain security administration processes and check that all requests for support are dealt with according to agreed procedures • Monitor the application and compliance of security administration procedures and review information systems for actual or potential breaches in security • Process and analyze evidence in line with policy, standards and guidelines and support production of forensics findings and reports 	<ul style="list-style-type: none"> • Take responsibility for major aspects of network specification and design within the organization

Competency Group: Foundational Digital Competencies

Competency Title: F6 Software Literacy

Awareness	Basic	Intermediate	Advanced	Expert
			<ul style="list-style-type: none"> • Produce outline system designs and specifications, and overall architectures, topologies, configuration databases and design documentation of networks and networking technology within the organization • Produce specifications of cloud-based or on-premises components, tiers and interfaces, for translation into detailed designs using selected services and products • Provide authoritative advice and guidance on any aspect of test planning and execution • Provide reports and proposals for improvement, to specialists, users and managers • Provide reports on progress, anomalies, risks and issues associated with the overall project • Provide specialist advice to support others • Provide specialist guidance and advice to less experienced colleagues to ensure best use is made of available assets, and to 	

Competency Group: Foundational Digital Competencies

Competency Title: F6 Software Literacy

Awareness	Basic	Intermediate	Advanced	Expert
			maintain or improve the installation service <ul style="list-style-type: none"> • Provide specialist guidance information to support systems testing and quality assurance functions, to assist in improving procedures • Provide technical expertise to enable the correct application of operational procedures • Specify requirements for environment, data, resources and tools • Undertake routine installations and de-installations of items of hardware and/or software • Use infrastructure management tools to determine load and performance statistics 	