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WRT-1006 Technical Report: Developing the Digital Engineering Competency Framework (DECF), Version 1.0

Hutchison, Nicole; Pepe, Kara; Blackburn, Mark; Verma, Dinesh; Kruse, Benjamin; Whitcomb, Cliff; Khan, Rabia; Peak, Russell; Baker, Adam; Wade, Jon...

Systems Engineering Research Center (SERC)

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Authors:

Nicole Hutchison, Kara Pepe, Mark Blackburn	Stevens Institute of Technology
Dinesh Verma, Benjamin Kruse	
Cliff Whitcomb, Rabia Khan	Naval Postgraduate School
Russell Peak, Adam Baker	Georgia Tech
Jon Wade	University of California, San Diego

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Executive Summary

Digital engineering 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] Digital transformation is fundamentally changing the way acquisition and engineering are per-formed 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.

The purpose of the Digital Engineering Competency Framework (DECF) is to provide clear guidance for the DoD acquisition workforce, in particular the engineering (ENG) acquisition workforce, through clearly defined competencies that illuminate the knowledge, skills, abilities, and behaviors (KSABs) required for digital engineering professionals. There are 5 competency groups and 22 competencies identified for the DECF v. 1.0 as shown in Figure 1.
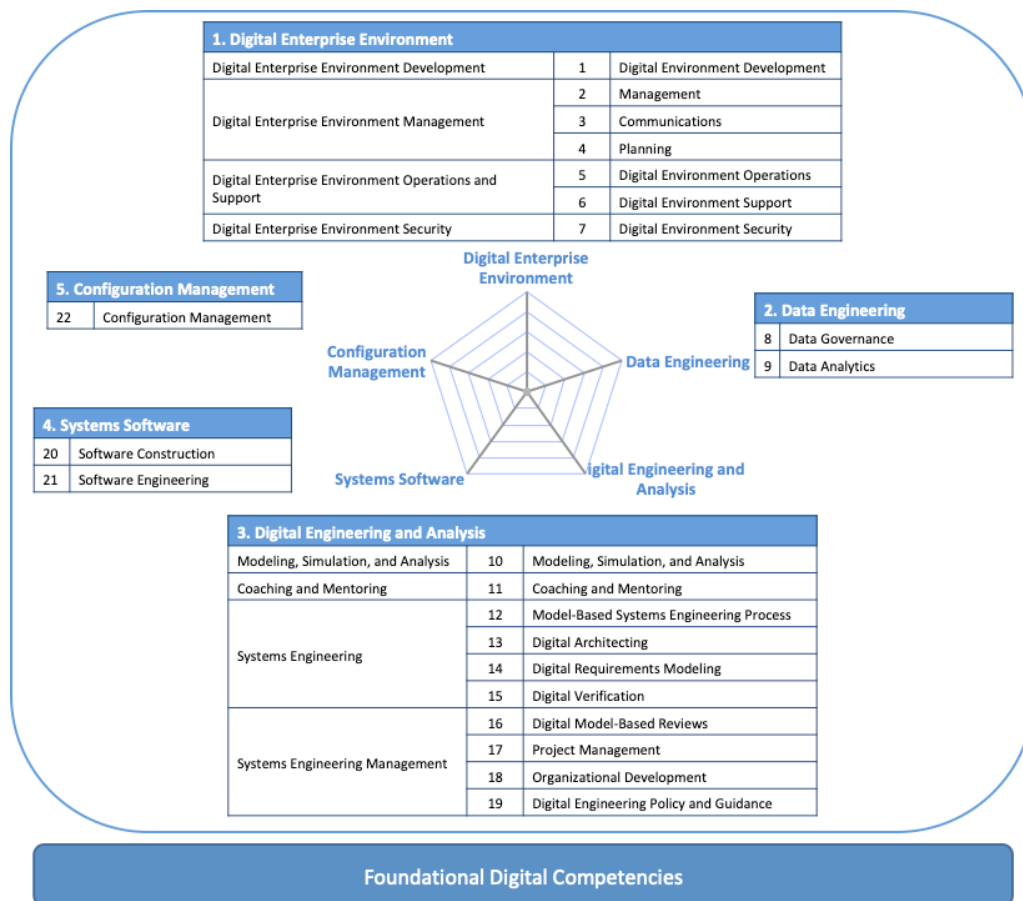
Figure 1. Structure of the DECF v. 1.0.

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

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 digital engineering.

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

- Digital Enterprise Environment Development addresses development of the digital engineering 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 and techniques and processes for the operation of digital enterprise environment systems to 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.
- Data Engineering, which includes data governance and analytics, incorporates model-based processes which help to ensure the formal management of data assets within a digital enterprise.
- Digital Engineering and Analysis includes modeling, simulation, and analysis, systems engineering and systems engineering management which constitute the means by which digital engineering takes full advantage of the digital power of computation, visualization and communication to take better, faster actions throughout the defense system lifecycle.
- Systems Software is the systemic application of digital engineering approaches to the development of software.
- Configuration Management refers to the development of strategies, policies, standards, and guidelines for configuration management of digital engineering related artifacts in accordance with model-based systems engineering methods.

These competencies are built on a foundation of digital competencies (formerly called "Digital Literacy") that are required to operate effectively in a digital environment.

Going forward, the team will analyze the current Defense Acquisition University Engineering (ENG) curriculum against the DECF. The goals are 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 curriculum.

The DECF may be updated to reflect learning that occurs during this future work.

1. Introduction – Digital Transformation

Digital transformation is fundamentally changing the way acquisition and engineering are per-formed 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.

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]

Evidence across the Services and industry has affirmed digital engineering 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 US Department of Defense (DoD) must continue to practice systems engineering efficiently and effectively to provide the best advantage for successful acquisitions and sustainment. Digital engineering 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 life cycle.

The purpose of the Digital Engineering Competency Framework (DECF) is to provide clear guidance for the DoD acquisition workforce, in particular the engineering (ENG) acquisition workforce, through clearly defined competencies that illuminate the knowledge, skills, abilities, and behaviors (KSABs) required for digital engineering 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 digital engineering.

1.1 Digital Engineering Strategy

In June 2018, the Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)) released a Digital Engineering Strategy, which outlines the vision for digital engineering (DE) and five major goals of the transition to a digitally based engineering and acquisition approach (DoD 2018). The DoD defines digital engineering 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). The five goals described in the Digital Engineering Strategy, necessary for a DE ecosystem to thrive, 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.

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

1.2 Digital Transformation

As the DoD transitions to digital engineering, there is a need to develop and maintain an acquisition workforce and culture that is literate in model-based engineering, competent in digital engineering models, methods, tools, and understands digital artifacts across the acquisition lifecycle. This is significant as digital engineering impacts how engineers and the acquisition workforce will perform their job functions, the digital artifacts delivered, and their interaction and sharing of information either locally or in a distributed manner.

There are a number of initiatives in the DoD to support progress toward these goals. In order to succeed in digital engineering, 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. This research is expected to develop a DECF that will:

- Define the critical knowledge, skills, abilities, and behaviors (competencies) required to implement digital engineering approaches;
- Highlight 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;
- Provide the basis for ensuring the acquisition workforce has the appropriate competencies to work within the envisioned digital environment.

There are already a number of competency models that are relevant to related disciplines, such as systems engineering and mission engineering, as well as competency models in use within the DoD for various acquisition career fields. These provide a foundation for the DECF. In addition, the team is working with thought leaders and current practitioners in DoD acquisition workforce to identify critical activities and skillsets. (See 'Research Approach' for details).

1.3 This Report

- Section 2 provides the methodology and approaches used to develop the DECF
- Section 3 provides context of digital engineering activities
- Section 4 lays out the structure of the DECF
- Section 5 provides conclusions and outlines future work and
- Appendices contain tables for all KSABs within the DECF.

2. Developing the DECF

DoD Instruction 1400.25, volume 250, "DoD Civilian Personnel Management Systems: Civilian Strategic Human Capital Planning", outlines 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.

The DECF 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.

The overarching structure of the DECF will consist of competency groups, competencies, proficiency levels in the competency, and constituting KSABs:

- Competency Group – Top-level grouping of related competencies that represents a core area of expertise in digital engineering;

- 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.

- Proficiency Level – For each competency, there will be five possible levels of attainment or proficiency: awareness, basic, intermediate, advanced, and expert.

- KSAB – A brief statement of *knowledge, skill, ability or behavior* related to a competency and associated with a specific proficiency level in said competency.

2.1 Approach

The approach taken to develop the DECF draws from existing competency models and from the practicing DE community. The DoD competency models (DAU ENG and PM and DON SECCM) are being used as a baseline for terminology, 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:
- Defense Acquisition University ENG and PM competency models (DAU 2016a and 2016b)
- INCOSE Systems Engineering Competency Framework (INCOSE 2018)
- MITRE Systems Engineering Competency Model (MITER 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 (
- Mission Engineering Competency Framework (Vesonder et al. 2018)
- Department of the Navy Systems Engineering Career Competency Model (SECCM) (Whitcomb et al. 2017)

In addition to analysis of existing models, the team gathered materials from the DE community related to competencies, including in-progress competency frameworks such as the NAVAIR/NAVSEA Digital Competency Framework. (2020) Paired with the assessment of existing models, experts and practitioners in DE and MBSE are providing insights into their common activities, current training programs, etc. 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

Use of the DECF is a critical input into its design and structure. 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 Digital Engineering 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 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 will to be able to run analyzes 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 competency related to specific roles may be created.

Creating DE training programs – The creation of training programs/curricula require 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 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 digital engineering.

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.

In addition to the use cases for how the DECF itself, the team is investigating the use cases in a DE environment: the roles, activities, and responsibilities anticipated in the workforce.

2.3 Validation

The DECF was developed iteratively. The initial version, notionally v. 0.25 in terms of maturity, was reviewed during a workshop with stakeholders in November 2019. Based on feedback from that workshop, the DECF was evolved and matured. In March 2020, the DECF v. 0.5 was reviewed at a second workshop with key stakeholders. After additional updates, the team released DECF v. 0.75 for review in May 2020. Comments collected on DECF v0.75 were adjudicated and used to further revise the DECF. This report reflects the DECF v. 1.0, the final version from the WRT-1006 Phase1 task.

The team engaged with a 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.

During the May-June 2020 review period, a total of 534 comments were received. Reviewers came from a mix of government and industry. The breakdown of comments by sector and by the context of the comments is shown in Figure 2. All review comments were adjudicated by the WRT-1006 team and updates shared with the sponsor and SME panel.
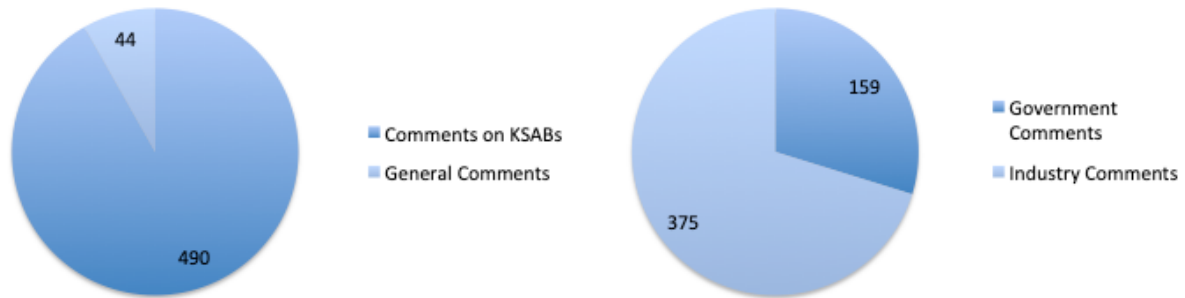
Figure 2. Characterization of review comments for DECF v0.75 .

There were four adjudication categories used for review comments:
- Accepted – the team agreed with the comment and the recommended change was made as described.
- Modified – the team agreed with the spirit of the comment, but the resulting change was different than recommended (e.g. when multiple comments were made around the same issue with different recommended approaches)
- Rejected – the team had a clear rationale for rejecting the comment; all rejected comments were reviewed with the sponsor
- Noted – comments that did not recommend or require changes to the DECF

Of the total comments received regarding DECF v0.75:
- 70% were **accepted**
- 28% were **modified** and
- 2% were **rejected**.
- <1% were **noted**.

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 walking through the steps required to perform these functions and mapping 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.

2.4 Modeling the DECF

The team constructed a digital model of the DECF using SysML and an OpenMBEE approach. (OpenMBEE 2020) The intent of this modeling approach is two-fold. first, it allows reviews to take place in a DE environment through the use of the online View Editor interface – giving potential users some real life experience using the required competencies. Second, it improves the visibility of review feedback and facilitates its implementation. The final version of the DECF will be delivered in both PDF and model forms.

The team utilized a Model-Based Systems Engineering approach to create a SysML model of the DECF, its context, and its use cases. This approach both leverages the capabilities of digital engineering and demonstrates the benefit proposition of their adoption. 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. We 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 digital engineering (see Figure 3 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. In between these two interfaces the model management system functions as an intermediary between these two systems. It maintains the integrity of the authoritative source of truth while also keeping the publicly available documents current with up to date model information.
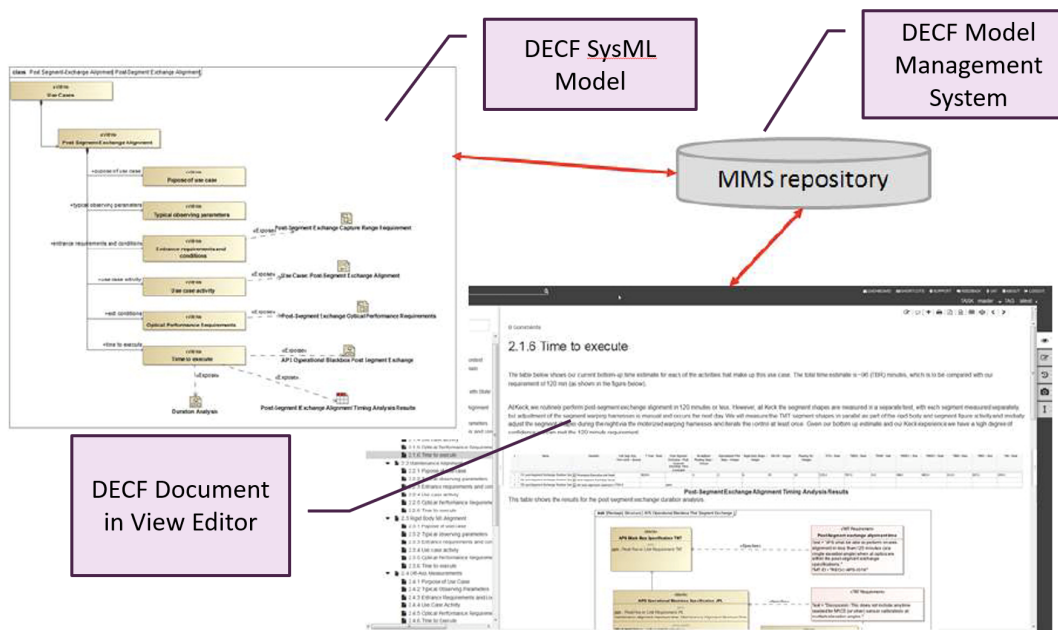
Figure 3. DECF OpenMBEE Structure

3. Digital Engineering Activities

A "digital engineering activity" is defined as any activity that must occur for successful system development in a digital engineering environment. These activities encompass the full systems engineering lifecycle activities as well as any additional management or detailed engineering activities that are expected to occur in an integrated digital environment. Incorporating the digitally-focused competencies related to the ENG competency model and analyzing the PM competency models for critical gaps gives reasonable coverage of the space.

A recently-completed survey by the SERC, INCOSE, and the NDIA Systems Engineering Division on model-based systems engineering (MBSE)/DE capabilities asked specific questions about workforce development for digital transformation. (McDermott et al. 2020) Though questions were not worded specifically to capture activities, the survey did ask about the creation and standardization of roles related to DE/MBSE, the clear definition of skills to support MBSE activities, and training to support these skills. These were answered via a Likert-scale "strongly agree" to "strongly disagree". The results of these questions are shown below (used with permission). Though there is a spread of responses, there was overall more disagreement and strong disagreement around these questions. Figure 4 illustrates the how strongly respondents agreed with the statement that their organizations had clearly defined MBSE roles, defined critical skills for MBSE, and linked skills to training.
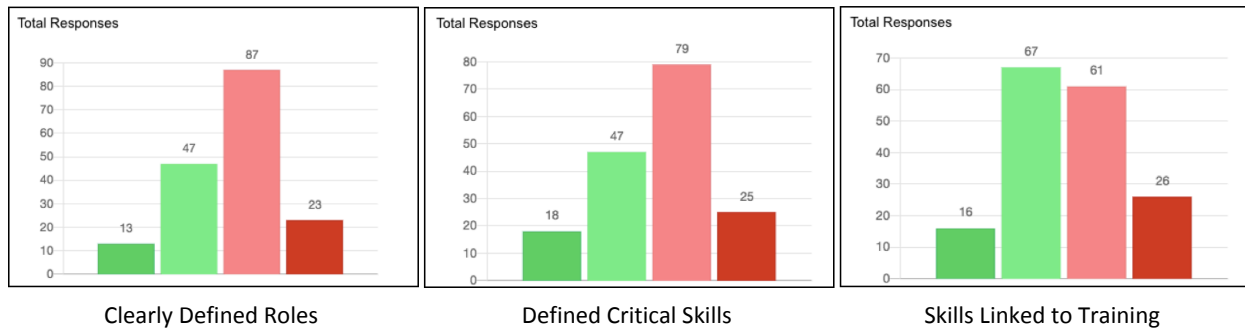
Figure 4. Highlighted Results of the MBSE Maturity Survey

Though not specifically activities focused, these responses provide insight into the fact that specific DE activities are also likely not defined. Clarity on required activities leads to identification of what is required to perform them (skills) and who should be performing them (roles). This indicates that while DE is being done, many responding organizations have not matured sufficiently to step back and develop a holistic perspective on the implications for the workforce.

3.1 General Digital Engineering Activities

In order to capture digital engineering activities, the team identified several use cases that would need to occur in a digital environment and walked through these to identify associated activities and related competencies. The use cases included:
- Digital sign-off
- Model curation

The team walked through a simulation of these activities, catalogued the activities that are required and reviewed the DECF to ensure that the competencies required to perform these activities are reflected in the DECF. An example of the videos used for examining the DECF in the context of digital engineering activities can be found here.

4. The Digital Engineering Competency Framework

4.1 DECF Organization

The overall structure of the DECF v. 1.0 is in compliance with DoD Instruction 1400.25. 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. These are collections of related competencies and should help the user grasp the aspects of digital engineering addressed by their constituent competencies.

4.2 Foundational Digital Competencies

A holistic digital engineering approach incorporates multiple disciplines into a rich model-based environment. The focus of the DECF was primarily around acquisition engineers ("ENG" career field), as described above. 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.

The DECF covers aspects central to accomplishing digital engineering. There are many other digital competencies that could be considered core to developing a digital workforce that also underpin the DECF. Table 1 is a competency model developed by NAVAIR that addresses digital competencies that are a good representation of the kinds of general competencies that should be considered for complete workforce development. These competencies were not directly added to the DECF, as they are more general. These kinds of digital competencies should be included in a holistic development of a digital engineering workforce.[3]

Table 1. Foundational Digital Competencies Based on NAVAIR Model.

ID	Category	Original Definition
1	**Information and Data Literacy**	To articulate information needs, to locate and retrieve digital data, information and content. To judge the relevance of the source and its content. To store, manage, and organize digital data, information and content.
2	**Communication and Collaboration**	To interact, communicate and collaborate through digital technologies while being aware of cultural and generational diversity. To participate in society through public and private digital services and participatory citizenship. To manage one's digital identity and reputation.
3	**Digital Content Creation**	To create and edit digital content To improve and integrate information and content into an existing body of knowledge while understanding how copyright and licenses are to be applied. To know how to give understandable instructions for a computer system.
4	**Safety**	To protect devices, content, personal data and privacy in digital environments. To protect physical and psychological health, and to be aware of digital technologies for social well-being and social inclusion. To be aware of the environmental impact of digital technologies and their use.
5	**Problem Solving**	To identify needs and problems, and to resolve conceptual problems and problem situations in digital environments. To use digital tools to innovate processes and products. To keep up-to-date with the digital evolution.

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[3] In DECF v. 0.5 and v. 0.75, which were 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. 1.0 as shown in Section 4.3.

ID	Category	Original Definition
6	**Digital Identity**	Ability to build a wholesome online and offline identity
7	**Digital Use**	Ability to use technology in a balanced, healthy, and civic way.
8	**Digital Safety**	Ability to understand, mitigate, and manage various cyber-risks through safe, responsible and ethical use of technology
9	**Digital Security**	Ability to detect, avoid, and manage different levels of cyber threats to protect data, devices, networks, and systems.
10	**Digital Emotional Intelligence**	Ability to recognize, navigate, and express emotions in one's digital intra and inter-personal interactions.
11	**Digital Communication**	Ability to communicate and collaborate with others using technology.
12	**Digital Literacy**	Ability to find, read, evaluate, synthesize, create, adapt, and share information, media, and technology.
13	**Digital Rights**	Ability to understand and uphold human rights and legal rights when using technology.

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. Therefore, lifecycle-focused competencies relevant for the ENG career field are incorporated into the DECF.

4.3 DECF v. 1.0 Overview

The competency hierarchy – competency groups, subgroups, and individual competencies – for the DECF as shown in Table 2. The DECF consists of a total of 22 competencies across 5 competency groups. Where appropriate, the competency groups are divided into subgroups. Subgroups contain related like competencies

Table 2. DE Competency Framework v. 1.0

Group	Subgroup	#	Competency Title
Digital Enterprise Environment	Digital Enterprise Environment Development	1	Digital Environment Development
	Digital Enterprise Environment Management	2	Management
		3	Communications
		4	Planning
	Digital Enterprise Environment Operations and Support	5	Digital Environment Operations
		6	Digital Environment Support
	Digital Enterprise Environment Security	7	Digital Environment Security
Data Engineering	Data Governance	8	Data Governance
	Data Analytics	9	Data Analytics
Digital Engineering and Analysis	Modeling, Simulation, and Analysis	10	Modeling, Simulation, and Analysis
	Coaching and Mentoring	11	Coaching and Mentoring
	Systems Engineering	12	Model-Based Systems Engineering Processes
		13	Digital Architecting
		14	Digital Requirements Modeling

Group	Subgroup	#	Competency Title
		15	Digital Verification
		16	Digital Model-Based Reviews
	Systems Engineering Management	17	Project Management
		18	Organizational Development
		19	Digital Engineering Policy and Guidance
Systems Software	Software Construction	20	Software Construction
	Software Engineering	21	Software Engineering
Configuration Management	Configuration Management	22	Configuration Management

The competency hierarchy provides a logical structure for the individual competencies, making the DECF easier for users to understand and utilize. The hierarchy in Table 2 gives an overview of all the skills required to provide value in a digital environment engineering regardless of specific roles.

Digital Enterprise Environment Development addresses development of the digital engineering environment including hardware and software aspects. Digital Enterprise Environment Management is for management, communications and planning related to enabling the work-force to manage the adoption of appropriate model-based tools and approaches and techniques and processes for the operation of digital enterprise environment systems to 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. Data Engineering, which includes data governance and analytics, are model-based processes that help to ensure the formal management of data assets within a digital enterprise. Digital Engineering and Analysis includes modeling, simulation, and analysis, systems engineering and systems engineering management which constitute the means by which digital engineering takes full advantage of the digital power of computation, visualization and communication to take better, faster actions throughout the defense system lifecycle. Systems Software is the systemic application of digital engineering approaches to the development of software. Finally, Configuration Management refers to the development of strategies, policies, standards, and guidelines for configuration management of digital engineering related artifacts in accordance with model-based systems engineering methods.

While every role is likely to require some skills from each of these competencies, no role should require all of 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.

4.4 Competencies

Tables 3-7 lay out the specific competencies contained within the competency hierarchy shown in Table 2. In compliance with DoD Instruction 1400.25, each competency is broken down into KSABs relevant to proficiency levels within each competency. These KSABs can be found in the DECF model. For convenience, they are also provided as appendices to this report (Appendices A-V).

Table 3. Competencies in the Digital Enterprise Environment Group – DECF v. 1.0

Subgroup	#	Competency	Description
Digital Enterprise Environment Development	1	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.
Digital Enterprise Environment Management	2	Management	Management in the digital enterprise environment aims to deliver a framework that ensures transformational processes in enterprises occur with pace, high-quality and security. It does this through a set of IT solutions that are designed to make digital businesses fast, seamless, and optimized at every level.
	3	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.
	4	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.
Digital Enterprise Environment Operations and Support	5	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.
	6	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.
Digital Enterprise Environment Security	7	Digital Environment Security	Digital Environment Security includes developing policies, standards, processes, and guidelines to ensure the physical and electronic security of digital environments and

Subgroup	#	Competency	Description
			automated systems. This includes performing security risk and vulnerability assessments, and business impact analyzes 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 environment physical, procedural, and technical security controls.

Table 4. Competencies in the Data Engineering Group – DECF v. 1.0

Subgroup	#	Competency	Description
Data Governance	8	Data Governance	Data Governance is a collection of practices and processes which 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.
Data Analytics	9	Data Analytics	Data analysis 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 5. Competencies in the Digital Engineering and Analysis Group – DECF v. 1.0

Subgroup	#	Competency	Description
Modeling, Simulation, and Analysis	10	Modeling, Simulation, and Analysis	Modeling, simulation and analysis 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 is 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.
Coaching and Mentoring	11	Coaching and Mentoring	Coaching and Mentoring competencies within the digital enterprise domain focus on the aspect of senior or more experienced individuals acting as advisors or counselors to junior level incumbents, on systems modeling and analysis.
Systems Engineering	12	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.
	13	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,

Subgroup	#	Competency	Description
			properties, and characteristics which 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.
	14	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, related to system architecture definition. It is also used to establish requirements traceability throughout the digital model architecture, to examine the relationships of requirements to digital artifacts, and to trace design solutions to requirements, and to ensure designs can be traced to the system capabilities and requirement sets within digital enterprise environment.
	15	Digital 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.
Systems Engineering Management	16	Digital Model-Based Reviews	Digital Model-Based Reviews define the series and sequence of model-based systems engineering activities which 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 analyzes, prototyping, manufacturing, testing, and sustainment of the system.
	17	Project Management	Project Management is to plan, coordinate, and monitor 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.
	18	Organizational Development	Organizational Development focuses on developing organizational policies, standards, and guidelines for model-based systems engineering methods and artifacts.
	19	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 practice. It includes defining strategy and approach to be used for modeling and analysis of complex systems.

Table 6. Competencies in the System Software Group – DECF v. 1.0

Subgroup	#	Competency	Description
Software Construction	20	Software Construction	Software Construction refers to the detailed creation of working software through a combination of coding, verification, unit testing, integration testing, and debugging.
Software Engineering	21	Software Engineering	Software Engineering is the systematic application of digital engineering approaches to the development of software.

Table 7. Competency in the Configuration Management Group – DECF v. 1.0

Subgroup	#	Competency	Description
Configuration Management	22	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.

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

5. Conclusion and Future Work

The DECF is intended to provide a comprehensive overview of the skills required for individuals to support acquisition in a digital environment. The overarching DECF v. 1.0 framework consists of 5 competency groups, 22 competencies, and a total of 630 KSABs from the competency groups organized across the 5 proficiency levels. Not every digital engineering professional will need to possess all KSABs. The model is intended to be tailored based on expectations for a given role. This tailoring will be critical for successful implementation.

Going forward, the team will analyze the current DAU ENG curriculum against the DECF. The goals are to:
- Identify which competencies are already covered within the existing curriculum
- Identify clear gaps between the existing curriculum and the DECF
- Create specific recommendations for training that could help address DECF competencies that are not currently covered in curriculum

To ensure the rapid fielding and integration of the DECF within the DoD, the team will seek opportunities to pilot use of this framework with a few DoD agencies. Organizations such as NAVAIR that already have an active focus on digital transformation would be idea candidate for this type of piloting. Pilot actions could include:
- Identification of key DE personnel/positions
- Guided self-assessment of key personnel against the DECF
- Analysis of training available to key personnel against the DECF
- Findings on the current baseline of the workforce with regard to the DECF along with identified training gaps and recommendations on how to fulfill training gaps within the organization

In addition, the DECF may be used to support demonstration activities for Section 231 of the National Defense Authorization Act 2020.

Data collected during all of these activities will be used to refine and incrementally update the DECF.

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Appendix A: KSABs for Digital Environment Development – DECF v1.0

KSAB	Proficiency Level
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	Advanced
Assess supplier's digital environment development and testing capabilities	Advanced
Develop, mature, and implement digital enterprise environment tools	Advanced
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	Advanced
Contribute to the development of digital environment installation procedures and standards	Advanced
Develop, mature, and use digital engineering methodologies in place of document-based approaches	Advanced
Evaluate and identify digital engineering tools for stakeholders based on current and future needs	Advanced
Determine the readiness levels of users with regard to upcoming changes in decision making for acquiring, deploying, and maintaining digital enterprise environment	Advanced
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	Advanced
Identify information and communication systems that support the digital enterprise environment processes and manage the relationship with specialists with authority for those systems	Advanced
Lead multi-organizational level digital artifacts and digital enterprise environment infrastructure development efforts	Advanced
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	Advanced
Produce specifications of cloud-based or on-premises components, tiers and interfaces, for translation into digital enterprise environment using selected services and products	Advanced

KSAB	Proficiency Level
Review digital enterprise environment related requirements and specifications, and define digital enterprise environment test conditions	Advanced
Develop digital enterprise environment application installation procedures and standards	Advanced
Align the contribution of systems and services to clearly stated business and financial goals and performance targets	Expert
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	Expert
Contribute to the development of digital enterprise environment organizational strategies that address the evolving business risk and information control requirements	Expert
Create and maintain overall digital enterprise environment network plans to support the organization's business strategy and service level agreements with customers	Expert
Establish a digital enterprise environment supporting infrastructure and environment to perform activities, collaborate, and communicate across stakeholders	Expert
Lead efforts to extending modeling penetration into new departments or product areas	Expert
Monitor emerging technologies which can be used to innovate and manage creativity in support of projects	Expert
Establish an end-to-end digital engineering enterprise by focusing on production, delivery and sustainment of the end item	Expert
Lead the development of digital enterprise environment organizational capabilities for methods and tools (including automation) to ensure adoption and adherence to policies and standards	Expert
Provide hardware and software recommendations to perform digital enterprise environment activities	Expert
Review new digital enterprise environment-related software application procurement proposals and provide specialist advice on digital enterprise environment security issues and implications	Expert
Specify requirements for digital enterprise environment, data, resources and tools	Expert

KSAB	Proficiency Level
Take responsibility for major aspects of digital enterprise environment network specification and design within the organization	Expert

Appendix B: KSABs for Management – DECF v1.0

KSAB	Proficiency Level
Describe how digital engineering tasks and products are incorporated into a contract	Awareness
Describe the risks and opportunities of using digital engineering	Awareness
Manage risks associated with digital enterprise environment testing and take preventative action when risks become unacceptable	Basic
Explain the concept of authoritative source of truth	Basic
Produce routine reports to assist in digital environment management activities and decision making	Intermediate
Produce reports as appropriate for digital enterprise environment portfolio governance, including making recommendations for changes to the portfolio	Advanced
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	Advanced
Ensure the workforce has proper digital engineering qualifications	Advanced
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	Advanced
Coordinate information and media resources to meet specific digital thread related objectives, while maintaining the professional standards and clarity of purpose throughout a project	Advanced
Maintain and update content management processes to meet the needs of users including those with disabilities	Advanced
Make decisions for changes to enterprise and project level digital enterprise environment relevant information	Advanced
Support a model based culture and environment, leveraging capabilities of the digital enterprise environment infrastructure of the organization	Advanced
Take responsibility for organization's digital engineering projects, providing effective team leadership, including information flow to and from team members during project work	Advanced

KSAB	Proficiency Level
Take responsibility for the design, procurement, installation, upgrading, operation, control, maintenance (including storage, modification and communication of data, voice, text, audio and images) and effective use of digital enterprise environment infrastructure components and monitors their performance	Advanced
Ensure consistency of techniques, methodologies and tools across all digital enterprise user groups	Expert
Develop new methods and organizational capabilities (including automation) for the management of digital enterprise environment systems and services	Expert
Provide technical management of digital enterprise environment operation, ensuring that agreed service levels are met and all relevant policies and procedures are adhered to	Expert
Build and prepare the digital enterprise environment workforce at all levels, by transferring knowledge, competence and skills, through training and education of digital engineering methods and tools	Expert
Initiate assessment of consequences and risks arising from decisions to obtain, change or continue the possession or use of a digital enterprise environment asset, system or service	Expert
Identify leadership teams (e.g., champions, sponsors, etc.) that are accountable to actively participate in managing and implementing the digital transformation efforts	Expert
Lead the definition, implementation and review of the organization portfolio management for its digital engineering related framework	Expert
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	Expert
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	Expert
Implement effective digital enterprise environment portfolio governance arrangements supported by effective reporting, using results from model-based engineering methods and tools	Expert
Transform the culture by encouraging the workforce to develop and implement enterprise-wide digital enterprise environment strategies	Expert

KSAB	Proficiency Level
Take full responsibility for decision making for acquiring, deploying, and maintaining the enterprise digital environment	Expert
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	Expert

Appendix C: KSABs for Communications – DECF v1.0

KSAB	Proficiency Level
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	Awareness
Describe the motivation for change within a digital engineering environment	Basic
Communicate using digital model artifacts from the digital enterprise environment	Basic
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	Advanced
Collate digital enterprise environment usage conclusions and recommendations and present lessons learned to stakeholders	Advanced
Define and communicate the digital modeling strategy for any given project	Advanced
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	Expert
Inspire creativity and flexibility in the management and application of digital engineering related artifacts and projects	Expert
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	Expert

KSAB	Proficiency Level
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.	Expert
Evaluate new developments in the organization and the industry and advise senior management on digital enterprise environment potential growth, problem areas and resourcing needs	Expert

Appendix D: KSABs for Planning – DECF v1.0

KSAB	Proficiency Level
Coordinate digital enterprise environment content management processes to meet the needs of users, including those with disabilities	Intermediate
Plan the digital enterprise environment infrastructure necessary to provide the digital application services to meet service level agreements	Intermediate
Implement and contribute to the development of a digital enterprise environment continuity management plan	Advanced
Lead the development and implementation of a digital enterprise environment continuity management plan	Advanced
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	Advanced
Authorize the structure of digital enterprise environment portfolios, and align digital enterprise environment with business strategy/objectives and emerging digital opportunities	Expert
Ensure that a framework of policies, standards, processes and practices is in place to guide provision of digital enterprise environment services, and that suitable monitoring of the governance framework is in place to report on adherence to these obligations	Expert
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	Expert

Appendix E: KSABs for Digital Environment Operations – DECF v1.0

KSAB	Proficiency Level
Follow digital enterprise environment procedures, including performing simple installations, replacing consumable items, checking correct working of installations, and documenting/reporting on work done	Awareness
Understand that as a model repository, the digital enterprise environment can be used as a single authoritative source of technical truth	Awareness
Understand established digital engineering publishing processes and dashboards used to distribute digital content (formally or informally) to interested stakeholders	Awareness
Adapt to changes in digital enterprise environment process or technology	Basic
Identify digital environment related operational problems and contribute to their resolution, checking that they are managed in accordance with agreed standards and procedures	Basic
Understand digital enterprise environment technical publication concepts, tools and methods and the way in which these are used	Basic
Use organization's agreed to digital enterprise environment procedures to publish content, and create and maintain data records	Basic
Carry out agreed upon operational procedures, including infrastructure configuration, installation and maintenance	Intermediate
Contribute to digital enterprise environment capacity modeling and planning	Intermediate
Provide technical expertise to enable the correct application of digital enterprise environment operational procedures	Intermediate
Configure digital engineering methods and tools to address the project needs	Intermediate
Implement systems and controls for digital enterprise environment to measure performance and manage risk	Intermediate
Use digital enterprise environment content publishing systems to manage published content across different channels	Intermediate

KSAB	Proficiency Level
Use standard procedures and tools to carry out defined digital enterprise environment system backups, restoring data where necessary	Intermediate
Provide support on the use of existing model-based engineering methods and tools	Intermediate
Configure modeling tools to automate the provisioning, testing and deployment of new and changed digital enterprise environment infrastructure	Advanced
Ensure advanced modeling activities are used to create significant change in digital enterprise environment adoption across multiple organization functions	Advanced
Create digital modeling and simulation artifacts and technology roadmaps, and share knowledge and insights from processes and results, with others	Advanced
Define digital environment configurations required for testing with reference to agreed upon testing standards	Advanced
Ensure that digital information is presented effectively	Advanced
Identify digital enterprise environment operational problems and contribute to their resolution, checking that they are managed in accordance with agreed standards and procedures	Advanced
Provide expert technical knowledge in the systems testing of platform-specific versions of the digital enterprise environment products, on varying platforms	Advanced
Perform digital enterprise environment activities related to administration of assets	Advanced
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	Advanced
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	Advanced
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	Expert
Set parameters for the prioritization of digital resources and the changes to be implemented	Expert

Appendix F: KSABs for Digital Environment Support – DECF v1.0

KSAB	Proficiency Level
Contribute to digital enterprise environment maintenance, installation and problem resolution	Basic
Initiate improvements to digital enterprise environment test processes and direct their implementation	Basic
Obtain and analyze digital enterprise environment usage data, and present it effectively	Basic
Ensure that project-specific needs are supported in the digital enterprise environment	Basic
Conduct tests on digital enterprise environment installations with guidance	Basic
Apply tools, techniques and processes to create and maintain an accurate digital enterprise environment register	Intermediate
Assess digital environment associated risks, and specify recovery routines and contingency procedures	Intermediate
Contribute to the planning and implementation of maintenance and installation of infrastructure components for virtualized environments	Intermediate
Contribute to the planning and implementation of maintenance and installation work, including building and configuration of infrastructure components in digital environments	Intermediate
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	Intermediate
Correct digital environment malfunctions, calling on other experienced colleagues and external resources if required	Intermediate
Identify potential hazards or risks related to the use of digital enterprise environment tools and equipment	Intermediate
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	Intermediate
Maintain accurate records of various metrics related to digital artifacts and digital enterprise environment infrastructure	Intermediate
Provide assistance to digital enterprise environment users following agreed upon procedures for further help or escalation	Intermediate
Maintain and troubleshoot digital enterprise environment tools and technologies	Intermediate

KSAB	Proficiency Level
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	Intermediate
Use appropriate digital enterprise environment tools, techniques, and proprietary guidelines to conform to application programming interface definitions for new or existing platforms and applications	Advanced
Schedule and supervise all digital enterprise environment maintenance and installation work	Advanced
Act to highlight and resolve potential instances of digital enterprise environment unauthorized usage such as unlicensed copies of software	Advanced
Develop, mature, and implement methods and processes to support digital enterprise environment activities across the enterprise and lifecycle	Advanced
Understand basic approaches for maintenance, installation, and problem resolution for digital environments	Advanced
Create and maintain an inventory of information assets, which are subject to relevant external oversight	Advanced
Analyze and implement technological innovations in digital environment to enable end-to-end digital enterprise	Advanced
Develop digital enterprise environment installation procedures and standards, and schedule installation work	Advanced
Document digital environment related faults, implement resolutions and retest to agreed standards	Advanced
Draft and maintain standards and procedures for digital enterprise environment component capacity management	Advanced
Identify and analyze problems and issues with decision making for acquiring, deploying, and maintaining enterprise digital environment and recommend corrective actions.	Advanced
Implement agreed upon digital enterprise environment infrastructure changes and maintenance routines	Advanced
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	Advanced
Manage digital enterprise environment capacity modeling and forecasting activities	Advanced
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	Advanced

KSAB	Proficiency Level
Produce reports and analysis to support digital enterprise environment asset management activities and aid decision making	Advanced
Provide reports on progress, anomalies, risks and issues associated with a digital enterprise environment modeling project	Advanced
Provide specialist guidance information to support digital enterprise environment systems testing and quality assurance functions, to assist in improving procedures	Advanced
Undertake routine installations and de-installations of digital enterprise environment items of hardware and/or software	Advanced
Use infrastructure management tools to determine digital enterprise environment load and performance statistics	Advanced
Oversee maintenance, installation, and problem resolution for digital enterprise environment	Advanced
Configure digital enterprise environment tools to maintain records of user requests, contact details, and outcomes	Advanced
Extract information from digital enterprise environment as input to regulatory authorities	Expert
Contribute to the creation and maintenance of digital environment policy, standards, procedures and documentation for security	Expert
Determine digital environment testing policies, including processes related to security	Expert
Evaluate new digital environment developments in the organization, and the industry and advise senior management on potential growth, problem areas and resourcing needs	Expert
Investigate and coordinate the resolution of potential and actual digital enterprise environment service problems	Expert
Lead and manage investigations into complex digital enterprise environment issues, engaging additional specialists if required	Expert
Lead the establishment and maintenance of consistent and integrated approach to digital enterprise environment governance in line with the organization's corporate governance requirements	Expert
Measure and monitor adherence to standards and ensure consistent execution of the digital enterprise environment processes across the organization	Expert

KSAB	Proficiency Level
Establish accountability to measure, foster, demonstrate, and improve tangible results of digital engineering across programs and the enterprise	Expert
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	Expert
Provide authoritative advice and guidance on any aspect of digital environment test planning and execution	Expert
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	Expert
Provide reports and proposals for digital enterprise environment improvement, to specialists, users and managers	Expert
Report on digital enterprise environment portfolio status as appropriate	Expert
Review information, in conjunction with service level agreements, to identify any digital enterprise environment capacity issues and specify any required changes	Expert

Appendix G: KSABs for Digital Environment Security – DECF v1.0

KSAB	Proficiency Level
Understand digital enterprise environment access and controls for the authoritative source of truth in the digital enterprise environment	Awareness
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	Awareness
Maintain relevant records and documentation on digital enterprise environment security administration tasks	Awareness
Perform simple digital enterprise environment security administration tasks	Awareness
Receive and respond to routine digital enterprise environment requests for security support	Awareness
Secure digital enterprise environment infrastructure and protect intellectual property	Awareness
Assist in the investigation and resolution of issues relating to access controls and security systems	Basic
Develop policies, standards, processes, and guidelines for ensuring the physical and electronic security of digital environments	Basic
Assist users in defining their access rights and privileges	Intermediate
Interpret digital enterprise environment information assurance and security policies and apply these to appropriately manage risks	Intermediate
Perform non-standard digital enterprise environment security administration tasks and resolve security administration issues	Intermediate
Provide advice and guidance to ensure adoption of and adherence to digital enterprise environment information assurance architectures, strategies, policies, standards and guidelines	Intermediate
Apply and maintain specific security controls as required by organizational policy and local risk assessments	Intermediate
Perform basic risk assessments for digital enterprise environment information systems	Intermediate
Use digital testing methods to support digital enterprise environment information assurance	Intermediate
Contribute to development of information security policy, standards and guidelines	Advanced

KSAB	Proficiency Level
Contribute to the creation and maintenance of policy, standards, procedures and documentation for security	Advanced
Develop corporate information assurance policy, standards and guidelines	Advanced
Obtain and act on vulnerability information and conduct security risk assessments, business impact analysis and accreditation on digital enterprise environment	Advanced
Perform security risk, vulnerability assessments, and business impact analysis for digital enterprise environment	Advanced
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	Advanced
Ensure that digital environment security records are accurate and complete and that requests for support are dealt with according to set standards and procedures	Advanced
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	Advanced
Investigate digital enterprise environment security breaches in accordance with established procedures and recommend required actions and support/follow up to ensure these are implemented	Advanced
Assess impact of suspected cyber attacks and manage security incidents, supporting digital enterprise environment digital forensics where appropriate	Advanced
Maintain digital enterprise environment security administration processes and check that all requests for support are dealt with according to agreed procedures	Advanced
Monitor the application and compliance of digital enterprise environment security administration procedures and review information systems for actual or potential breaches in security	Advanced
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	Advanced
Provide advice and guidance on digital enterprise environment-based security strategies to manage identified risks and ensure adoption of IT-industry standard processes	Advanced
Provide guidance in defining digital enterprise environment access rights and privileges	Advanced

KSAB	Proficiency Level
Provide secure connected information network recommendations to perform digital enterprise environment activities	Advanced
Develop and communicate corporate information security policy, standards and guidelines	Expert
Develop policies, standards, processes, and guidelines for ensuring the physical and electronic security of automated systems	Expert
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	Expert
Ensure that all identified breaches in digital environment security are promptly and thoroughly investigated and that any changes required to maintain security are implemented	Expert
Ensure that the digital environment policy and standards for security administration are fit for purpose, current and are correctly implemented	Expert
Ensure that the policy and standards for digital enterprise environment security administration are fit for purpose, current and are correctly implemented	Expert
Direct the development, implementation, delivery and support of an digital enterprise environment information security strategy aligned to the strategic requirements of the business	Expert
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	Expert
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	Expert
Set policies, standards and guidelines for how the organization conducts digital enterprise environment digital forensic investigations	Expert
Establish digital enterprise environment access and controls for the authoritative source of truth	Expert

Appendix H: KSABs for Data Governance – DECF v1.0

KSAB	Proficiency Level
Aware of the data required to inform program and technical decisions	Awareness
Explain the importance of a data model	Awareness
Assist in providing accessibility, retrievability, security and protection of data in an ethical manner	Basic
Critically review, analyze, synthesize, compare, and interpret information	Basic
Draw conclusions from relevant and/or missing information	Basic
Identify data connections between issues	Basic
Understand project-specific needs in the digital environment such as database or data warehouse specifications	Basic
Understand, orient to, and integrate new information	Basic
Understand and apply principles of usability and accessibility to published information	Basic
Understand the principles underlying the relationship among facts and apply this understanding when solving problems	Basic
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	Intermediate
Contribute to the development of organizational strategies that address information control requirements	Intermediate
Develop appropriate physical database or data warehouse design elements, within set policies, to meet business change or development project data requirements	Intermediate
Update methods, processes, and tools to enable data and model exchanges while protecting property rights for both vendors and for the government	Intermediate
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)	Intermediate
Ensure that operational problems are identified, recorded, monitored and resolved, using relevant data and data analyzes	Advanced
Assess and document the impacts, threats and opportunities to the organization, using relevant data and data	Advanced

KSAB	Proficiency Level
analyzes	
Assess and manages risks around the use of information	Advanced
Assess issues which might prevent the organization from making maximum use of its information assets	Advanced
Derive data management structures and metadata to support consistency of information retrieval, combination, analysis, pattern recognition and interpretation, throughout the organization	Advanced
Develop and maintain specialist knowledge of database and data warehouse concepts, design principles, architectures, software and facilities	Advanced
Devise and implement master data management processes, including classification, security, quality, ethical principles, retrieval and retention processes	Advanced
Ensure effective controls are in place for internal delegation, audit and control relating to information and records management	Advanced
Ensure implementation of information and records management policies and standard practice	Advanced
Ensure that formal information access requests and complaints are dealt with according to approved procedures	Advanced
Ensure that physical database design policy supports transactional data requirements for performance and availability	Advanced
Identify the implications of copyright, data protection and other legal issues associated with publishing data	Advanced
Implement physical database designs to support transactional data requirements for performance and availability	Advanced
Maintain and implement information handling procedures	Advanced
Manage the investigation of data requirements in order to establish, modify or maintain data structures	Advanced
Manage the iteration, review and maintenance of data requirements and data models	Advanced
Manipulate specific data from information services, to satisfy defined information needs	Advanced
Monitor the external environment to gather information on emerging technologies	Advanced
Provide advice and guidance to database designers and other application development team members using the data structures and associated components	Advanced

KSAB	Proficiency Level
Provide advice on the transformation of data/information from one format or medium to another	Advanced
Provide expert guidance in the selection, provision and use of database and data warehouse architectures, software and facilities	Advanced
Provide reports on the consolidated status of information controls to inform effective decision making	Advanced
Provide specialist advice to those accountable for information governance to correct digital media related compliance issues	Advanced
Recommend remediation actions on information and documentation, records management, information assurance and data protection, as required	Advanced
Report on system quality and collects metrics on test cases	Advanced
Sets standards for data modeling and design tools and techniques, advise on their application, and ensure compliance	Advanced
Take responsibility for the accessibility, retrievability, security, quality, retention and ethical handling of specific subsets of data	Advanced
Understand the implications of information, both internal and external, that can be mined from business systems and elsewhere	Advanced
Validate external information from multiple sources, independently	Advanced
Enable the availability, integrity and searchability of information through the application of formal data and metadata structures and protection measures	Advanced
Assesses the integrity of data from multiple sources	Advanced
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)	Expert
Assess and advise on the practicality of testing process alternatives, including automated testing, using data and data analysis	Expert
Collaborate with internal and external parties to facilitate intelligence gathering	Expert

KSAB	Proficiency Level
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	Expert
Design test cases and test scripts independently and without supervision, mapping back to pre-determined criteria, recording and reporting outcomes	Expert
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	Expert
Develop organizational policies, standards, and guidelines for data management, aligned with principles congruent to the ethical use and dissemination of digital artifacts	Expert
Develop organizational policies, standards, and guidelines for information and records management ensuring that uniformly recognized and accepted data definitions are developed and applied throughout the organization	Expert
Develop the overall strategy for the delivery of information and knowledge, including preferred media, overall information structure, and rules for formatting content to meet the needs of the organization and its desired audience	Expert
Ensure that the information required to support the organization is defined, and devise appropriate processes and data architectures to support enterprise digital engineering implementation	Expert
Ensure that there is a business perspective based on data analyzes, of how any new technical capabilities will be integrated into the enterprise, including planning around key business cycles, selecting appropriate customers for migration, etc.	Expert
Establish and communicate the organization's information management strategy	Expert
Identify issues with portfolio structure, cost, risk, inter-dependencies, impact upon on current business activities and the strategic benefits to be realized, using relevant data and data analyzes	Expert
Identify and establish the veracity of the external sources of information which are relevant to the operational needs of the enterprise	Expert
Identify the impact of any relevant statutory, internal or external regulations on the organization's use of information and develop strategies for compliance	Expert

KSAB	Proficiency Level
Lead and plan activities to communicate and implement information management strategies	Expert
Direct the creation and review of an enterprise information assurance strategy to support the strategic requirements of the business	Expert
Establish processes for regular and consistent access to, and independent verification of, external information from multiple sources	Expert
Protect the integrity, availability, authenticity, non-repudiation and confidentiality of information and data in storage and in transit	Expert
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	Expert
Specify at a strategic level the business functions and data subjects needed to support future business, thereby enabling the development of an information architecture	Expert

Appendix I: KSABs for Data Analytics – DECF v1.0

KSAB	Proficiency Level
Apply data analysis, design, and modeling techniques to establish, modify or maintain a data structure and its associated components (entity descriptions, relationship descriptions, attribute definitions).	Basic
Leverage data and analytics to enable insights and achieve faster and better data-driven decisions	Basic
Apply data analysis, design, modeling, and quality assurance techniques, based upon a detailed understanding of business processes, to establish, modify or maintain data structures and associated components (entity descriptions, relationship descriptions, attribute definitions)	Intermediate
Undertake data analysis activities and deliver analysis outputs, in accordance with customer needs and conforming to agreed standards	Intermediate
Contribute to the data engineering of digital information systems with the creation of reports, technology roadmapping, and the sharing of knowledge and insights	Advanced
Ensure that digital data warehouse design policy supports demands for business intelligence and data analytics	Advanced
Develop data hypotheses and methods, evaluate analytics models, share insights and findings, and continue to iterate with additional data	Advanced
Establish and manage methods, techniques, and capabilities to enable the organization to analyze data, to generate insights, create value, and drive decision-making.	Advanced
Evaluate the need for analytics, assess the problems to be solved and what internal or external data sources to use or acquire	Advanced
Implement data warehouse designs that support demands for business intelligence and data analytics	Advanced
Investigate corporate data requirements, and apply data analysis, design, modeling, and quality assurance techniques, to establish data structures	Advanced
Manage reviews of the benefits and value of analytics techniques and tools and recommends improvements	Advanced

KSAB	Proficiency Level
Specify and apply appropriate mathematical, statistical, predictive modeling or machine-learning techniques to analyze data, generate insights, create value and support decision-making	Advanced
Develop analytics policy, standards and guidelines	Expert
Direct the creation and review of a cross-functional, enterprise-wide approach and culture for analytics	Expert
Lead the organization's commitment to efficient and effective analysis of textual, numerical, visual or audio information	Expert
Lead the provision of the organization's analytics capabilities	Expert
Set direction and lead the introduction and use of analytics to meet overall business requirements, ensuring consistency across all user groups	Expert

Appendix J: KSABs for Modeling, Simulation, and Analysis – DECF v1.0

KSAB	Proficiency Level
Describe a variety of system analysis techniques which can be used to derive information about a system	Awareness
Describe different types of modeling and simulation and provides examples	Awareness
Describe the scope and limitations of models and simulations, including definition, implementation and analysis	Awareness
Explain how the purpose of modeling and simulation affect the approach taken	Awareness
Explain the difference between modeling and simulation	Awareness
Explain the relevance of outputs from systems modeling and analysis, and how these relate to overall system development	Awareness
Understand that modeling and simulation provide insight into program cost, schedule, performance, and associated risks	Awareness
Understand the purpose and benefits of modeling	Awareness
Understand the various modeling toolsets	Awareness
Explain the use of models and simulations within a digital engineering environment	Basic
Explain why models and simulations have a limit of valid use, and the risks of using models and simulations outside those limits	Basic
Explain why models are developed for a specific purpose or use and provides examples	Basic
Know where to find model descriptions	Basic
Use appropriate system analysis techniques to derive information about the real system	Basic
Use established techniques as directed, to model simple subject areas with clearly-defined boundaries	Basic
Use models to support analysis	Basic
Use models to support engineering activities and decision making across the lifecycle	Basic
Use various modeling toolsets	Basic
Assist in complex modeling activities	Intermediate

KSAB	Proficiency Level
Applies modeling and simulation applications and tools, to cover a full range of modeling situations	Intermediate
Have a well-developed understanding of modeling tools and how to implement them in both classified and unclassified environments	Intermediate
Integrate modeling capabilities with other product and analytical models including physics-based models	Intermediate
Interpret and use outcomes of modeling and analysis, with guidance	Intermediate
Model current and desired scenarios, as directed	Intermediate
Query the model for how reliability requirements are addressed	Intermediate
Select appropriate tools and techniques for system modeling and analysis	Intermediate
Apply maintenance and calibration for an engineering tool	Intermediate
Use system analysis techniques to derive information about the real system, with guidance	Intermediate
Use technological innovations to improve decision making, system capabilities, and performance of computationally intensive engineering activities	Intermediate
Use tools and techniques to conduct analysis of models, with guidance	Intermediate
Apply modeling and simulation techniques to forecast the demand upon a particular resource or service	Advanced
Advise on selection of appropriate modeling or analysis approach, based on understanding the strengths and weaknesses of various modeling and analysis techniques	Advanced
Advise on the choice of modeling techniques and approach, to communicate with customers accordingly	Advanced
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	Advanced
Apply a range of mathematical, statistical, predictive modeling or machine-learning techniques in consultation with experts if appropriate, and with sensitivity to the limitations of the techniques	Advanced
Understand that various modeling and simulation applications and tools are required to cover a full range of modeling and simulation situations	Advanced
Coordinate complex modeling work	Advanced

KSAB	Proficiency Level
Develop and implement clearly defined digital modeling plans and method statements	Advanced
Develop approaches to integrating modeling tools with other types of engineering tools such as requirements management tools and configuration management tools	Advanced
Ensure staff use the model to support their analysis	Advanced
Ensure that appropriate modeling and simulation tools and methods are available, understood and employed in architecture development	Advanced
Use models to identify and evaluate alternative architectures and the trade-offs in cost, performance and scalability	Advanced
Implement the strategy and approach to be adopted for the modeling and analysis on a system or system element	Advanced
Review and judge the outputs of systems modeling and analysis, ensuring the results can be used for the intended purpose	Advanced
Support a modeling and simulation program through the preparation of technical plans and the application of digital thread principles	Advanced
Conduct mission-level analyzes across multiple systems or services	Expert
Advise and arbitrate on complex issues relating to systems modeling and analysis	Expert
Advise on the suitability and limitations of models and analysis techniques used	Expert
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	Expert
Develop the capabilities and the requirement sets within digital modeling and simulation environment	Expert
Ensure the maintenance of models for a designated function	Expert
Serve as a modeling expert in industry initiatives	Expert
Review and judge the suitability of systems modeling and analysis approaches and results	Expert

Appendix K: KSABs for Coaching and Mentoring – DECF v1.0

KSAB	Proficiency Level
Mentor basic practitioners in systems modeling and analysis	Intermediate
Coach basic practitioners in systems modeling and analysis	Intermediate
Coach intermediate practitioners in systems modeling and analysis	Advanced
Guide supervised practitioners in modeling and systems analysis	Advanced
Mentor intermediate practitioners in systems modeling and analysis	Advanced
Coach advanced practitioners in systems modeling and analysis	Expert
Mentor advanced practitioners in systems modeling and analysis	Expert

Appendix L: KSABs for MBSE Processes – DECF v1.0

KSAB	Proficiency Level
Knowledgeable about digital model project lifecycle	Awareness
Explain why system representations are required and the benefits they can bring to developments	Awareness
Understand the use of models in the context of digital engineering	Awareness
Understand need to assess aspects of model quality including conformance to modeling language and application method constraints	Awareness
Understand published modeling methodologies, i.e. OOSEM, JPL-SA, RUP-SE, etc.	Awareness
Understand that system models are created for system development efforts in accordance with applicable standards and policies	Awareness
Understand the basic fundamentals of Model-Based Systems Engineering (MBSE), Model-Based Engineering (MBE), and the broader Model-Centric Engineering (MCE) concepts	Awareness
Understand the uses of system models for system development efforts in accordance with applicable standards and policies	Awareness
Understand the value that modeling concepts bring to complex system development efforts throughout the system lifecycle	Awareness
Understand the importance of model traceability from concept to disposal in maintaining an authoritative source of truth	Awareness
Assist with the evaluation of system-of-interest change requests using MBSE processes	Basic
Contribute to modeling tasks employing a model-based systems engineering approach	Basic
Describe digital artifacts contribution to the following engineering concepts: Systems of Systems (SoS), program interoperability, and modularity	Basic
Describe how digital system model artifacts advance the state-of-the-practice of digital engineering	Basic
Develop digital model artifacts, according to intent	Basic

KSAB	Proficiency Level
Analyze and interpret the results obtained using model-based engineering methods and tools	Basic
Understands model-based engineering methods, tools and technologies that may assist in streamlining work and improving productivity	Basic
Evaluate the system model and architectural products created and maintained by others	Basic
Explain the difference in digital enterprise environment stakeholder views	Basic
Use appropriate representations of a system or system element in order to derive information about the real system	Basic
Use model formalisms to aid in the development, integration, and curation of models	Basic
Use modeling language, concepts, diagrams, data attributes	Basic
Use modeling toolsets to generate diagrams, to establish system model data attributes	Basic
Use models as the basis for defining, evaluating, comparing, and optimizing alternatives and making decisions	Basic
Use models to communicate, collaborate, and perform model-driven lifecycle activities by exchanging information between technical disciplines or organizations	Basic
Use system models for design analysis	Basic
Contribute to the system model development and interpretation activities	Basic
Apply digital modeling tools to the solution of an engineering problem	Basic
Analyze the system model and architectural products	Intermediate
Build models in a digital enterprise environment collaborative modeling environment	Intermediate
Capture and maintain model provenance and pedigree in order to establish trust, credibility, accuracy and a basis for judging model reuse	Intermediate
Develop knowledge and skills with a new or updated tool, and apply the tool in the solution of an engineering problem	Intermediate
Ensure digital artifacts are up-to-date, consistent, interoperable, accessible, uncorrupted, and properly and safely stored	Intermediate
Generate digital enterprise environment system models	Intermediate

KSAB	Proficiency Level
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	Intermediate
Integrate all other model domains and physics-based models with the system model	Intermediate
Maintain system models for system development efforts in accordance with applicable standards and policies to reduce acquisition lifecycle timeline	Intermediate
Review system models to identify system components or capabilities based on the application	Intermediate
Review the system model created by others	Intermediate
Select and define appropriate representations of a system or system element	Intermediate
Understand need to organize complex models, define the inter-relationships among model elements and diagrams	Intermediate
Understand the capabilities and the requirement sets within the digital enterprise environment	Intermediate
Use digital enterprise environment tools and techniques to represent a system or system element	Intermediate
Use system models for system development efforts in accordance with applicable standards and polices to reduce acquisition lifecycle timeline	Intermediate
Conduct operational, architectural, and requirements research, analysis, and documentation of assigned programs	Intermediate
Apply advanced concepts, principles and practices of model-based system engineering process	Advanced
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	Advanced
Integrate supporting engineering disciplines and specification development into system architecture	Advanced
Integrate MBSE processes for complex system development efforts to appropriately represent the system requirements and design within the digital enterprise environment	Advanced
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	Advanced

KSAB	Proficiency Level
Identify sources of error in model-based engineering methods and take appropriate corrective action	Advanced
Conduct analysis to ensure interoperability with external programs, systems, or capabilities	Advanced
Evaluate and select appropriate model-based engineering methods and tools in line with agreed policies and standards	Advanced
Design MBSE solutions for complex systems including operational, architectural, and requirements research, analysis, and documentation of assigned programs	Advanced
Review and improve usage and application of digital engineering methods and tools	Advanced
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	Advanced
Ensure that digital engineering activities and digital artifacts development are performed according to intent	Advanced
Evaluate supervision of the system model and architectural products created and maintained by others	Advanced
Identify and maintain an approach that integrates models generated by all stakeholders to digitally represent the system of interest throughout the lifecycle	Advanced
Implement MBSE solutions for complex systems	Advanced
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	Advanced
Determine appropriate representation or analysis of the digital model	Advanced
Determine appropriate representations or analysis of complex system or system elements	Advanced
Lead complex system model and architectural development and analysis efforts	Advanced
Lead the development of digital models in specific business, infrastructure or functional area	Advanced
Lead the integration and combination of different models and analyzes for a system or system element	Advanced
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	Advanced

KSAB	Proficiency Level
Plan modeling activities, selecting appropriate techniques and the correct level of detail for meeting assigned objectives	Advanced
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	Advanced
Plan and coordinate team modeling activities and for ensuring the quality of their work	Advanced
Review the creation of system models and architectural products and artifacts produced by other systems engineers to ensure proper format and content	Advanced
Review the maintenance of system models and architectural products produced by other systems engineers to ensure proper format and content	Advanced
Support the technical authority expert in approving standard modeling and architectural products and submitting waivers and deviations for approval	Advanced
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	Advanced
Utilize architectural products to assist with analysis of alternatives to make a recommendation for the best solution	Advanced
Utilize digital model artifacts to assist with analysis of alternatives to provide a set of technically acceptable solutions	Advanced
Utilize system model and architectural products to conduct gap analysis	Advanced
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	Advanced
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	Advanced

KSAB	Proficiency Level
Act as the technical authority for system model and architecture	Expert
Advise across the enterprise, on systems modeling and analysis	Expert
Develop advanced concepts, principles and practices of model-based system engineering process, requirements, and products	Expert
Evaluate multiple system models and architectures at the mission or system-of-system level	Expert
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	Expert
Define and manage the model-based engineering activities to ensure achievement of the projected business benefits after delivery	Expert
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	Expert
Engage with senior managers to ensure the business portfolio will deliver the agreed upon digital artifact objectives	Expert
Incorporate technological innovation to improve the engineering practice of model-based engineering methods and digitization	Expert
Provide advice to support the design of service components including designing in flexible and scalable capacity, using model-based engineering methods and digital artifacts	Expert
Recommend and implement corrective action by engaging and influencing senior management, using results from model-based engineering methods and tools	Expert
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	Expert

Appendix M: KSABs for Digital Architecting – DECF v1.0

KSAB	Proficiency Level
Understand how a model-based systems engineering approach can enable architecture design	Awareness
Understand system model and architectural concepts, including the DODAF framework	Awareness
Create system digital models and basic architecture products, under direct supervision	Basic
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	Basic
Comply with style guides to properly develop system models and architectural products	Basic
Describe what it means for a digital model to be accurate, complete, trusted, and reusable	Basic
Identify and locate data necessary to create system model and architectural products when using architecting tools	Basic
Identify the relationship(s) between defense architecture frameworks and system models	Basic
Interact with relevant stakeholders to create digital engineering oriented architecture for a system's design	Basic
Utilize modeling languages to create or maintain system architectural products based on data provided	Basic
Provide architecture assessment to make decisions based on the digital model architecture to ensure requirements are met for the system development throughout the life-cycle	Intermediate
Apply system model and architectural concepts based on different stakeholder views and how they relate	Intermediate
Collaborate with disciplinary subject matter experts to create system models and architectural products	Intermediate
Collaborate with disciplinary subject matter experts to maintain system models and architectural products	Intermediate
Construct models to be traceable from concept to disposal, so that they can become the authoritative source of truth	Intermediate
Create required architectural products for a system or system-of-systems in accordance with applicable standards and policies with minimal or no supervision	Intermediate
Create system models for system development efforts in accordance with applicable standards and policies	Intermediate
Define the inter-relationships among model elements and diagrams	Intermediate
Demonstrate a full understanding of system model and architectural techniques	Intermediate

KSAB	Proficiency Level
Review architecture diagrams	Intermediate
Review how the system model and architecture are aligned with the framework	Intermediate
Review system architectural products (e.g., structural diagram, behavior diagram, requirements diagram, parametric diagram) to identify system components or capabilities based on the application	Intermediate
Review the architectural products created by others, including digital twins and digital assets	Intermediate
Contribute to the development of solution architectures in specific business, infrastructure or functional areas, using model-based engineering methods and digital artifacts	Advanced
Develop framework for system digital model and architecture	Advanced
Manage complex system model and architectural development and analysis efforts	Advanced

Appendix N: KSABs for Digital Requirements Modeling – DECF v1.0

KSAB	Proficiency Level
Use requirements traceability when modeling system-of-interest	Basic
Contribute to requirements management using digital modeling	Basic
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	Intermediate
Create requirements traceability in the digital model architecture	Intermediate
Ensure traceability between requirements and specifications when modeling	Intermediate
Generate a system specification in a digital enterprise environment model where all requirements and RDs are generated from the modeled system	Intermediate
Generate models using requirements and use case diagrams to include requirements elicitation, generation, analysis, verification and validation	Intermediate
Perform requirements engineering using digital techniques, deriving lower level requirements & traceability of parent-child relationships to establish, validate, and maintain a set of system requirements at all system and subsystem levels	Intermediate
Translate requirements into system specifications using digital modeling products	Intermediate
Understand relationships between system requirements and the system being developed	Intermediate
Ascertain needs requirements of project to ensure proper modeling tools and technology are selected for the current project	Advanced
Examine engineering artifacts and trace designs to requirements	Advanced
Develop the capabilities and the requirement sets within digital enterprise environment	Advanced
Lead the modeling development of digital models for complex solutions, ensuring consistency with specified requirements agreed with both external, and internal customers	Expert

Appendix O: KSABs for Digital Verification – DECF v1.0

KSAB	Proficiency Level
Develop an understanding of the role of testing within system development, as a tool for design improvement as well as a verification process	Awareness
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)	Intermediate
Analyze and report test activities and results using model-based engineering methods and tools	Intermediate
Verify digital model using digital thread	Advanced
Verify system model for the technical authority	Advanced
Extend the digital enterprise environment model to define test strategies or cases	Advanced

Appendix P: KSABs for Digital Model-Based Reviews – DECF v1.0

KSAB	Proficiency Level
Coordinate with subject matter experts to review and confirm information and results from models	Basic
Conduct model-based reviews and audits, to ensure effective collaboration for system-of-interest evolution	Intermediate
Confer with subject matter experts on models produced to gain concurrence on results	Intermediate
Review resulting models with stakeholders and gain resolution to resultant issues	Intermediate
Use system models for analysis of design and technical reviews to execute trade-off and design analyzes, prototype, manufacture, test, and sustainment of the developed system	Intermediate
Use system models for collaboration during design and technical reviews to execute trade-off and design analyzes, prototype, manufacture, test, and sustainment of the developed system	Intermediate
Verify that system model products developed are aligned with the review and/or analysis	Intermediate
Define the series and sequence of model-based engineering activities to bring stakeholders to the required level of commitment, prior to formal reviews	Advanced
Conduct technical reviews to evaluate digital products on a continuous basis as the technical baseline matures, and inform decisions	Advanced
Communicate modeling results to managers and obtain feedback for agreement	Advanced
Utilize system model and architectural products to conduct reviews	Advanced
Approve system model as the technical authority	Expert

Appendix Q: KSABs for Project Management – DECF v1.0

KSAB	Proficiency Level
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	Intermediate
Advise on program cost, schedule, performance, and supportability risk assessments, using knowledge gleaned from digital engineering methods and tools	Intermediate
Lead system modeling for a project	Intermediate
Manage models that are produced within a project	Intermediate
Able to formalize the development, integration, and use of models to inform enterprise and program decision making	Advanced
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	Advanced
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	Advanced
Define new projects and support them through their lifecycle	Advanced
Implement model-based engineering methods and tools at program, project and team level including selection and tailoring in line with agreed standards	Advanced
Take action to ensure targets are met within established safety and quality procedures, including, where appropriate, handover of digital artifacts to the client	Advanced
Prioritize the creation of system model and architectural products to meet larger program milestones and events	Advanced
Maintain an overview of the contribution of programs to organizational success	Expert
Implement processes which support cost-effective technology development and selection decisions	Expert
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	Expert

Appendix R: KSABs for Organizational Development – DECF v1.0

KSAB	Proficiency Level
Create technology roadmaps using model-based engineering methods, to align organizational plans with emerging technology solutions	Intermediate
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	Advanced
Monitor environmental and market trends and pro-actively assesses impact on organization strategies, benefits and risks, using model-based engineering methods and digital artifacts	Advanced
Provide advice, guidance and expertise to support adoption of model-based methods and tools, and adherence to policies and standards	Advanced
Play a leading role in establishing modeling language-based MBSE at an enterprise	Advanced
Establish a systems modeling culture and environment, leveraging the capabilities of the organization	Expert
Initiate organization-wide modeling improvement activities and obtain customer buy-in to general changes	Expert
Develop organizational policies, standards, and guidelines for model-based engineering methods and artifacts	Expert
Lead the establishment of MBSE at an enterprise level	Expert
Leverage the capabilities of MBSE across the organization	Expert
Establish and share best practices, for re-use or adaptation of model-based engineering methods and digital artifacts, to the broader community	Expert
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	Expert
Lead the establishment of a MBSE enterprise with the use of formalized modeling language and ontology	Expert
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	Expert

KSAB	Proficiency Level
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	Expert

Appendix S: KSABs for Digital Engineering Policy and Guidance – DECF v1.0

KSAB	Proficiency Level
Ensure the correct implementation of standards and procedures in digital enterprise environment projects	Awareness
Understand the maintenance of system models for system development efforts are accomplished in accordance with applicable standards and policies	Awareness
Define plans, processes, and appropriate tools for model governance and analysis on a project	Basic
Create and update the documentation of digital engineering methods and tools	Intermediate
Update engineering processes, manuals, and instructions to achieve desired digital engineering benefits	Intermediate
Contribute to organizational policies, standards, and guidelines for methods and tools	Advanced
Identify process improvements to model-based engineering methods, and contribute to organization system testing standards and definition of best practice	Advanced
Tailor processes in line with agreed standards and evaluation of digital engineering methods and tools	Advanced
Develop policy and guidance about models, simulations, and digital engineering	Advanced
Maintain standards or guidance for the execution of model-based system engineering and architectural design	Advanced
Manage the system model and architecture products for policy compliance and framework alignment	Advanced
Prepare instructions in support of collaboration of model development, to ensure accurate use and operation between technical disciplines and organizations	Advanced
Review and judge the adequacy of tailoring of enterprise-level systems modeling and analysis processes for specific projects	Advanced
Create standards or guidance for the execution of model-based system engineering and architectural design	Expert
Define modeling standards and quality targets for an organization	Expert
Define strategy and approach to be used for modeling and analysis of complex or novel system or system elements	Expert

KSAB	Proficiency Level
Establish formal guidance for the system model and architectural design within a command (e.g., Command Style Guide, command policy, handbooks)	Expert
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	Expert
Extend MBSE at an enterprise level by penetrating the concept into new departments or product areas	Expert
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	Expert
Ensure that appropriate model-based engineering methods and standards (corporate, industry, national and international) are adhered to	Expert
Identify and monitor environmental and market trends using modeling-based engineering methods and pro-actively assess impact on business strategies, benefits and risks	Expert
Create governance approaches for model-based systems engineering activities and digital artifacts to enable governance activity to be conducted with reasonable independence from management activity, in line with the organization's corporate governance requirements	Expert

Appendix T: KSABs for Software Construction – DECF v1.0

KSAB	Proficiency Level
Construct software for verification by following coding standards, which support code reviews and unit testing	Basic
Construct software for verification by organizing code which supports automated testing	Basic
Understand algorithms and of coding practices	Basic
Minimize software complexity by emphasizing code creation that is simple and readable, using software construction standards, modular design and other specific coding techniques	Basic
Minimize software complexity by restricting the use of complex or hard-to-understand language structures	Basic
Perform variability encapsulation to make the software assets easy to configure and customize	Basic
Perform software variability implementation with mechanisms such as parameterization, conditional compilation, design patterns, and so forth	Basic
Use existing software construction assets such as libraries, modules, components, source code, and commercial off-the-shelf (COTS), to solve different problems	Basic
Build extensible software to assist in managing future changes and updates	Intermediate
Create working software through a combination of coding, verification, unit testing, integration testing, and debugging	Intermediate
Create working software through a combination of coding, verification, unit testing, integration testing, and debugging	Intermediate
Encapsulate reusable code fragments into well-structured libraries or components, to avoid the problem of code clones	Intermediate
Ensure that system software is tailored to facilitate the achievement of service objectives	Advanced
Apply knowledge of algorithms and coding practices	Advanced
Specify user/system interfaces, including validation and error correction procedures, processing rules, access, security and audit controls	Advanced
Tailor system software to maximize hardware functionality	Advanced

KSAB	Proficiency Level
Translate logical designs into physical designs	Advanced
Ensure adherence to agreed software development standards and good practice	Expert

Appendix U: KSABs for Software Engineering – DECF v1.0

KSAB	Proficiency Level
Execute given software test scripts under supervision	Awareness
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	Awareness
Identify and report testing software issues and risks, associated with own work	Basic
Interpret, execute and record software test cases in accordance with project test plans	Basic
Perform software unit tests and integration tests throughout system lifecycle	Basic
Receive and respond to routine requests for software security support	Basic
Test the variability provided by reusable software assets	Basic
Assist in the configuration of software and equipment and the systems testing of platform-specific versions of one or more software products	Intermediate
Carry out agreed system software maintenance tasks	Intermediate
Correct malfunctions on system installations	Intermediate
Document software faults, implement resolutions and retest to agreed standards	Intermediate
Use system management software and tools to collect agreed performance statistics	Intermediate
Advise on the correct and effective use of system software	Advanced
Assess software-associated risk and specify recovery routines and contingency procedures	Advanced
Assist the user community in the provision of software transition support and change planning	Advanced
Conduct tests of hardware and/or software using supplied test procedures and diagnostic tools	Advanced
Configure software and equipment and test platform-specific versions of one or more software products	Advanced
Contribute to the development of software information assurance policies, standards and guidelines	Advanced
Coordinate and manage planning of the system software and/or acceptance tests, including software security testing, within a development or integration project or program	Advanced

KSAB	Proficiency Level
Ensure that operational documentation for system software is fit for purpose and current	Advanced
Interpret, execute and document complex software test scripts using agreed methods and standards	Advanced
Investigate and coordinate the resolution of potential and actual software service problems	Advanced
Investigate software security breaches in accordance with established procedures and recommend required actions and support/follow up to ensure these are implemented	Advanced
Lead a team, by providing expert technical knowledge in the systems testing of platform-specific versions of the software products, on varying platforms	Advanced
Plan the installation and testing of new versions of system software	Advanced
Prepare and maintain operational documentation for system software	Advanced
Process and analyze software security evidence in line with policy, standards and guidelines and support production of forensics findings and reports	Advanced
Produce test scripts, materials and regression test packs to test new and amended software or services	Advanced
Provide authoritative advice and guidance on any aspect of software test planning and execution	Advanced
Provide reports on progress, anomalies, risks and issues associated with the overall software project	Advanced
Provide software specialist advice to support others	Advanced
Provide specialist guidance information to support systems software testing and quality assurance functions, to assist in improving procedures	Advanced
Provide technical expertise to enable the correct application of software operational procedures	Advanced
Report the outcome of testing and identify potential improvements to the process and to the software products according to agreed designs and standards	Advanced
Review system software updates and identify those that merit action	Advanced
Specify requirements for software digital, data, resources and tools	Advanced
Assess supplier's software development and testing capabilities	Expert

KSAB	Proficiency Level
Define software configurations required for testing with reference to agreed testing standards	Expert
Determine software testing policy, and Supports the software development processes including software security testing	Expert
Ensure sites deliver site software implementation plans that align with the overall plan	Expert
Ensure the availability of hardware, software, and resources for the systems testing of platform specific versions of one or more software products	Expert
Lead complex software security investigations engaging additional specialists if required	Expert
Manage all risks associated with software testing and take preventative action when any risks become unacceptable	Expert
Ensure compliance between business strategies and software information security	Expert
Manage complex software security investigations engaging additional specialists if required	Expert
Review new software application proposals and provide specialist advice on security issues and implications	Expert
Set policies, standards and guidelines for how an organization conducts software digital forensic investigations	Expert

Appendix V: KSABs for Configuration Management – DECF v1.0

KSAB	Proficiency Level
Apply tools, techniques and processes to administer, track, log, report on, and correct configuration items, components and changes	Basic
Assist with audits to check the accuracy of information and undertakes any necessary corrective action under direction	Basic
Contribute to configuration management using digital modeling	Basic
Apply tools, techniques and processes to track, log and correct information related to configuration items	Intermediate
Create traceability records, from test cases back to requirements	Intermediate
Ensure that users comply with identification standards for object types, environments, processes, lifecycles, documentation, versions, formats, baselines, releases and templates	Intermediate
Perform audits to check the accuracy of information and undertake any necessary corrective action under direction	Intermediate
Asses the details of digital enterprise environment hardware/software items that have been installed and removed so that configuration management records can be updated	Intermediate
Verify and approve changes ensuring protection of assets and components from unauthorized change, diversion and inappropriate use	Intermediate
Contribute to development of configuration management strategies, policies, standards, and guidelines in accordance with model-based engineering methods and digital artifacts	Advanced
Agree to the scope of configuration management processes and the configuration items and related information to be controlled	Advanced
Develop, configure and maintain tools (including automation) to identify, track, log and record accurate, complete and current information	Advanced

KSAB	Proficiency Level
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	Advanced
Identify, evaluate and manage the adoption of appropriate tools, techniques and processes (including automation) for configuration management of digitally-based artifacts and systems	Advanced
Plan the capture and management of configuration items and related information	Advanced
Propose and agree on the configuration items to be uniquely identified with naming conventions	Advanced
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	Advanced
Develop configuration management strategies, policies, standards, and guidelines for digital engineering related artifacts	Expert
Develop new methods such as automation and organizational capabilities for the configuration management of digital artifacts	Expert