Digital Engineering Workforce Plan

April 2022

Pursuant to Section 231 of the National Defense Authorization Act for Fiscal Year (FY) 2020 (P.L 116-92)

Under Secretary of Defense for Research and Engineering

Digital Engineering Workforce Plan

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1. Introduction

The U.S. Department of Defense (DoD) requires robust engineering practices to develop weapon systems the nation needs to maintain superiority against threats from adversaries worldwide. To support this effort, the Department is transforming its engineering practices to an approach that incorporates technological innovations into an integrated, digital, model-based approach. This digital engineering approach will require new methods, processes, and tools, which will change the way the engineering community operates. Software plays an essential role in implementing digital engineering and is also discussed in this plan.

To succeed in implementing digital engineering, DoD is making a deliberate effort to transform the workforce. This Digital Engineering Workforce Plan seeks to meet the current and emerging needs in acquiring, developing, and retaining qualified government civilian and military staff to achieve the goal of implementing digital engineering.

Section 231 of the FY 2020 National Defense Authorization Act (NDAA), Public Law 116-92, directs the Secretary of Defense to establish a digital engineering capability:

- For the development and deployment of digital engineering models for use in the defense acquisition process
- To provide testing infrastructure and software to support automated approaches for testing, evaluation, and deployment throughout the defense acquisition process

The digital engineering capability will:

- Be accessible to, and usable by, individuals throughout the Department of Defense who have responsibilities relating to capability design, development, testing, evaluation, and operation
- Provide for the development, validation, use, curation, and maintenance of technically accurate digital systems, models of systems, subsystems, and their components, at the appropriate level of fidelity to ensure that test activities adequately simulate the environment in which a system will be deployed
- Include software to automate testing throughout the program life cycle, including to satisfy developmental test requirements and operational test

As part of establishing a digital engineering capability, the Department was directed to:

- Select not fewer than 4 and not more than 10 programs to participate in demonstration activities to demonstrate digital engineering approaches
- Use the results of the demonstration activities in guiding the development of new policies and guidance
- Use the results of the demonstration activities in guiding the development of a workforce and infrastructure plan to support the new policies and guidance
- Establish a steering committee to assist in carrying out the efforts

This workforce plan specifically addresses the requirement in Section 231(b)(3)(C), “develop a workforce and infrastructure plan[1] to support any new policies and guidance implemented in

[1] As part of the Section 231 effort, a separate Digital Engineering Infrastructure Plan is being developed by the Test Resources Management Center (TRMC).

connection with the demonstration activities, including any policies and guidance implemented after the completion of such activities."

This workforce plan identifies and addresses skill gaps as well as identifies actions to close the skills gaps. The workforce skill gaps are derived from competencies which will support roles and responsibilities of the projected workforce to meet future digital engineering requirements.

Workforce planning is an iterative process that needs to be flexible enough to adapt to changing conditions. This workforce plan is developed to guide the initial efforts to address the near-term skill gaps. This workforce plan provides information for the acquisition functional areas to assist in the development of training (to include credentials) and provides information and recommendations to the Components during their workforce development, recruitment, and hiring initiatives. DoD will monitor, assess, and adjust processes to continuously develop and sustain a digital engineering workforce.

2. Digital Engineering

Digital engineering is a fundamental change to the way people work and operate. It incorporates the use of digital computing, modeling, analytical capabilities, and new technologies to conduct engineering in a more integrated virtual environment. It seeks to move away from traditional paper-based processes to processes that originate and remain digital, allowing the connected workforce to have access to the most up-to-date information, referred to as the single, authoritative source of truth. It is also model-centric, which allows the Department to refine designs in the conceptual phase to facilitate the design process, augment testing, and reduce the need for expensive mockups. Examples of how a digital engineering capability can be used are as follows:

- Facilitate digital communication of system requirements between government and vendor using model-based systems engineering (MBSE)/Systems Modeling Language (SysML) views
- Allow use of engineering models and virtual environments to test designs across broader parameters than live testing permits
- Allow use of models to support 3D manufacturing
- Allow use of digital twins (virtual representations of physical systems) to support predictive maintenance based on real-world usage data

New digital engineering methods, processes, and tools will change the way the engineering community operates; however, this shift extends beyond the engineering community with an impact on the research, requirements, acquisition, test and evaluation, cost, sustainment, and intelligence communities.

The OUSD(R&E) DoD Digital Engineering Strategy (2018) describes the purpose, direction, and priorities necessary to implement digital engineering in the Department. Since digital engineering is a fundamental change to the way work is performed, a new way of thinking is needed in order for DoD leadership and workforce to embrace the concepts and remove barriers.

The digital engineering knowledge base, elements of which are at various levels of maturity, will evolve over time. Currently, DoD is documenting this knowledge in a broad array of standards, web resources, and academic and trade literature. The Department has ongoing efforts to

continually improve, update, and further organize this knowledge base to fully implement digital engineering in a Body of Knowledge (BoK). In addition to documenting the knowledge base, the Department is developing a DoD Instruction to encourage and support the adoption and implementation of digital engineering.

Currently a wide range of information is available to enable digital engineering (e.g., modeling languages, processes, architecture frameworks), but DoD needs a common set of digital engineering standards to cover the range of models and data to be captured and exchanged across disciplines, domains, and phases of the life cycle.

As a result, DoD is establishing commonality, developing a shared understanding of concepts, and ensuring consistency and rigor in implementing digital engineering across engineering activities.

Developing a Workforce to Support Digital Engineering

The greatest challenge facing the workforce is the pace of technology advancements, which require swift adaptation by the current workforce and the hiring of new talent if needed. DoD is competing with the commercial industry by using incentives such as student loan repayment, graduate school tuition reimbursement, continuous learning opportunities, and a flexible work-life environment while widely showcasing DoD's innovative work and opportunities available to those aspiring to a career in high-technology areas. As outlined in the Secretary of Defense's priorities, DoD will build opportunities for growth and development, invest in training and education, and create new opportunities for advancement that drive promotion and retention for our total civilian and military workforce. DoD plans to build out a range of innovative workforce skills and capabilities and remove barriers that limit its people from realizing their full potential as partners in the Department's work.

As DoD transitions to digital engineering, there is a need to develop and maintain an acquisition workforce and culture that understands:

- Model-based engineering
- Modern software development practices
- Digital engineering processes, methods, and tools
- Digital artifacts across the acquisition life cycle

Implementing digital engineering will influence how engineers and the acquisition workforce perform their job functions, how digital artifacts are delivered, and how information is shared either locally or in a distributed manner. Workforce training and education are a critical component to developing the knowledge, competence, and skills that the workforce will need to support the digital engineering transformation.

Competition for highly qualified personnel with any digital experience is constantly increasing. The Department needs to develop and sustain a digital engineering workforce cadre that is skilled in the application of digital tools, modeling, secure technologies, and software acquisition to support the development of capabilities for the warfighter.

DoD is transforming the current acquisition workforce management framework to a new framework for the defense acquisition community that focuses on core functions that design, develop, and field operational capabilities to our warfighters. The Acquisition Workforce

Transformation effort (i.e., Back-to-Basics (BtB) reform initiative) consolidates the 14 traditional acquisition career fields down to six functional areas:

- Program Management
- Contracting
- Life Cycle Logistics
- Engineering and Technical Management (ETM)
- Test and Evaluation (T&E)
- Business Financial Management/Cost Estimating

As part of the Acquisition Workforce Transformation effort, the ETM functional area developed a new competency model with knowledge, skills, and abilities applicable to every acquisition individual in the functional area. The ETM competencies, which have been approved by the Functional Area Leader based on input from the Components, are applicable to digital and software engineering. The competencies are identified in Appendix A and are guiding the development of new acquisition training.

3. Current Activities and Enablers

3.1 Demonstrations Programs

In order to identify which skill gaps are applicable to civilian and military personnel throughout DoD who have responsibilities relating to capability design, development, testing, evaluation, and operation of a digital engineering capability, DoD conducted demonstration activities to evaluate current policy, guidance, specifications, workforce competencies, and standards to determine what changes are necessary to implement digital engineering. In accordance with Sec. 231(b)(2), DoD selected the following five programs for those demonstrations:

1. Integrated Logistics System–Supply (ILS-S) – U.S. Air Force
2. Air Operations Center–Weapon System (AOC-WS) – U.S. Air Force
3. Aegis Combat System Test Bed (CSTB) – U.S. Navy
4. Joint Multi-Role (JMR) Mission System Architecture Demonstration (MSAD) – U.S. Army
5. F-35 Cyber Ops Modeling Project–Orchestrate–Simulate-Execute (COMPOSE) Project – U.S. Air Force/DOT&E

Observations

Following the demonstration activities, the following observations were noted:

- Infrastructure and Digital Engineering Ecosystem: DoD needs to continue developing standard infrastructure-related technology, processes, and support capabilities to ensure availability of a digital engineering ecosystem suitable to meet operational challenges.
- Digital Engineering Capabilities and Usage: DoD programs would benefit from a standard approach to assess a program's overall digital capability. This standard assessment should include (but is not limited to) specifying digital engineering approaches (e.g., processes, tools); assessing contractor digital engineering competency; and characterizing the program's digital engineering infrastructure.

- Integration of Data Types: Demonstration programs benefited from automating data ingestion and integration processes. A common data integration framework to support DoD acquisition programs would enable better returns on investments.
- Continuous Authority to Operate[2] (cATO): The value of cATO (cost savings, rapid deployment, and improved security posture) was evident for programs implementing a Development, Security, Operations (DevSecOps) workflow. Both controls-based and data-analytics-based approaches to cATO are currently in use and serve different legitimate program needs.

These demonstrations showed a wide range in the implementation and application of digital engineering, from constructive multisystem mission simulations to cybersecurity network modeling to testing in DevSecOps environments. This range of applications presents a challenge to the Department as digital engineering workforce development must cover a multitude of topics, including but not limited to: modeling (of varying types and fidelities), simulations, software development, data science, cybersecurity, and more.

The Department is already addressing many of these areas in its workforce development efforts. Recent updates to the workforce competency models in the ETM and T&E functional areas are addressing emerging workforce skill requirements. As the Department moves forward, it will continue to adapt and update the applicable workforce competencies in response to new requirements that emerge from acquisition programs and technology innovations. The observations from the demonstrations will help inform the development of training material for the workforce. Abilities identified, such as configuring automatic data ingestion and implementing a cATO will need to be addressed in guidance and training.

3.2 Current Workforce Education Options

A number of existing training opportunities already address the emerging need for digital engineering skills. The Department is also building upon current efforts to develop training through avenues within the Department, in academia, and in the commercial or online space (e.g., Coursera, etc.).

Defense Acquisition University Training

Defense Acquisition University (DAU) has started deploying job-relevant credentials to meet emerging mission and job-specific needs. Defense Acquisition Credentials provide the knowledge, skills, and abilities to perform a specific acquisition-related functions and tasks.

Defense Acquisition Credentials may include courses from approved non-DAU sources. At this time two Defense Acquisition Credentials are applicable to the digital and software engineering areas (Table 1).

[2] An “Authorization to Operate” is part of the DoD Chief Information Officer Risk Management Process for cybersecurity governed by DoDI 8510.01

Table 1. DAU Credentials Applicable to Digital Engineering and Software Engineering

Credential	Description	Target Attendees	Length
Digital Engineering for DoD Consumers Credential	This credential promotes the learning of key digital engineering information and perspectives. It establishes how models, simulations, and digital engineering can be a benefit over the entire system life cycle and how models, simulations and digital engineering can support systems engineering processes. It is expected to provide an understanding of the role of model-based systems engineering, the needs for digital artifacts related standards, how to define a finite set of digital artifacts, and the ability to develop constructs for assembling digital artifacts. In addition, this credential addresses Digital Engineering across the Department of Defense (DoD) Acquisition Lifecycle and DoD's Digital Engineering fundamentals, strategic goals, and policies. Concepts explored include, but are not limited to DoD's shift towards an acquisition environment that relies on models, simulations, and Digital Engineering that identify with the DoD Digital Engineering Strategy, DoD Digital Engineering Fundamentals, and DoDI 5000.02. This credential is currently made up of two courses: • CLE 084 - Models, Simulations, and Digital Engineering (DAU) • CENG 001 - MBSE: Model-Based Systems Engineering (Coursera)	Defense acquisition workforce personnel, including Engineering and Technical Management (ETM), Program Management and Life Cycle Logistics functional areas	CLE 084 5 Hours CENG 001 21 Hours

Credential	Description	Target Attendees	Length
Agile DoD Team Member Credential	This credential is a cross-functional, general-purpose credential on the tenets and principles of agile that will provide the owner with the knowledge and skills necessary to perform on an agile program in DoD. The credential will explore what it takes to perform a successful agile transformation across an organization. Topics include but are not limited to: create a product vision, create a product roadmap, write a user story, participate in an iteration or sprint planning meeting, and interpret agile metrics. This credential is currently made up of two courses: • CLE 076 – Introduction to Agile Software Acquisition (DAU) • ACQ 1700 – Agile for DoD Acquisition Team Members (DAU)	Defense acquisition workforce personnel, including Project Management, ETM, T&E, Life Cycle Logistics, Business Financial Management, and Contracting functional areas	CLE 076 5 Hours ACQ 1700 2 days

The following stand-alone DAU courses apply to the digital and software engineering areas (Table 2).

Table 2. DAU Stand-Alone Courses That Apply to Digital Engineering and Software Engineering

Course	Description	Target Attendees	Length
CLE 023 – Modeling and Simulation in T&E	This continuous learning module provides a thorough understanding of how modeling and simulation can be used to support the test and evaluation (T&E) activities in support of weapon system development.	Defense acquisition workforce personnel, including T&E, ETM, and Program Management functional areas	8 hours

Course	Description	Target Attendees	Length
CLE 078 – Software Acquisition for the Program Office Workforce	This continuous learning module explains program management challenges that are unique to software-reliant programs. It discusses developing and managing requirements, constructing acquisition strategies, funding and contracting considerations, software development methodologies, cybersecurity design considerations, testing, measurement tools, fielding, and sustainment strategies. Students will gain a strong understanding of the unique aspects of software-reliant systems in DoD acquisition and will be able to apply related experienced-based considerations, best practices, lessons learned, and rules of thumb to improve the success of these programs.	Defense acquisition personnel engaged in Software Development	4 hours
ISA 1011 – Basic Information Systems Acquisition	This course describes Information Technology (IT) products, processes, and services that are acquired in support of the National Defense Strategy (NDS) for any IT acquisition. IT is made up of software and hardware. This course focuses on the software aspects as described by the DoD Digital Modernization Strategy. This course describes what the software-based technology is, why it is important to DoD, and how to acquire the technology.	Defense acquisition personnel in the ETM, Program Management, and Life Cycle Logistics functional areas	10 hours

<u>New DAU Engineering and Technical Management (ETM) Courses (released February 1, 2022)</u>

The DoD acquisition workforce consists of more than 180,000 civilian and military personnel. The Department is revitalizing the training philosophy for the workforce to encourage a culture of lifelong learning and to empower individuals to tailor their professional development. In this new construct, the six functional areas (Program Management, Contracting, Life Cycle Logistics, ETM, T&E, and Business Financial Management/Cost Estimating) allow for more flexibility in gaining credentials.

As part of the Department's Acquisition Workforce Transformation effort, the ETM Functional Area developed a competency model that included digital and software engineering competencies (see Appendix A). These digital and software engineering competencies guided the development of courses designed to support certification at the Foundational and

Practitioner skill levels. The largest acquisition body in DoD is the ETM functional area, which includes more than 72,600 workforce members (nearly 40 percent of the defense acquisition workforce). In addition, there are approximately 9,200 personnel in the T&E functional area that can benefit from the training built to develop digital and software engineering competencies.

In addition to the acquisition workforce, many individuals (military and civilian) across the Department will benefit from this training. For example, the DoD Engineering (Non-Construction) workforce consists of approximately 85,400 acquisition and non-acquisition personnel and the Science and Technology (S&T) workforce consists of 16,900 acquisition and non-acquisition personnel. This training will advance our current workforce by broadening critical skills and abilities to foster the digital transformation.

The following table includes ETM courses released on February 1, 2022. The courses are based on the digital and software engineering competencies and are part of the ETM functional area training certification requirements.

Table 3. ETM Courses Released February 2022

Course	Description	Target Attendees	Length
Digital Literacy Fundamentals (ETM 1070)	This online training course introduces digital literacy concept and strategies. Students will understand digital behaviors and practices to support implementations of digital concepts. Students gain foundational level skills to understand the importance of identifying, communicating, and preserving information when operating within a digital environment. Students learn digital approaches that use authoritative sources of systems' data and models as a continuum across disciplines to support life cycle activities from concept through disposal	This course is required for members of the ETM functional area seeking Foundational Certification. This course is also intended for anyone needing a basic course in the use of digital tools in the development process.	2.5 Hours

Course	Description	Target Attendees	Length
Digital Literacy for Practitioners (ETM 2070V)	This virtual instructor-led training (VILT) course builds upon Digital Literacy Fundamentals (ETM 1070). Students learn how to apply digital engineering behaviors and practices to support implementations of digital concepts. Students gain practitioner level skills for identifying, communicating, and preserving information when operating within a digital environment. Students learn how to integrate digital approaches that use authoritative sources of systems' data and models as a continuum across disciplines to support life cycle activities from concept through disposal. As a group, students discuss best practices and lessons learned that will help them overcome barriers when implementing digital concepts within their own organizations.	This course is required for members of the Engineering and Technical Management (ETM) Functional Area seeking Practitioner Certification. This course is also intended for anyone wanting to learn to apply digital behaviors and practices.	4.5 Hours
Software Literacy Fundamentals (ETM 1080)	This three-module online training course explores the importance of software in DoD and examines the features of a modern software approach in developing software. DoDI 5000.87, "Operation of the Software Acquisition Pathway," is the foundation for the entire course and the basis for Module 1. The DoD transformation to DevSecOps is the basis for Module 2, and the software design considerations of cybersecurity and the resilience of software is the topic for Module 3. Overall, this course provides the software literacy foundations needed to operate in a modern DoD software factory/program environment.	This course is required for members of the Engineering and Technical Management (ETM) functional area seeking Foundational Certification. This course is also intended for anyone needing a basic course in modern approaches to software development.	3 Hours

Course	Description	Target Attendees	Length
Software Literacy for Practitioners (ETM 2080V)	This blended (On-Line Training (OLT) and Virtual Instructor-Led Training (VILT)) course provides the learner with more in-depth knowledge and skills on aspects of modern software development and deployment. The course provides Performance-Based Training (PBT) to learners who are looking to use DoDI 5000.87 Software Acquisition pathway. The course focuses on topics such as modern software requirements management, agile software development that includes cybersecurity design considerations, and how to transition to an Agile-DevSecOps environment to provide capability at the speed of relevance to our warfighters. As a result of taking this course, students will transform their thinking to an Agile-DevSecOps mindset/culture. They will ensure that cybersecurity and resilient software design considerations are included in their product backlogs.	This course is required for members of the Engineering and Technical Management (ETM) Functional Area seeking Practitioner Certification. This course is also intended for anyone wanting to learn to apply modern software development and deployment practices.	5 Hours

Component-Unique Training

The Components have been developing Component-unique training in areas such as MBSE and modeling languages to support their current needs. This training is a combination of organically developed and outsourced training. This training is delivered at several knowledge levels, basic to advanced, as different workforce functions will need different levels of MBSE and modeling language knowledge. For some, this training provides vital, hands-on MBSE and modeling language learning experiences.

MBSE is the practice of developing a set of system models to support the system engineering process to bring the long-established methods into a more dynamic and digital environment. These models provide an efficient way to explore, update, and communicate system aspects in a digital environment. MBSE can enable the implementation of digital engineering. Specialized modeling languages (e.g., SysML, etc.) exist to assist in modeling key aspects and be used to integrate with other engineering analysis models.

As the workforce development activities continue, the Department will take advantage of any Component-unique training and use the training if it is applicable across the other Components. Components should continue to develop Component-unique training.

Academia

Academic Degrees and Certificates Related to Systems Engineering, and Modeling and Simulation

A number of institutions provide degrees and certificates in systems engineering or modeling and simulation. These include but are not limited to George Mason University; Colorado State University; the University of Arizona; George Washington University; the University of Alabama, Huntsville; the University of Central Florida; the John Hopkins University, the Stevens Institute of Technology, the Air Force Institute of Technology; and the Naval Postgraduate School.

Some of these institutes are updating their curriculums to incorporate digital engineering processes, methods, and tools.

Academic Degrees and Certificates Related to Software Development

Numerous academic institutions offer programs in computer science, computer engineering, software engineering, and data science. These programs, at multiple degree levels, provide the fundamentals for developing modern software that is critical to DoD software-intensive systems.

These academic programs provide recruiting opportunities for identifying new hires and opportunities for the current workforce to seek advanced education.

Online Training Resources

Commercial online training covers software development, information technology, and data science quite extensively. This training includes general training on topics like test-driven development and automated testing, as well as training on very specific software languages or frameworks. These training sites include but are not limited to:

- Code Academy (codeacademy.com) – coding and data science
- Treehouse (teamtreehouse.com) – coding
- Coursera (coursera.org) – broad array of subjects
- Udemy (udemy.com) – broad array of subjects
- Cloud Guru – (acloudguru.com) – focus on networking and cloud technology infrastructure
- Pluralsight (pluralsight.com) – broad array of courses on software development, information technology operations, cybersecurity, data science, AI/ML

3.3 Projecting Future Needs: Notional Projected Digital Engineering Functions and Roles

The demand for digital engineering knowledge is evolving for a number of functions and work roles in DoD. These digital engineering functions and roles will require different levels of proficiency in digital engineering in order to perform the work successfully.

Workforce members can perform different roles and responsibilities, which can be aligned to two different tracks: management and technical. The tracks sometimes require different skills or levels of proficiency in specific competencies.

In the management track, an individual needs an understanding of how technology and digital engineering capabilities are planned for and work in order to understand the risks and rewards

the capability provides. Personnel in this track need to understand how digital artifacts are delivered and how that information is shared and used either locally or in a distributed manner.

In the technical track, an individual needs a deeper understanding of the technical details of the technology to be implemented as well as the operations of the digital engineering capability. Personnel in this track need to understand the application of digital tools, modeling, secure technologies, and software acquisition to support the development of capabilities for the warfighter.

In an effort to characterize the workforce and identify the needs of these different roles and functions, the following tables (Tables 4 and 5) were developed to identify a notional set of digital engineering functions and roles. These notional roles will help guide the development of new training assets.

Management Track

The roles in the management track (Table 4) will require an understanding of the digital engineering concepts, technology, the risks, and the rewards. It is essential to have specific knowledge to plan and implement digital engineering. These roles may also involve specific tasks (e.g., contracting, etc.) that contribute to efficiently and effectively implement digital engineering.

Table 4. Digital Engineering Management Track

Function	Description	Typical Role
Initiate and Plan	Develop acquisition strategy, program plans, digital engineering strategy, and other technical programmatic documentation	Program Office Personnel
Implementation Support	Support activities to instantiate and maintain digital engineering capabilities	Contracting, Finance, etc.

Technical and Specialist Tracks

The roles in the technical and specialist tracks (Table 5) will require an in-depth understanding of technology, software, models, hardware, and processes in order to create digital engineering capabilities. These roles require hands-on experience and those individuals need to remain closely informed on new advancement related to digital engineering.

Table 5. Digital Engineering Technical and Specialist Tracks

Function	Description	Typical Role
Design	Design and construct/assemble digital engineering ecosystems, to include networks, hardware, software, data, and security	Subject matter experts in applicable technical areas

Monitor and Control	Manage the evolution of models over time, including purpose, structure, updates, and configuration control of models; maintain infrastructure and tools; maintain model data schemas and the authoritative source of truth; identify modeling languages and tools; identify required models; develop Government Reference Architecture; manage processes and execute digital threads and artifacts	Digital Engineering Lead
Build and Execute models	Design, construct, update, and maintain models using selected modeling language(s) and tools. Execute those models to support the functional activities (e.g., engineering, test, etc.)	Modeling Specialist
Utilize	Use and analyze model information to perform job function (design, test, etc.) and provide information feedback for model updates	Engineers, Logisticians, etc.

These management and technical roles will evolve over time, and as they do, they will be used to identify additional knowledge, skills, and abilities required by the workforce. These additional knowledge, skills, and abilities will be addressed during the periodic review of the DAU curriculum and incorporated into future training.

4. Path Ahead

4.1 New DoD Instruction

To encourage and support the adoption of digital engineering in the Department, DoD is developing a new instruction (policy) on digital engineering implementation. This instruction addresses responsibilities for different DoD organizations (e.g., OUSD(R&E), OUSD(A&S), Components, etc.), discusses procedures, and directs acquisition program managers to implement digital engineering to the maximum extent feasible across the acquisition life cycle. It also provides information on how the Department will support programs with a digital engineering capability.

4.2 New Digital Engineering Body of Knowledge (DEBoK)

DoD is developing a Digital Engineering Body of Knowledge (DEBoK) to provide a complete set of concepts, terms, activities, best practices, and implementation examples identified by the digital engineering community of practice. The DEBoK is currently in a piloting effort; the goal is to have an initial operating capability in the first half of 2022. Ultimately the DEBoK will be hosted in an interactive environment for stakeholders to digitally navigate the content. The DEBoK will be maintained and updated by the digital engineering community of practice.

4.3 New DAU Credentials

In addition to the courses listed in Section 3.2, DAU is developing a number of new digital engineering credentials. A credential is an indicator of an individual's knowledge, skills, and abilities to perform an acquisition-related function. A credential equips the acquisition workforce

members through a set of training or other means of learning that enhance(s) individual or team job performance and targeted development.

As part of the Acquisition Workforce Transformation effort, DAU is designing a number of new credentials to equip acquisition professionals for the future. Some of these new credentials will focus on digital engineering, software engineering, and test and evaluation knowledge and skills necessary to perform some of the projected digital engineering roles and functions.

4.4 Encouraging Mentorships, Rotational Assignments, and Coaching/Workshops

The Components should continue to pursue opportunities to provide their workforce with mentorships, rotational assignments, and coaching or workshops.

Mentoring is a formal or informal association between two people, a senior mentor (usually outside the protégé's supervisory chain) and a junior protégé. Two important outcomes of mentoring are skills enhancement and knowledge transfer. Skills enhancement mentoring enables experienced, highly competent staff to pass their expertise on to others who need to acquire specified skills. Knowledge transfer provides for the interchange of knowledge between members of different organizations or between senior and junior employees such that knowledge is not lost when senior employees depart.

Rotational assignments allow acquisition workforce personnel to participate in temporary (3-12 month) career broadening opportunities. The employees are able to take on increased levels (or different types) of responsibility and enhance their skills through specialized on-the-job training. These rotations help develop a cadre of cross-functional, high-potential leaders.

Preferably the mentorships or rotational assignments will provide the learning employee an opportunity for hands-on experience. The level of aptitude necessary to perform work in modeling, simulation, and software development is best acquired by doing.

Pairing senior personnel with junior personnel, whether or not it is in a traditional mentor-protégé structure or a senior/junior pairing arrangement, allows for open and two-way discussions. These discussions allow for seniors to share their experiences and guide the juniors in in career development as well as expose the seniors to new tools and view points.

Coaching and workshops allow subject matter experts to assist program offices to implement new processes. The Components should employ a team of subject matter experts who can work with program offices to implement digital engineering. These experts can foster the adoption of best practices and can help steer clear of typical road blocks.

4.5 Public-Private Talent Exchange (PPTE) Program

As authorized by Congress in 10 U.S.C. 1599g, the Department developed a Public-Private Talent Exchange program. The program allows the Department to enter into an agreement with a private-sector organization to allow both parties to host willing participants. This allows for the temporary assignment (detail) of a DoD civilian employee to a private-sector organization and the temporary assignment (detail) an employee of a private-sector organization to DoD. This program allows the participants to acquire new skills, share best practices/lessons learned, and obtain a greater understanding of each other's perspectives. Components should consider the

Public-Private Talent Exchange program in developing the workforce to implement digital engineering. Additional information can be found at https://www.hci.mil/ppte.html.

4.6 Workforce Staffing Requirements

The Military and Civilian staffing requirements across the Department are developed in accordance with DoD Directive 1100.4, "Guidance for Manpower Management." Staffing requirements are driven by workload and are established at the minimum levels necessary to accomplish mission. The Components' long-range strategies that use a mix of personnel (military, civilian and contract) are based on assigned missions, available funds, performance of inherently government functions, and other statutory and regulatory requirements. As the Components incorporate the Secretary of Defense's priorities into their respective long-range strategies and workforce forecasts, this workforce plan can inform some of those activities/initiatives to assist in making major changes in the Department that will enable the implementation of digital engineering.

4.7 Workforce Hiring Options

DoD provides managers and human resource professionals with access to efficient hiring authorities to ensure the right candidates are hired in a timely fashion to support the DoD acquisition mission. In recent years, DoD has been granted a number of special hiring authorities to expedite the process.

DoD Hiring Authorities (Applicable to organizations with members in the Acquisition Workforce):

- Direct Hire Authority for Certain Personnel of the Department of Defense USD(P&R) Memorandum dated April 2, 2020. (Section 1109 of NDAA for FY 2020)
- Direct Hire Authority for DoD Postsecondary and Recent Graduates (Section 1106 of the NDAA for Fiscal Year 2017; and Section 1102 of the NDAA for Fiscal Year 2019)

Acquisition Workforce Personnel Demonstration Project (AcqDemo) Hiring Authorities (Applicable only to organizations participating in AcqDemo):

- Direct Hire Appointment for the Business Management and Technical Management Career Paths
- Direct Hire Authority for DoD Postsecondary and Recent Graduates
- Veteran Direct Hire Appointments for the Business Management and Technical Management Professional and Technical Management Support Career Paths
- Acquisition Student Intern Appointments
- Scholastic Achievement Appointments

Details on the current hiring authorities can be found at:
https://www.hci.mil/hiringauthorities.html

4.8 Develop Workforce (Resources) - Leverage Defense Acquisition Workforce Development Account (DAWDA)

Moving forward, several actions are necessary to ensure the workforce is adequately trained to perform digital engineering and software development functions.

DAWDA provides funding for the recruitment, training, and retention of DoD acquisition personnel. DoD organizations can request DAWDA funding to develop training across the broad-spectrum digital engineering and software engineering roles for the government workforce.

The DAWDA is managed by the Human Capital Initiatives (HCI) office within OUSD(A&S). DAWDA can be requested for each budget year. The DAWDA program requests are submitted to identify the specific use of the funding that include, but are not limited to, the items listed below:

Training and Career Development

- Continuously improve certification training and available on-the-job resources, certification and mission critical skill gap training, advanced education, leadership training, functional area/competency training, conferences, seminars, continuous learning, and rotational assignments

Studies and Analysis

- Conduct analysis and develop tools that lead to improvements in the defense acquisition workforce
- Conduct benchmarking studies, workforce assessments, training needs assessments

Recruiting, Recognition, and Retention Initiatives

- Targeted incentives for recruiting and outreach, including college career days, recruiting events, Science, Technology, Engineering, and Mathematics (STEM) recruiting, and branding initiatives
- Targeted incentives for retention of high performers with critical skills and for skills in critical supply and recognition for specific acts
- Student Loan Repayment Program

Hiring (salary and compensation)

- To ensure the defense acquisition workforce is sustained and maintained at appropriate levels for critical function and high priority needs
- Hiring of college student interns, entry level, journeymen and subject matter experts (EL hires funded for up to 3 years; Journeymen up to 2 years

5. Conclusion and Path Ahead

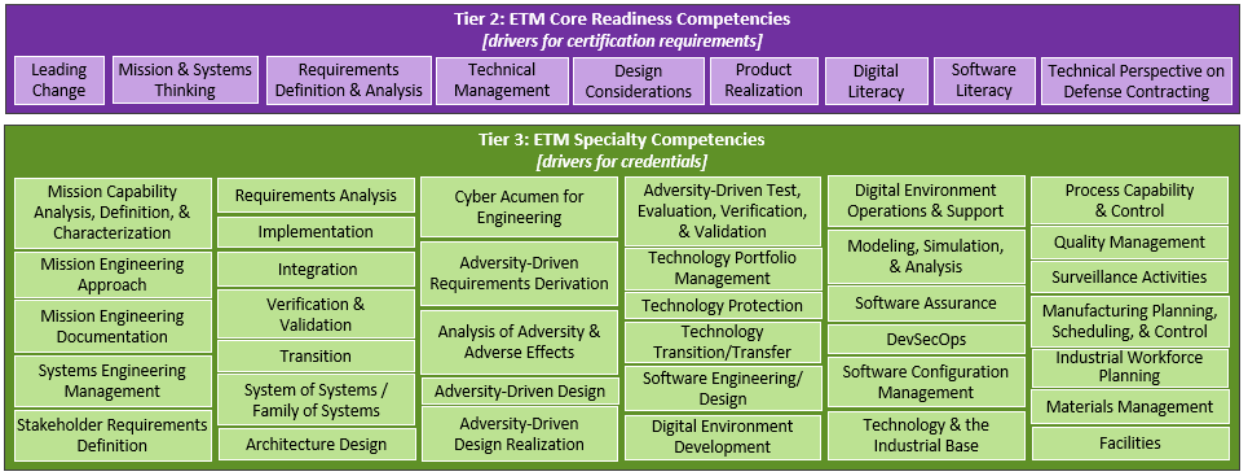
Implementing the plan to improve the quality of the Department's digital engineering workforce builds upon the progress and successes of the last few years. We will continue to develop a ready and capable workforce that is able to meet the challenge. We will encourage the continued development of a professional workforce that is dedicated to mission, increased knowledge, and a level of skill commensurate with their function and role. We will seek feedback from the students taking the digital engineering training courses and request inputs from the Component engineering and test and evaluation communities.

We plan to track and assess progress of the initiatives identified in a number of established workforce groups (e.g., ETM Functional Area Team, etc.). We will track the number of students

who have enrolled and passed the ETM courses listed in Section 3.2 as well as the number who have enrolled and achieved either a digital or software engineering credential. We will update this workforce plan whenever changes in mission, funding, or work priorities significantly change workforce needs.

Appendix A: Digital and Software Engineering Competencies

Competencies in the ETM Functional Area.



Tier 2 and Tier 3 ETM Competencies

Competency	**Definition**
Digital Literacy	Considering digital behaviors and practices to support implementations of digital concepts (e.g., IT, cybersecurity, and digital engineering).
Software Literacy	Considering the diverse role of software in delivering, designing, and utilizing various system types (e.g., system-of-systems, cloud-native systems, cyber physical systems, and embedded systems) to achieve required capability that minimizes complexity; anticipates change; and plans for verification, reuse, and software activities estimation.
Digital Environment Development	Develop a digital enterprise environment that 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 Environment Operations and Support	Operate within and supporting a digital enterprise environment.
Modeling, Simulation, and Analysis	Create and analyzing a digital prototype of a physical system to predict its performance in the real world. Models and simulations are used to help system designers and engineers understand whether, under what conditions, and in which ways a system component could fail and what loads it can withstand through analysis.

Competency	Definition
Architecture Design	Create a system or mission architecture design using digital models that satisfies the documented requirements for hardware, software, and human elements; their enabling processes; and related internal and external interfaces.
Software Engineering/Design	Plan and implement software (including prototypes and executable models) within a continuous integration and continuous delivery pipeline that can transition into a development program for fielding as well as for long-term maintainability using software development methodologies, architectural structures, viewpoints, styles, design decisions, and frameworks.
DevSecOps	Analyze DevSecOps methodologies, including interface to documentation and production requirements.
Software Configuration Management	Establish and maintain consistency of a product or system's attributes with its requirements and evolving technical baseline over its life-cycle. This includes strategies for identifying and managing the configuration throughout the life cycle of: ▪ System and software development and test environment(s), ▪ Design, test, and analysis artifacts (including documentation), ▪ The software itself, and ▪ External dependencies like associated systems, underlying hardware, and software stack
Software Assurance	Explore and specify how the system is meeting the key security attributes that the software solution must satisfy. Examples of key attributes include availability, integrity, and confidentiality.

Appendix B: FY20 National Defense Authorization Act (Sec 231)

SEC. 231. DIGITAL ENGINEERING CAPABILITY TO AUTOMATE TESTING AND EVALUATION

(a) DIGITAL ENGINEERING CAPABILITY —

(1) IN GENERAL — The Secretary of Defense shall establish a digital engineering capability to be used —

(A) for the development and deployment of digital engineering models for use in the defense acquisition process; and

(B) to provide testing infrastructure and software to support automated approaches for testing, evaluation, and deployment throughout the defense acquisition process.

(2) REQUIREMENTS — The capability developed under subsection (a) shall meet the following requirements:

(A) The capability will be accessible to, and useable by, individuals throughout the Department of Defense who have responsibilities relating to capability design, development, testing, evaluation, and operation.

(B) The capability will provide for the development, validation, use, curation, and maintenance of technically accurate digital systems, models of systems, subsystems, and their components, at the appropriate level of fidelity to ensure that test activities adequately simulate the environment in which a system will be deployed.

(C) The capability will include software to automate testing throughout the program life cycle, including to satisfy developmental test requirements and operational test requirements. Such software may be developed in accordance with the authorities provided under section 800, and shall support—

(i) security testing that includes vulnerability scanning and penetration testing performed by individuals, including threat-based red team exploitations and assessments with zero-trust assumptions; and

(ii) high-confidence distribution of software to the field on a time-bound, repeatable, frequent, and iterative basis.

(b) DEMONSTRATION ACTIVITIES —

(1) IN GENERAL — In developing the capability required under subsection (a), the Secretary of Defense shall carry out activities to demonstrate digital engineering approaches to automated testing that—

(A) enable continuous software development and delivery;

(B) satisfy developmental test requirements for the software-intensive programs of the Department of Defense; and

(C) satisfy operational test and evaluation requirements for such programs.

(2) PROGRAM SELECTION — Not later than 180 days after the date of the enactment of this Act, the Secretary of Defense shall assess and select not fewer than four and not more than ten programs of the Department of Defense to participate in the demonstration activities under paragraph (1), including—

(A) at least one program participating in the pilot program authorized under section 873 of the National Defense Authorization Act for Fiscal Year 2018 (Public Law 115–91; 10 U.S.C. 2223a note);

(B) at least one program participating in the pilot program authorized under section 874 of such Act (Public Law 115–91; 10 U.S.C. 2302 note);

(C) at least one major defense acquisition program (as defined in section 2430 of title 10, United States Code);

(D) at least one command and control program;

(E) at least one defense business system (as defined in section 2222(i) of title 10, United States Code); and

(F) at least one program from each military service.

(3) ADDITIONAL REQUIREMENTS — As part of the demonstration activities under paragraph (1), the Secretary shall—

(A) conduct a comparative analysis that assesses the risks and benefits of the digital engineering supported automated testing approaches of the programs participating in the demonstration activities relative to traditional testing approaches that are not supported by digital engineering;

(B) ensure that the intellectual property strategy for each of the programs participating in the demonstration activities is best aligned to meet the goals of the program; and

(C) develop a workforce and infrastructure plan to support any new policies and guidance implemented in connection with the demonstration activities, including any policies and guidance implemented after the completion of such activities.

(c) POLICIES AND GUIDANCE REQUIRED — Not later than one year after the date of the enactment of this Act, based on the results of the demonstration activities carried out under subsection (b), the Secretary of Defense shall issue or modify policies and guidance to —

(1) promote the use of digital engineering capabilities for development and for automated testing; and

(2) address roles, responsibilities, and procedures relating to such capabilities.

(d) STEERING COMMITTEE —

(1) IN GENERAL — The Secretary of Defense shall establish a steering committee to assist the Secretary in carrying out subsections (a) through (c).

(2) MEMBERSHIP — The steering committee shall be composed of the following members or their designees:

(A) The Under Secretary of Defense for Research and Engineering.

(B) The Under Secretary of Defense for Acquisition and Sustainment.

(C) The Chief Information Officer.

(D) The Director of Operational Test and Evaluation.

(E) The Director of Cost Assessment and Program Evaluation.

(F) The Service Acquisition Executives.

(G) The Service testing commands.

(H) The Director of the Defense Digital Service.

(e) REPORTS REQUIRED —

(1) IMPLEMENTATION — Not later than March 15, 2020, the Secretary of Defense shall submit to the congressional defense committees a report on the progress of the Secretary in implementing subsections (a) through (c). The report shall include an explanation of how the results of the demonstration activities carried out under subsection (b) will be incorporated into the policy and guidance required under subsection (c), particularly the policy and guidance of the members of the steering committee established under subsection (d).

(2) LEGISLATIVE RECOMMENDATIONS — Not later than October 15, 2020, the Secretary of Defense shall provide to the congressional defense committees a briefing that identifies any changes to existing law that may be necessary to facilitate the implementation of subsections (a) through (c).

(f) INDEPENDENT ASSESSMENT —

(1) IN GENERAL — Not later than March 15, 2021, the Defense Innovation Board and the Defense Science Board shall jointly complete an independent assessment of the progress of the Secretary in implementing subsections (a) through (c). The Secretary of Defense shall ensure that the Defense Innovation Board and the Defense Science Board have access to the resources, data, and information necessary to complete the assessment.

(2) INFORMATION TO CONGRESS — Not later than 30 days after the date on which the assessment under paragraph (1) is completed, the Defense Innovation Board and the Defense Science Board shall jointly provide to the congressional defense committees —

(A) a report summarizing the assessment; and

(B) a briefing on the findings of the assessment.

Acronyms

ACQ	Acquisition
AcqDemo	Acquisition Workforce Personnel Demonstration Project
ACS	Aegis Combat System
AOC-WS	Air Operations Center–Weapon System
BoK	Body of Knowledge
BtB	Back-to-Basics
C2	Command and Control
cATO	Continuous Authority to Operate
CENG	Credential – Engineering (DAU Course Code)
CLE	Continuous Learning – Engineering (DAU Course Code)
COMPOSE	Cyber Ops Modeling Project–Orchestrate–Simulate-Execute
CSTB	Aegis Combat System Test Bed
DAU	Defense Acquisition University
DAWDA	Defense Acquisition Workforce Development Account (DAWDA)
DAWIA	Defense Acquisition Workforce Improvement Act
DBS	Defense Business System
DE	Digital Engineering
DEBoK	Digital Engineering Body of Knowledge
DevSecOps	Development, Security, Operations
DoD	Department of Defense
DOT&E	Director of Operational Test and Evaluation
ETM	Engineering and Technical Management
FVL	Future Vertical Lift
GRA	Government Reference Architecture
HCI	Human Capital Initiative
ILS-S	Integrated Logistics System–Supply (ILS-S) – U.S. Air Force

IT	Information Technology
JMR	Joint Multi-Role
JMR MSAD	Joint Multi-Role Mission System Architecture Demonstration
KREL	Kessel Run Experimentation Lab
MBSE	Model-Based Systems Engineering
MPSE	Mission Planning Support Environment
MSAD	Mission System Architecture Demonstration
NDAA	National Defense Authorization Act
NDS	National Defense Strategy
OLT	On-Line Training
PBT	Performance-Based Training
PPTE	Public-Private Talent Exchange
S&T	Science and Technology
STEM	Science, Technology, Engineering, and Mathematics
SysML	Systems Modeling Language
T&E	Test and Evaluation
USD(A&S)	Under Secretary of Defense for Acquisition and Sustainment
USD(P&R)	Under Secretary of Defense for Personnel and Readiness
VILT	Virtual instructor-led training

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