Forward

The Department of the Navy (DON) embraces Digital Engineering as a means to maximize agility, interoperability, reusability, and scalability across the DON. This Navy and Marine Corps Digital Systems Engineering Transformation Strategy specifies activities necessary to enhance engineering acquisition practices within our enterprise. Our strategy aligns with Department of Defense Digital Engineering Strategy goals, shifts how we work from traditional document-centric activities to digital-centric activities, and informs designers, developers, managers, and technical authority stakeholders with continuous access to authoritative data.

Our Navy and Marine Corps teams have already started implementing digital approaches within our activities and acquisition programs. We will expand those efforts, working with our industry partners, to provide a standard of practice that delivers affordable, lethal capabilities to the warfighter at the speed of relevance.

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Foreword

The Department of the Navy (DON) must design, deliver, and sustain increasingly complex system of systems, platforms, sensors, information and weapons that are responsive to rapidly changing operational and threat environments, and must do so under increasingly restrictive budgets and aggressive delivery schedules. This Digital Systems Engineering Transformation Strategy provides the approach the United States Navy and Marine Corps will pursue to achieve this objective.

In June 2018, the Department of Defense (DoD) released their Digital Engineering Strategy, intended to guide the planning, development, and implementation of digital transformation across the military services. The DoD Digital Engineering Strategy offered five strategic goals which, when taken together, constitute "what" is necessary to foster the use of Digital Engineering practices. The DoD Digital Engineering Strategy also stated that the military services must develop the "how" -- the steps necessary to apply Digital Engineering as a timely imperative. This document details the DON response, describing our vision, goals, processes, and delegated actions to implement Digital Engineering within the US Navy and Marine Corps.

The rate of commercial technological change, combined with global connectivity, exponentially improving computational speed, and software-based digital control systems allows allies and adversaries alike to innovate very quickly. The rate of innovation has broad and significant implications regarding maintaining military advantages, technical superiority, and superior decision speed. Our job as scientists, engineers, program managers, analysts and technicians supporting naval acquisition is to provide our customers with that decisive material and decision advantage. Any capability gaps identified by fleet campaign assessments will also require a distributed and connected maritime network solution across programmatic requirements.

This Navy and Marine Corps Digital Systems Engineering Transformation Strategy shifts the practice of systems engineering from traditional document-centric activities to digital-centric activities. It supports common application across the Navy and Marine Corps, and encompasses provision and access to digital models and data applied in a Model-based Systems Engineering approach in order to improve the understanding, quality, consistency and timely delivery of warfighter capability across all domains, and across all stages of the program lifecycle.

Military research was formative in the invention, integration, and use of digital technologies, so using digital tools to conduct engineering is not new to our workforce or our industry partners. However, change does not come without challenges. Leadership advocacy, changes in business and acquisition practices, workforce training, and provision of data models and tools in secure, accessible environments will be necessary in order to succeed.

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This document supports 2018 Navy Strategy to "*build a more lethal force"* and to *"reform the Department for greater performance and affordability*". It also aligns with National Defense Strategy objectives to "*continuously deliver performance at affordability and speed as we change the Department's mindset, culture and management systems*", to "*adopt our culture and processes to achieve a step change in lethality, affordability and velocity*" and to "*establish architecture superiority*." Furthermore, this document aligns with the Chief of Naval Operations Guidance and Design for Maintaining Maritime Superiority 2.0 to "*share data across the force and effectively leverage that increased awareness,*" *"enhance operational capability whenever and wherever possible",* and "*as technology moves faster and as more tools become available, make sure that we can get things done."*

This Navy and Marine Corps Digital Systems Engineering Transformation Strategy authored within the offices of the Acquisition Executive of the Navy, addresses the approach to the assessment, analysis, design, development, modeling and simulation, configuration management, testing, and delivery of acquisition program capabilities for both the Navy and Marine Corps.

This Naval Digital Systems Engineering Transformation Strategy is one part of naval digital strategies to evolve our workforce, processes and practices for improved modernization, upgradeability, and effect.

Executive Summary

The Department of the Navy (DON) must change in order to improve how it delivers timely and effective capability to our warfighters. This requires altering how the DON designs, develops, validates, delivers, operates and sustains warfighting systems. This is not a choice; it is an imperative requiring immediacy and a sense of urgency. In support of that imperative, we choose to implement a Digital Engineering Strategy.

Current engineering and acquisition processes do not suit the complexity, interconnectivity, and interoperability of modern warfare systems. Whereas past systems often were mechanical-based designs with few cross-system interfaces, modern systems implement software control systems with multiple interfaces supporting network-centric warfare tactics and strategies. The dynamic nature of military operations, and the increasingly complex systems performing it, compel rapid transition away from past practices of manually assimilating vast amounts of document-centric data and toward a digital data-centric approach.

This US Navy and Marine Corps Digital Systems Engineering Transformation Strategy is intended to transform systems engineering capabilities by using common, composable, interactive, model-based systems to store and exchange data, models, and information within and across programs. Digital Engineering uses models and authoritative data to coordinate and integrate all disciplines and phases of work for the life cycle of a platform or system. Digital Engineering allows engineers and leaders to better understand and assess complex choices, automates requirements traceability to achieve design satisfaction, and supports timely decision-making through integration, automation, visualization, and high performance computing. Specific objectives of this Digital Systems Engineering Transformation Strategy, which aligns with the Defense Digital Engineering Strategy, June 2018, are:

OBJECTIVE 1 – Formalize the development, integration and use of models

This objective will be coordinated with the Chief of Naval Operations, Commandant of the Marine Corps and the Naval Chief Information Office in consonance with their digital transformation plans. Immediate tasks include identifying where to implement models for near-term acquisition program efficiency, improved systems interoperability, operational effectiveness and cost savings. Primary goals are to provide integrated, networked, upgradeable capability to the fleet faster, and to build an enduring research and development infrastructure that will enable future digital capability across the enterprise.

OBJECTIVE 2 – Provide an enduring authoritative knowledge source

This objective will establish a single, accessible, authoritative source of knowledge. “Knowledge” is inclusive of data, models, engineering information, capabilities, requirements,

and allocations of functions to existing programs of record or to emerging science & technology efforts. It also includes an enduring historical record of investment and prior technical decisions. Knowledge is accessed and used by all team members to develop, design, and validate operational capabilities, connecting disparate data sources within a common data framework. The vision for this knowledge source includes secure access and use by Navy, Marine Corps, and industry partners, using both unclassified and classified networks.

OBJECTIVE 3 – Incorporate technological innovation to improve the engineering practice

This objective will institutionalize, expand, and accelerate the use of Digital Engineering to support computational analysis of numerous alternatives early in the design process, and to enable greater speed and utilization of Artificial Intelligence (AI) and Machine Learning (ML) in software development, deployment and sustainment. This enables near-real-time application software revisions, while maintaining appropriate authority to operate (ATO) and configuration control.

OBJECTIVE 4 – Establish the supporting infrastructure and environments for the Digital Engineering practice

This objective will modernize and connect digital environments readily available across the research and development enterprise. The digital environment must support secure system modeling, design, development, and live, virtual and constructive simulation and testing. Accomplishment will require connecting users across a high bandwidth network, linking the government workforce to tools, data and test venues across the enterprise, providing a digital environment necessary to perform the engineering business of the Navy and Marine Corps.

OBJECTIVE 5 – Transform the culture and workforce to adopt and support Digital Engineering across the lifecycle

Digital Engineering is a paradigm shift requiring new skills, proficiency, knowledge, and practice across the engineering competency, as well as other supporting technical and acquisition functions. Leadership must provide the tools, processes, methods, training and the connective, collaborative environment necessary for Digital Engineering to succeed. They must also coordinate development and training of personnel with timely application of acquired skills in support of program priorities. This will accelerate delivery of benefit, support continued application of new skills, and prevent atrophy through lack of use.

Background

Engineers devise and deliver solutions to problems. Systems engineers coordinate and integrate teams, comprised of performers across varied technical disciplines, to deliver solutions while addressing challenges dealing with increased system complexity. As desired or required capabilities become more challenging, and as the number of potential solutions increases, systems engineers need tools to help them solve complex problems more quickly.

Digital Engineering is key to managing the development and delivery of increasingly complex and interconnected warfighting systems and desired capabilities. Historically, the DON systems engineering process has been document-centric, focused on individual program performance specifications and multiple program contract documents. Digital Engineering supports adoption of a new culture that uses digital models to analyze, design, test, produce, field, and sustain capabilities. The use of digital models supports early communication between technical disciplines. Development of the digital model(s) is a focused priority, and the performance specification, acquisition documentation, and other data artifacts are the result of the solutions identified by the modeling process. This approach will be more dynamic, more comprehensive, and will reduce the time and effort required to create recurring documentation. It also helps reduce the number of formal contract deliverables and accelerates the acquisition process.

Definitions

Digital Engineering (Navy) - An integrated, computation-based approach that uses authoritative sources of system data and models across disciplines to support lifecycle activities from concept through disposal

Model Based Systems Engineering (MBSE) is formalized application of modeling to support system requirements, design, analysis, verification and validation activities. Applying MBSE enables a better understanding of all aspects of capability development and system behaviors before generating the performance specification. Digital models have the potential to provide multiple integrated, linked, and related views at the subsystem, system, and system of systems levels. The integration of these views within the digital environment allows for a comprehensive and automated evaluation, which can identify inconsistencies or gaps in the model and rapidly assess impacts and mitigation options when changes are first considered.

Definitions

Model Based Systems Engineering (INCOSE) – Formalized application of modeling to support system requirements design, analysis, verification and validation, beginning in the conceptual design phase and continuing through development and later life cycle phases

Additional benefits of Digital Engineering include creation and use of a single authoritative knowledge source within the digital environment. This authoritative knowledge source captures information from multiple inputs, which are integrated to form the system view. This approach ensures completeness and consistency of design data throughout the development, procurement, and sustainment life cycle.

> *"The pace of change also demands that we design ships with modernization in mind. The "core" of those future ships - the hull, and the propulsion and power plants - will likely be built to last for decades. To leave room for future modernization, we should buy as much power capacity as we can afford. On top of that hull and power plant, we must plan from the outset to modernize the "punch" -- the combat systems, sensors, and payloads -- at the speed that technological advances allow."*
>
> *- CNO ADM John Richardson, "The Future Navy", May 2017*

Goals

The overarching goal is to migrate from a document-centric engineering approach to a Digital Engineering-centric approach, and to realize gains in effectiveness, interoperability, and future upgradeability of Naval Acquisition Systems. One objective is to provide an Integrated Modeling Environment (IME) that supports collaboration regarding their engineering approach, technical processes, and use of models and data formats across all Navy and Marine Corps System Commands.

As shown in Figure 1, this change affects the people, processes, products, policies, tools, and organizations that provide engineering services to achieve the Naval Vision 2020. It also calls for use of an authoritative knowledge repository accessible to all stakeholders to ensure the use of correct, updated, and authoritative information throughout the life cycle by participants.

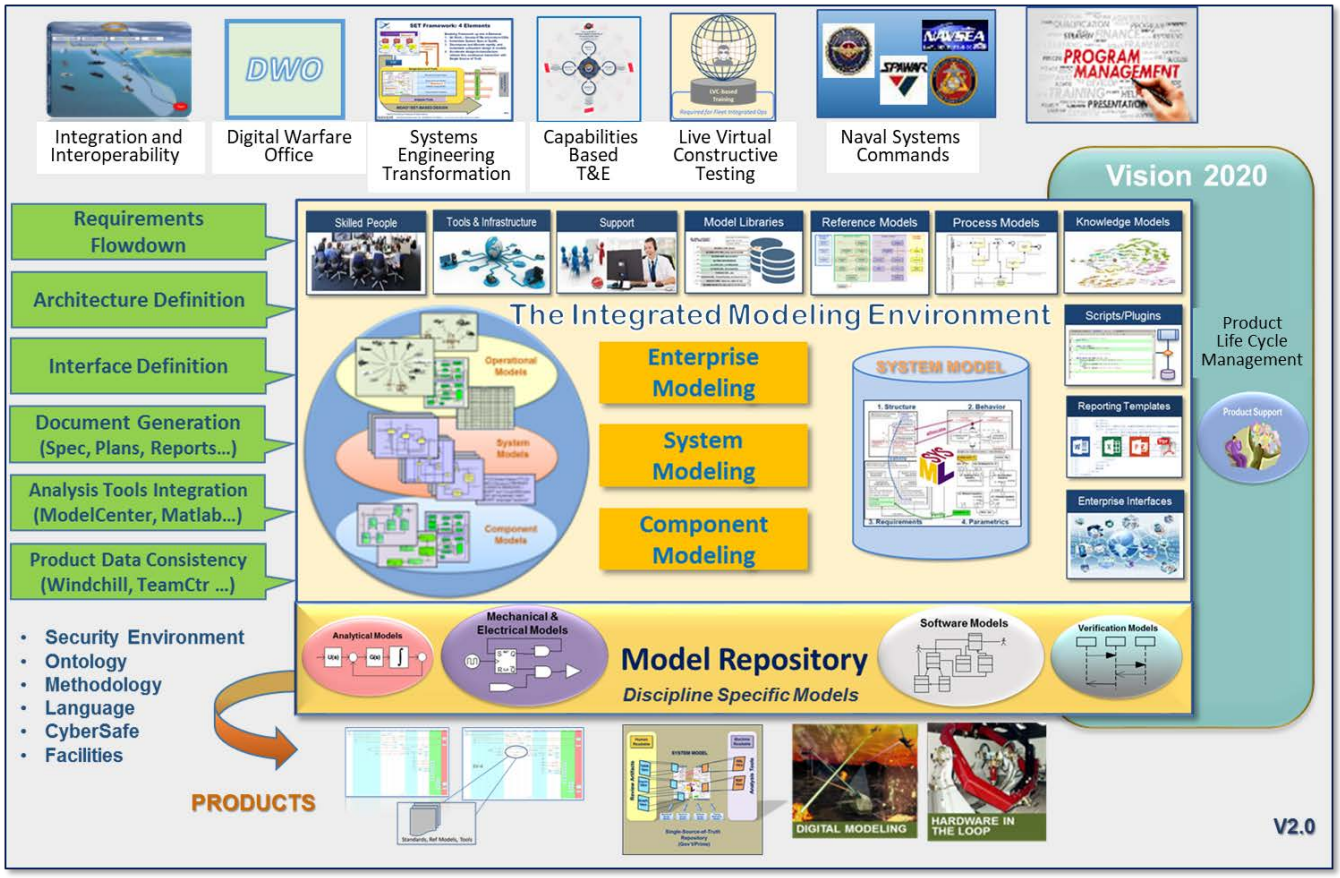

Figure 1 – Naval Enterprise Integrated Modeling Environment

OBJECTIVE 1 – Formalize the development, integration and use of models

Digital Engineering compels that we first understand system behavior and identify supporting system functions, including allocation of those functions to component systems and subsystems through modeling, prior to establishing acquisition performance requirements. The focus is upon allowing the performance specification as a resulting output of the modeling process, rather than writing the performance specification first.

As shown in Figure 2, the transition from a document-centric approach to a digitally-centric approach will allow us to:

- Trace allocated system requirements to validated stakeholder mission capabilities
- Model system functional behavior(s) required to accomplish desired capabilities
- Generate a functional system hierarchy directly from the model
- Develop performance requirements for each functional element with consideration for external constraints such as programmatic, safety, cyber and security requirements imposed by statutes, regulations, standards and policy
- Develop verification requirements for each performance requirement, including system of systems interoperability requirements
- Review, monitor, assess, and approve system and program compliance using the Digital Engineering framework

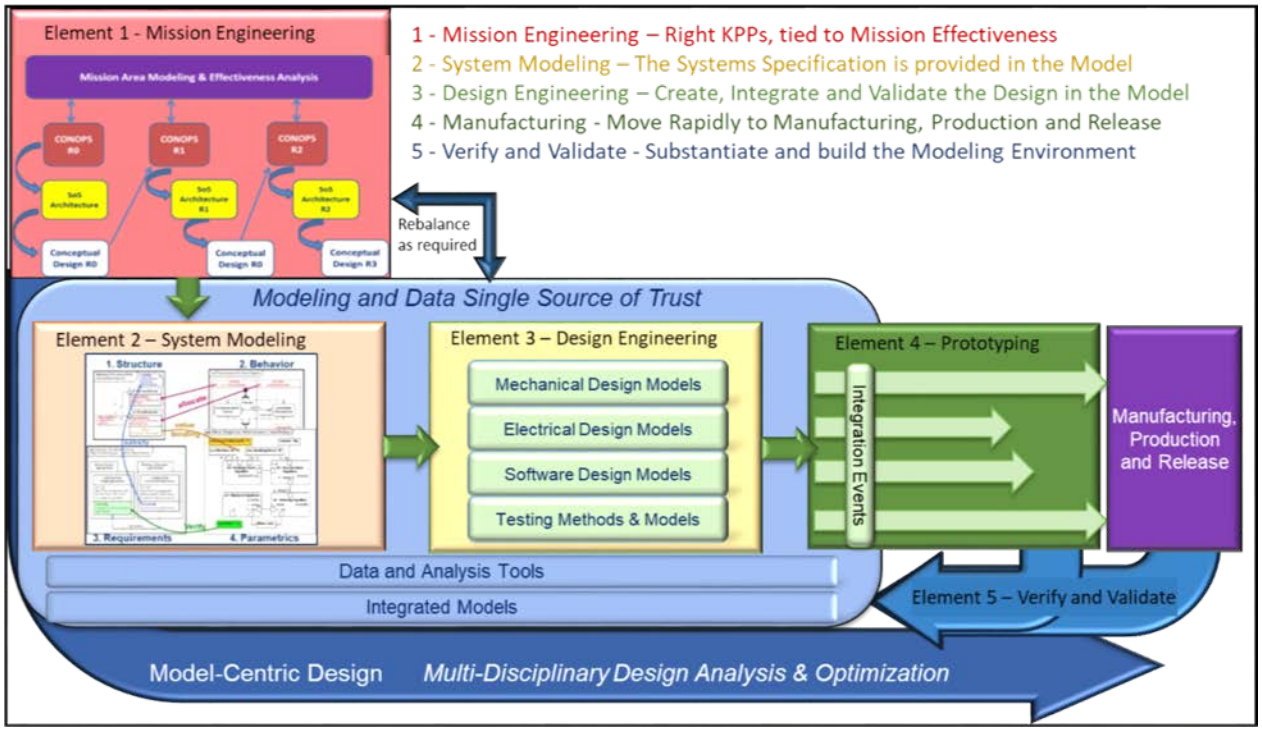

Figure 2 – Model-Based Approach to Systems Engineering Accomplishment

Naval Systems Commands exercise delegated Technical Authority, which is the responsibility and accountability to establish, monitor and approve technical standards, tools, and processes, and certify Navy and Marine Corps system and program compliance with approved architecture tools and policies. Technical Authority responsibilities under Digital Engineering will not change, but the methods required to analyze design, assess risk, and report non-compliance to decision makers and program authorities will need to evolve.

OBJECTIVE 2 – Provide an enduring authoritative knowledge source

A critical element to executing the Digital Engineering is the approach for publishing, storing, curating, tagging, and securing data and models so that they are discoverable, available, trustable, and ready to use when needed by authorized personnel. Engineers and other personnel have a need to access authoritative data and models, to maintain its integrity, and to perform their designated roles as performers, reviewers or approvers as delegated under Technical Authority. Models must be available from any stakeholder's network, based upon secure, controlled, and consistent access and authorization rights. Data and models must be common and understandable, using appropriate metadata, semantics, and syntax. Data and models must also be available, have well-defined and well-controlled interfaces, use clear classification and control markings, and recorded retention rules.

OBJECTIVE 3 – Incorporate technological innovation to improve the engineering practice

The end-to-end digital enterprise will incorporate a model-based approach in a connected environment in order to conduct full lifecycle activities from concept to disposal. Digital Engineering is an effective way to increase understanding, convey complex concepts, complete effective system integration, reduce testing time, and support effective decision-making. It also reduces the risk of designing to bad requirements and facilitates reusability and knowledge transfer using an authoritative knowledge source.

As the fleet missions become more complex and involve more systems of systems, the need to understand the full scope of all capabilities, requirements and integration paths for each system through development, design, production, deployment and sustainment becomes more important. As shown in Figure 3, Digital Engineering provides this full understanding from inception to disposal, thru use of an Authoritative Data Source of Reference. Digital Engineering also enables rapid and informed trades regarding new missions or insertion of innovative capabilities, providing confidence in integrity and consistency of function to all affected systems.

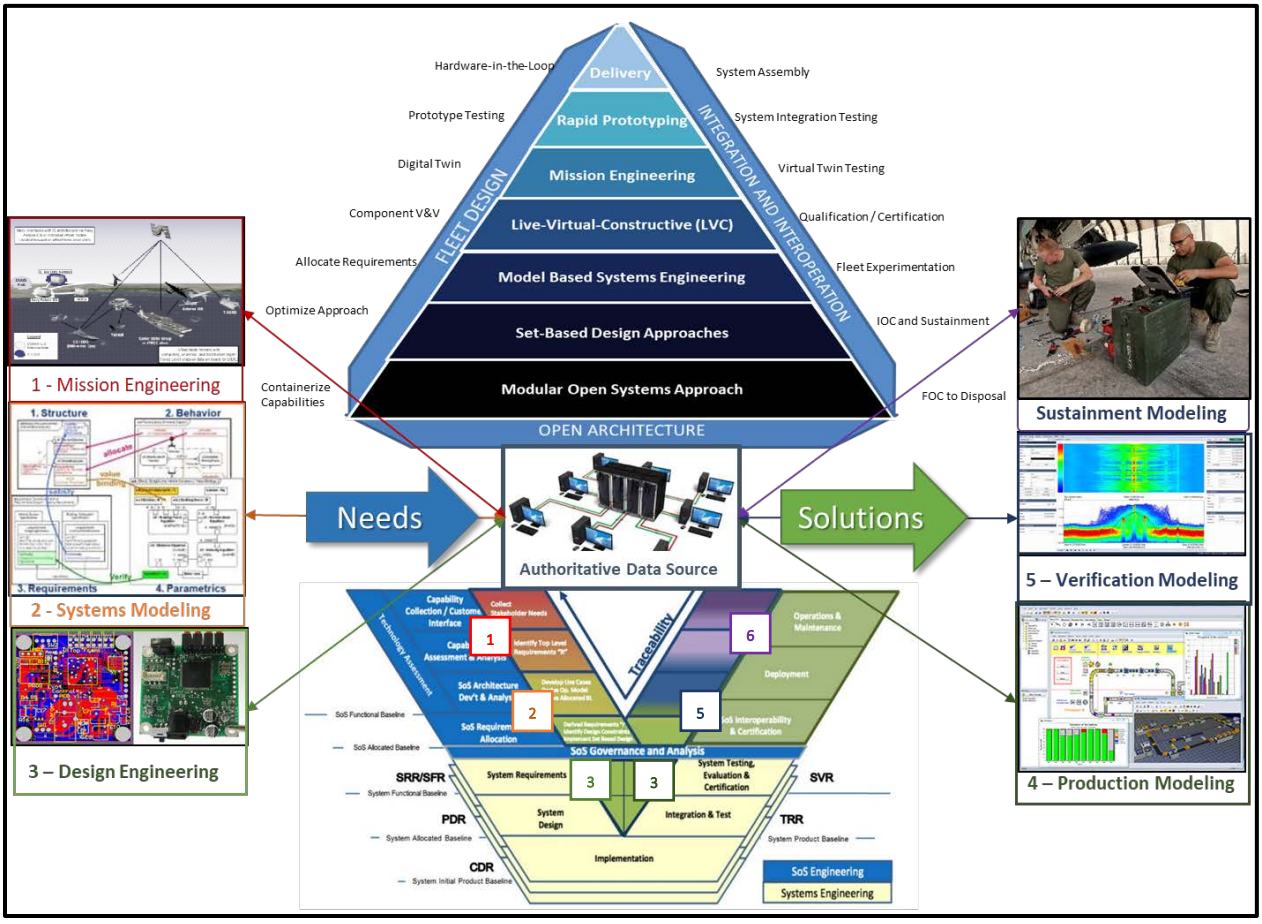

Figure 3 – Role of Digital Models connecting System of Systems Analysis, Standards, and Model Based Systems Engineering

Digital models are useful for more than design, construction, and rapid technology insertion. Building a Digital Engineering portfolio early, and maintaining it for the life of the program, supports improved manufacturability, reduced maintenance and higher operational availability. As shown in Figure 4, creation of an accurate model helps ensure supplies and repair parts are appropriately considered and properly provisioned, maximizing operational availability and fleet readiness.

Extended lifespans and inevitable mission changes means platforms and systems often require modifications in order to respond to new contingencies. Use of digital models can help reduce resources expended on expensive, one-of-a-kind mock-ups, or incorrect implementation of design changes. A high fidelity digital model can also determine whether current maintenance and support facilities are still acceptable. If not, existing facilities can be modified, or new facilities provided, to be ready when needed.

Digital Engineering also allows for efficient introduction of upgrades and product improvements. Using a Digital Engineering approach, the feasibility of upgrades can be determined quickly, prototypes created rapidly, and modifications installed with fewer initial errors.

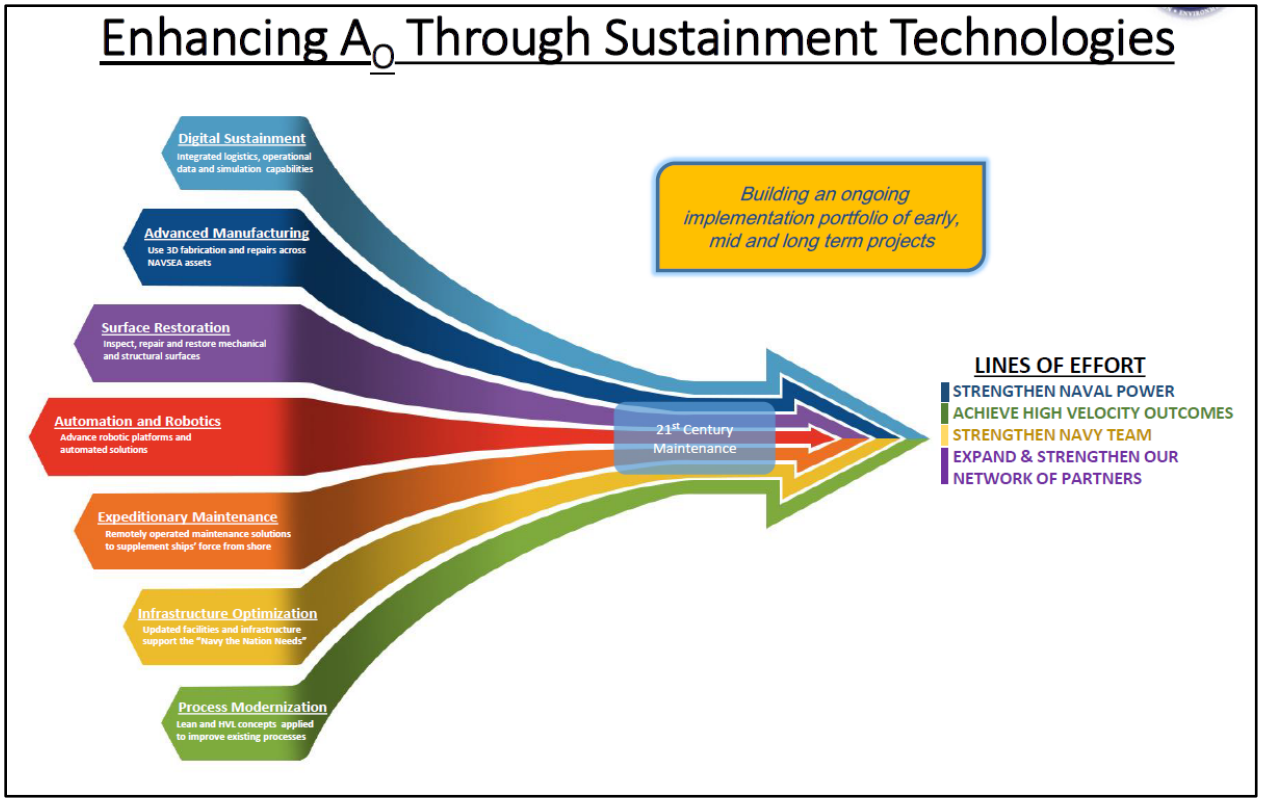

Figure 4 – Digital Engineering Role in Sustainment and Enhancing A_o

OBJECTIVE 4 – Establish the supporting infrastructure and environments for the Digital Engineering practice

An integrated modeling environment (IME) must be established to support Digital Engineering objectives. The IME must be data-centric, provide high bandwidth and throughput, be accessible from multiple networks, and be fully aligned with the Naval Digital Data and Analysis Strategy.

Key tools sets must be provided within the IME to support MBSE processes using Systems Modeling Language (SysML) and Unified Modeling Language (UML). Tool and model users must be able to interact with the government at the model level to support design, configuration management, requirements management, and the creation and satisfaction of Contract Data Requirements List (CDRL) items. Unambiguous authentication policies will be required to ensure only properly vetted and cleared personnel have access to the modeling environment. All individuals and activities accessing the IME must be tracked and logged to support security requirements and maintenance of data pedigree.

Anticipated uses of a Naval Digital Engineering IME includes access to MBSE systems models, platform models, operational threads and webs, and cyber models. These models should be available to perform mission engineering, systems conceptual design, modeling, simulation and analysis, all phases of the systems engineering acquisition, and test and evaluation enabled by live-virtual constructive builds.

The Naval Digital Engineering IME should be present at classified and unclassified security levels to support the full scope of Navy and Marine Corps acquisition programs, sustainment efforts, and engineering workforce superior performance. Appropriate security tagging of data elements is required throughout the IME infrastructure. As Security Classification Guides and data compilation policies are established, the Digital Engineering environment must implement guidance in an automated manner.

OBJECTIVE 5 – Transform the culture and workforce to adopt and support Digital Engineering across the lifecycle

Implementing Digital Engineering is a change management function. Therefore, it requires concerted leadership planning, support, and consistent effort to succeed. Equipping our workforce with relevant skills and experience is a prerequisite to adopting and supporting Digital Engineering across the lifecycle. Moving to a Digital Engineering environment will likely result in new types of positions needed to implement Digital Engineering across DON. Our proposed approach to transforming the Digital Engineering workforce requires combined efforts in personnel recruitment, development and training.

We must identify appropriate roles of Naval employees involved in Digital Engineering and MBSE, as well as the training required to support each role. Training is required in a timely and effective manner so that acquired skills do not atrophy prior to use. Currently identified sets of modeling communities of practice include:

- Model Developers, Users, and Architects
- Model Based Systems Engineers
- Modeling Administrators, Configuration Managers, Curators, and Facilitators, and Verification, Validation and Accreditation (VV&A) Subject Matter Experts
- Systems/Project Owners, Project Leads, Technical Subject Matter Experts

The Naval Systems Commands and their engineering activities have already developed some courses, but expect to develop a full curriculum supporting training, development and sustainment of a model-centric workforce for all required skill areas and required skill levels. Courses implemented to date are:

- MBSE and SysML 101- A week-long course which targets modelers and architects who will regularly perform modeling but do not currently have a comprehensive grasp of SysML. This course instructs participants on the three main building blocks of MBSE; language, tools, processes and techniques. The course also describes benefits of moving from the document based-paradigm to MBSE, and highlights support of systems engineering processes. Additionally, the course provides in-depth introduction to SysML application MagicDraw™.

- MBSE Fundamentals course – This half-day course provides a high level overview of MBSE intended for Project Owners, Program Managers, Technical Directors, Supervisors, and other personnel indirectly involved with effective use of models.

The Naval Postgraduate School will integrate MBSE into its resident Master of Science in Systems Engineering curriculum starting in 2019, using SysML design tools and application within core coursework for five classes.

Additionally, specialized training supporting software development is required for some Digital Engineering roles:

- Defense Acquisition University (DAU) Cloud and DevSecOps Training
- DAU Information Assurance Manager Level 1, DoD 8570.01-M
- Certification for Cloud Computing professionals (e.g. CompTIA™ Cloud Essentials, Amazon™ Web Services, Cloud Practitioner, Microsoft Azure™ for Information Technology Professionals)

The Naval Air Systems Command has conducted an internally funded strategic initiative called the Systems Engineering Transformation (SET) Initiative, piloted at their Aircraft Division. The SET Initiative established an organizational construct, shown in Figure 5. Other Systems Commands plan to leverage SET lessons-learned in support of Navy and Marine Corps Digital Engineering implementation.

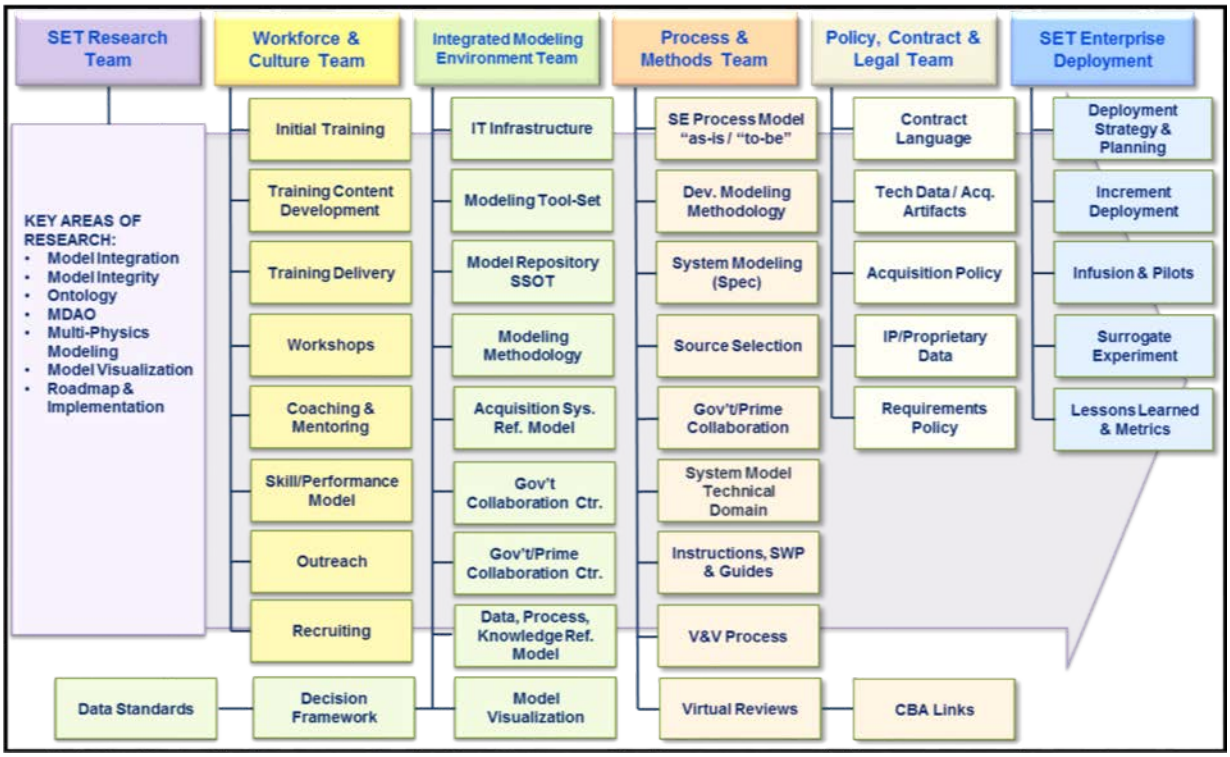

Figure 5 – Systems Engineering Transformation (SET) Implementation Plan

Governance

The Navy and Marine Corps will use an existing, mature technical oversight structure provided by the Systems Engineering Stakeholders Group (SESG) to collaborate and to determine technical requirements for implementing digital transformation. Figure 6 depicts the SESG membership. Leadership consists of the Chief Engineers (CHENGs) from each Systems Command, as well as the Deputy Assistant Secretary of the Navy, Research, Development Test and Evaluation (DASN (RDT&E)). Other key stakeholders include resource sponsors for the Navy and Marine Corps, the Naval Postgraduate School, the United States Naval Academy, and Program Executive Office for Strategic Systems Programs (PEO SSP).

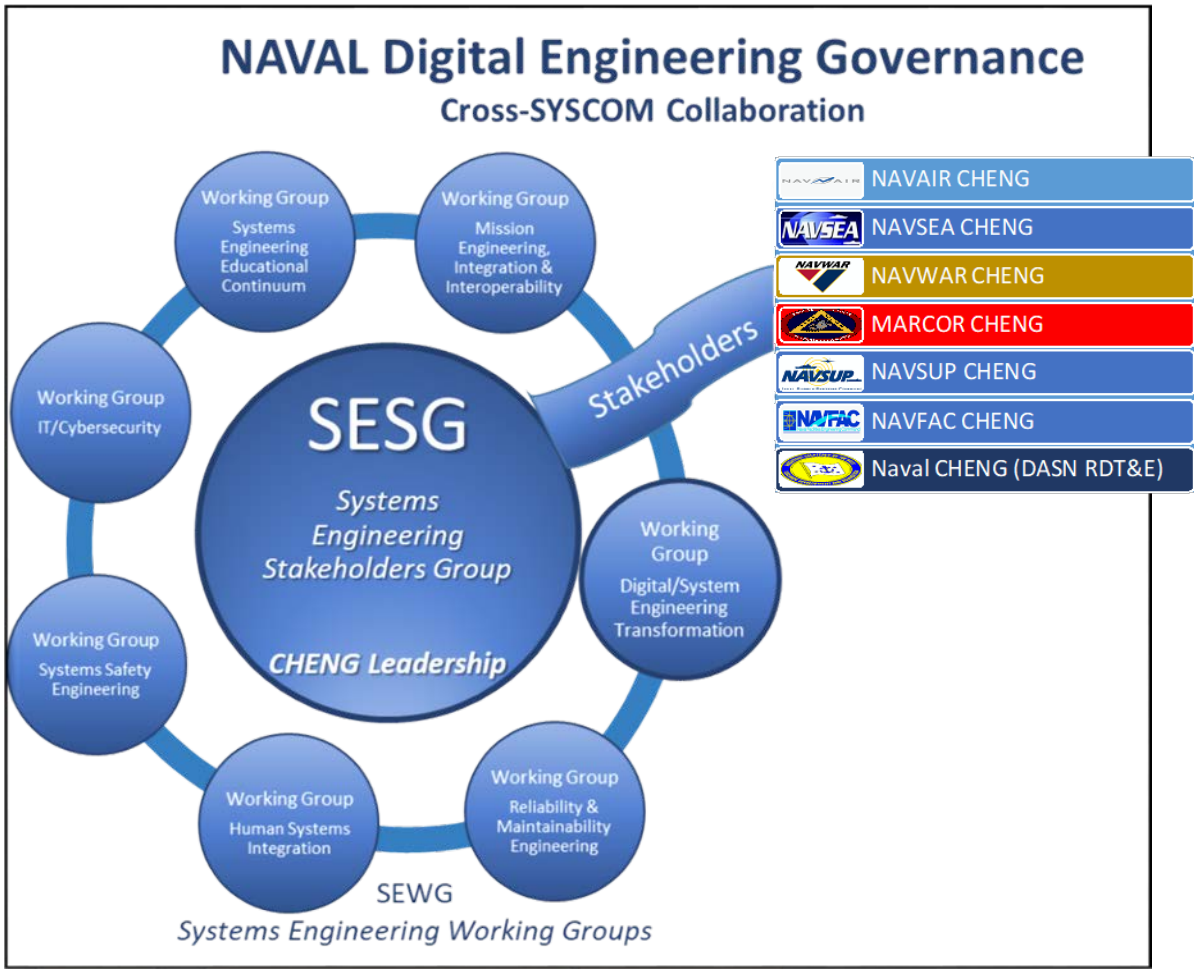

Figure 6 – Naval Digital Engineering Governance and Cross-SYSCOM Collaboration by Chief Engineers (CHENGs)

This governance structure implements the Digital Engineering transformation at the collaborative SYSCOM level, under the Technical Authority (TA) of the CHENGs.

Cross-SYSCOM Working Groups established under the SESG will support implementation of the Navy and Marine Corps Digital Systems Engineering Transformation Strategy at the Corporate, SYSCOM, or domain level. Appropriate use of models and tools will be codified by the Technical Authority as metrics, and will be used as Objective Quality Evidence at technical reviews. Areas for further discussion include: digital standards, tools, and processes; workforce skills and training; model validation; data validation; model schemas; model sustainment requirements; and dictionaries, term definitions, and ontology.

Program offices play a critical role in digital transformation, are central to managing digital expectations, and are essential to its success. Both government and industry engineering activities must highlight potential cost, schedule, and performance improvements realized under a Digital Engineering approach to the Program Manager before they commit to an acquisition strategy. Program offices must also be encouraged to use digital deliverables in place of paper documentation, prioritize funding in support of digital efforts for new acquisition initiatives and major product improvements, and make smart decisions regarding implementation of Digital Engineering for contracts in place. The Program Office team will need to understand which data and intellectual property rights the government must retain and which can be satisfied with government purpose rights, and properly balance requirements with available funding.

Next Steps

OBJECTIVE 1 – Formalize the development, integration and use of models

1.1 Use digital approaches to deliver immediate and long-term competitive advantage in operations and readiness with Naval acquisition programs

1.1.1 Implement Digital Engineering for all new Naval acquisition programs, and significant modifications or enhancements to existing sustainment programs, under direction of the Milestone Decision Authority or delegated Program Decision Authority

1.1.2 Implement Digital Engineering for legacy programs and non-acquisition programs as soon as possible as determined by the Program Executive Offices and SYSCOM Commanders, who have been tasked to identify programs that can be "digitized"

1.1.3 Implement Digital Engineering across programs and domains utilizing the Digital Warfare Office /Naval Digital Integration Support Cell, formed to address cross-program integration and interoperability roles and responsibilities. The Digital Integration Support Cell will provide the core environment, services, and expertise to successfully support and scale digital and data initiatives taking place throughout the DON

1.2 Scale results from pilot projects across mission areas

1.2.1 Implement across common programs and systems, incorporating lessons learned

1.2.2 Collaborate with industry and other services to capture best practices

1.3 Implement and maintain mission-level models within an integrated modeling environment to support programs and capabilities across mission areas

1.4 Incorporate institutional changes through requirements, resourcing, and acquisition policy, prioritizing and implementing digital approaches within naval acquisition and sustainment programs

OBJECTIVE 2 – Provide an enduring authoritative knowledge source

2.1 Develop an authoritative knowledge source for accessing the models, data, standards, and strategies, used to implement the digital transformation; the authoritative knowledge source will include reference libraries, reference models, process models, physical models, and other items needed to perform Digital Engineering

2.1.1 Implement an authoritative knowledge source that is accessible from any stakeholder network

2.1.2 Provide required (multi-point) authentication for access and separation of project data and information for both government, industry, and other acquisition partners accessing the authoritative knowledge source from their networks

2.2 Establish a configuration management policy for maintaining the authoritative knowledge source and technical baselines

2.2.1 Establish a standard set of configuration management processes for models, as used and shared throughout their lifecycle

2.2.2 Provide a set of standard Digital Engineering tools that are accessible via the same networks

2.2.3 Create, share and manage a common ontology and lexicon as a reference dictionary

2.3 Identify a Digital configuration management champion (Data Curator) to manage, oversee and map efforts related to data and digital transformation

2.3.1 Establish technical procedures for developing and maintaining models

2.3.2 Review and approve data architectures, data standards, and data-related aspects of program plans as part of the requirements and acquisition process

2.4 Establish and share best practices for the development and assessment of data architectures, data standards and data strategies

2.5 Identify common reference models for use across the Naval enterprise, for acquisition, technical analysis and development efforts

2.6 Establish combined and clear security guidelines for modeling capabilities, tasks, functions, gaps, allocation to programs, and program specifics

OBJECTIVE 3 – Incorporate technological innovation to improve the engineering practice.

3.1 Implement agile, user-centered approaches to design, develop, test, certify, field, train, and sustain rapid, responsive, and reliable digital capabilities

3.2 Implement processes and metrics to clearly determine mission outcomes, produce and prioritize options for digital solutions, scope pilot projects, and scale digital solutions

3.3 Utilize system models for objective quality evidence for Systems Engineering Technical Reviews (SETRs). Establish model maturity metrics for use in SETR events. Automate checks as much as possible

3.4 Leverage artificial intelligence and machine learning technologies that learn, adapt, and act autonomously

3.5 Establish a system of systems meta-model for the development of the rules, constraints, models, and theories applicable across a set of systems

3.6 Ensure data is readily available by leveraging technologies that provide for an environment where computing, storage, and networking resources are logically separated from physical locations, and are managed by software, through a web-based interface

OBJECTIVE 4 – Establish the supporting infrastructure and environments for the Digital Engineering practice.

4.1 Identify and modify Systems Command Technical Authority and associated documentation to incorporate Digital Engineering and design and integration principles

4.2 Implement integrated live, virtual and constructive environments to support the design, development, testing, certification, fielding, and training of integrated capabilities in a time-effective and cost-effective manner, based on desired mission capability outcomes

4.3 Create a common Naval Development Secure Operations (DevSecOps) environment where the Navy, Marine Corps, and their partners can prototype, test, refine, and deploy algorithms, analytic tools and solutions based on data and user feedback to improve warfighting and readiness outcomes

OBJECTIVE 5 – Transform the culture and workforce to adopt and support Digital Engineering across the lifecycle

5.1 Develop and promulgate guides for professionals who execute Digital Engineering and MBSE

5.1.1 Create and make broadly available a standard suite of MBSE tools that include a requirements management framework, schema and templates, an integrated dictionary, file exchange formats and data guides

5.1.2 Create modeling style guides shared across SYSCOMs and Program Offices, as well as our industry partners

5.2 Foster development of the MBSE and Digital Engineering workforce

5.2.1 Establish and assess competencies that require Digital Engineering skills and training

5.2.2 Establish training for a Digital Engineering skilled and proficient workforce, providing for retooling of the workforce in order to maintain subject matter expertise

5.2.3 Establish communities of interest where people can share lessons learned, discuss issues, and pose questions when executing Digital Engineering

5.2.4 Participate in community forums outside the Naval and DoD enterprise to capture best practices, drive standards development, and support common government-industry engineering approaches and best practices

5.3 Use Leadership Forums, program reviews and public affairs resources to foster a positive Digital Engineering campaign ; identify gains and share success stories regarding new efforts

Business Case

The Navy and Marine Corps have funded ad-hoc digital-related engineering evolutionary efforts for decades. However, concerted funding to accelerate the implementation of the authoritative knowledge source, establish the tools and training environments, and transform our engineering processes and authorities are necessary to catalyze the return on investment.

Digital Engineering will be applied within pilot efforts in order to deliver lethal and sustainable effects sooner, improve decision-making agility, deliver system of systems capabilities more affordably, and spread best practices across the engineering and acquisition workforce. We expect Digital Engineering to yield savings on current and future programs over the systems life cycle by enabling future expandability and upgradeability with less rework, streamlining sustainment practices and reducing required material inventories. We will identify the right amount of centralized funding to lead development of enterprise solutions, which will benefit the entire Navy and Marine Corps acquisition workforce, taking advantage of economies of scale concerning the purchase of tools and tool licenses.

Results of this strategy will help inform future investment decisions in future execution years toward greater interoperability systems and architectures. Future program plans and budgets should emphasize wise places to implement Digital Engineering in order to realize time and cost savings, test sooner, provide capability to the fleet faster, and build the infrastructure to enable future digital capabilities.