Models, Simulations, and Digital Engineering in Systems Engineering Restructure (Defense Acquisition University CLE011)

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Vision of Digital Engineering
(aka Model-Based)

CURRENT STATE
- Our workforce uses stove-piped data sources and models in isolation to support various activities throughout the life-cycle
- Current practice relies on standalone (discipline-specific) models
- Communication is through <u>static</u> <u>disconnected</u> documents and subject to interpretation

FUTURE STATE
- Digital Engineering moves the engineering discipline towards an integrated model-based approach
  - Through the use of digital environments, processes, methods, tools, and digital artifacts
  - To support planning, requirements, design, analysis, verification, validation, operation, **and/or** sustainment of a system.
- Digital Engineering ecosystem links our data sources and models across the lifecycle
  - Provides the authoritative source of truth

Current: Stove-piped models and data sources   **Future:** Digital Engineering Ecosystem

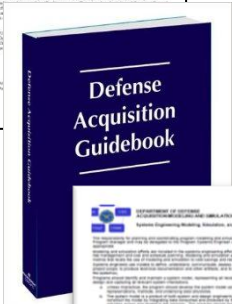# Leveraging Multiple Activities to Advance Digital Engineering Within DoD

Infusion in Policy & Guidance

http://www.acq.osd.mil/se/pg/guidance.html

DoDI 5000.02, Enclosure 3, Section 9: Modeling and Simulation

Defense Acquisition Guidebook Chapter 4
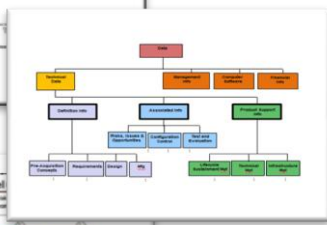
DoD Digital Engineering Fundamentals
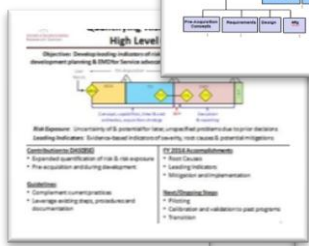
Defense Acquisition University

DoD Initiatives

Digital Engineering Working Group

DoD Digital Engineering Working Group (DEWG)

DSM Taxonomy: Defining categories of data across acquisition

SERC: Model Centric Collaborative Environment

Engineered Resilient Systems: Adapting to changing requirements

HPCMP CREATE: Physics Based Modeling

Other Partnerships

USAF Own the Technical Baseline

NDIA: Essential Elements of the System Model

DMDII
DIGITAL MANUFACTURING AND DESIGN INNOVATION INSTITUTE

Additive Manufacturing

Inter-Agency Working Group on the Engineering of Complex Systems

Inter-Agency Working Group

NASA: Sounding Rocket Program

Advancing the state of practice for Digital Engineering within DoD

CLE 011 Objective & Scope

CLE 011 - Models Simulations and Digital Engineering in Systems Engineering

- Mission: Develop and field a distance learning course CLE011, to incorporate Digital Engineering Concepts while maintaining modeling and simulation fundamentals.

- Scope: Length: 4-5 hours. Series of modules 20-30 minutes

- Target audience: Acquisition professionals from all workforce areas (PM, ENG, LOG,T&E, S&T, Contracting)

CLE 011 Course Description

ORIGINAL: Modeling and Simulation (M&S) for Systems Engineering

- Provided an overview of how M&S supports the DoD acquisition process, outlines relevant DoD acquisition policy and guidance and summarizes how M&S supports Systems Engineering.

- How to plan for its effective use; the reuse of M&S assets; the key aspects of Verification, Validation, & Accreditation (VV&A); and understand how the government should plan for contracting support for M&S.

RESTRUCTURED: Models, Simulations and Digital Engineering in Systems Engineering

- Describe the use of models and simulations in the context of the digital engineering (model-based) activities ongoing in the Department, and the Defense Industry.
- Discuss the value of consistent and coherent use of models in support of DoD acquisition system activities.
- Outline the need for properly aligning the use of digital artifacts to tasks, and the attributes necessary to ensure success on engineering efforts.

Incorporating Digital Model-Centric Engineering in the Engineering Curriculum

CLE 011 Course Outline

- **This course consists of the following:**
  - Course Overview (Introduction)
  - Course Topics:
    - o Lesson 01 Digital Engineering Concepts
    - o Lesson 02 Preparing for Digital Engineering Ecosystem
    - o Lesson 03 Acquisition Considerations
    - o Lesson 04 Using Digital Artifacts to Gaining Community Acceptance and Understanding Risk
    - o Lesson 05 Examples Using Digital Artifacts
  - Course Summary
  - End of Course-Exam
  - User Survey

This course specifically address DOD directions and guidance

Lesson 1
Digital Engineering Concepts

Lesson one provides a basic understanding of the use of "models" in the context of Digital Engineering. Modeling is essential to aid in understanding complex systems and system interdependencies.

This lesson sets the stage for understanding:

- The motivation for change to have models and supporting technical data as the source of truth and not the documents.

- The tenets in DoD policy and guidance supporting the change to Digital Engineering

- The terms that support the concept for Digital Engineering

- Use of model based approach to increase program success and establish the models as the authoritative source

- Models, simulations, and artifacts developed and used as a technical continuum through the program lifecycle.
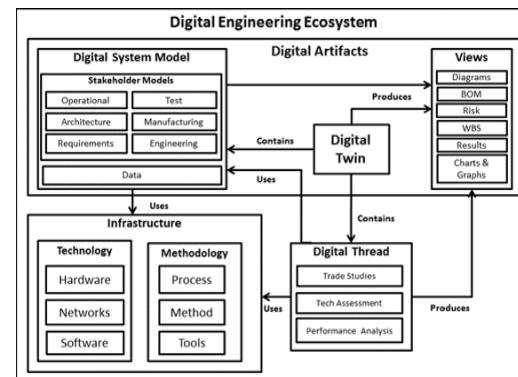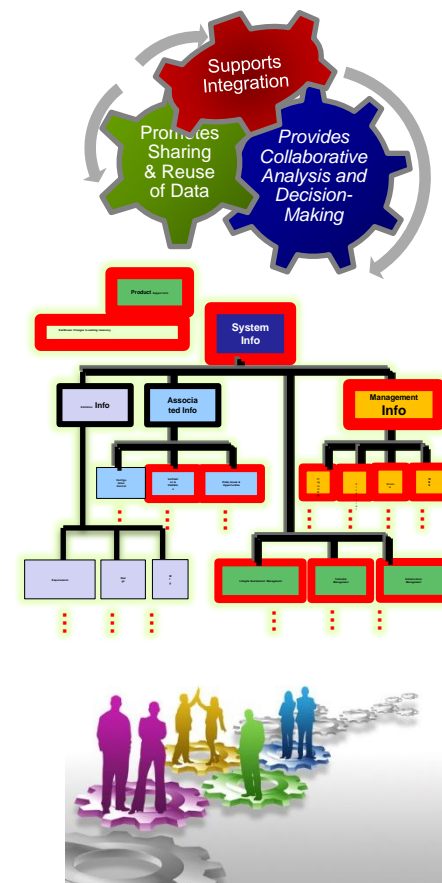
Lesson 2
Preparing for a Digital Engineering Ecosystem

Lesson two provides the considerations when moving towards the future state of the Digital Engineering Ecosystem.

This lesson explores considerations for:

- Integrating methods, processes, tools and data in a collaborative environment
- Incorporating the Digital System Model (DSM) taxonomy as general guidance of how the data should be structured, developed, and used
- Providing end-to-end data management for creating, processing, sharing, and reusing data/information across across the lifecycle
- Defining workforce needs for the development and use of models, data and digital artifacts during the acquisition lifecycle.
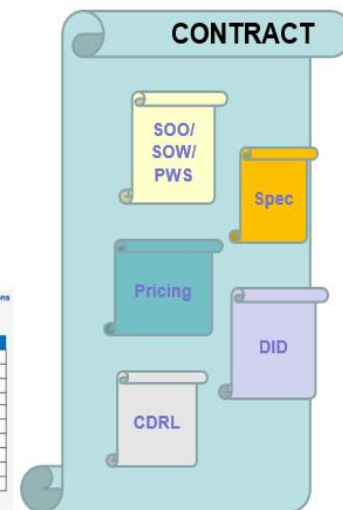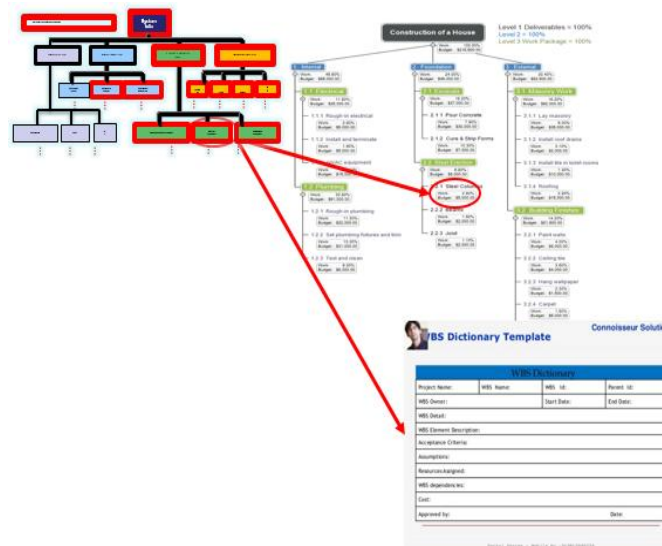
Lesson 3
Acquisition Considerations

Lesson three provides understanding of how Digital Engineering tasks and products are put on contract.

DE Ecosystem related tasks require multiple considerations that consist of:

- Inclusion of modeling, simulation, and digital engineering tasks in the RFP.
- Obtaining the appropriate model and digital engineering artifacts and deliverables using the proper contractual mechanism.
- Acquiring the data and data rights to support digital engineering activities
- Identifying and managing the full spectrum of IP and related issues throughout the lifecycle
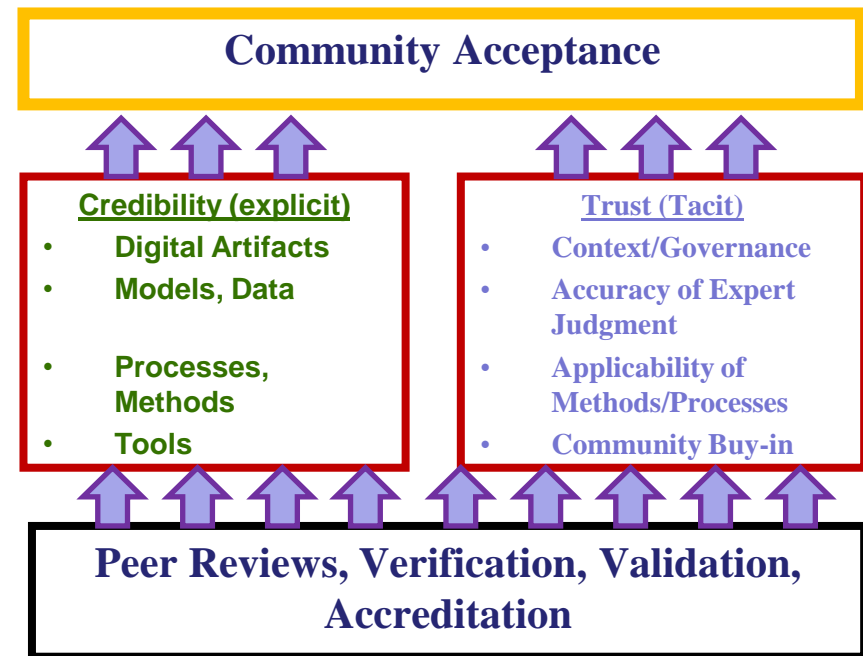
Lesson 4
Using Digital Engineering to Gain Community Acceptance and Understand Risks

Lesson four provides key enablers for understanding how to gain Acceptance and Approval for Models and Digital Engineering artifacts.

This lesson provides an understanding of how to:

- Gain the communities' acceptance and the stakeholder's trust for using Digital Engineering
- Verify and validate the models to increase confidence in the pedigree of the single source of truth
- Identify and mitigate the programs' risks
- Determine the risks associated with using a Digital Engineering approach

Community Acceptance

Credibility (explicit)
- **Digital Artifacts**
- **Models, Data**
- **Processes, Methods**
- **Tools**

Trust (Tacit)
- **Context/Governance**
- **Accuracy of Expert Judgment**
- **Applicability of Methods/Processes**
- **Community Buy-in**

Peer Reviews, Verification, Validation, Accreditation

Lesson 5
Examples of Using Digital Artifacts

Lesson five provides an understanding of how digital artifacts support system-of-systems, program interoperability, and modularity (as part of Modular and Open System Approach)

This lesson provides examples showing how:

- Digital artifacts support interoperability to consistently share and exchange data and models across stakeholders

- Digital artifacts support the spectrum from one system to a System of Systems (SoS) in order to deliver unique capabilities that achieve the mission

- Digital artifacts support Modular Open Systems Approaches (MOSA) to enable modular and adaptable open interfaces of new and/or legacy systems
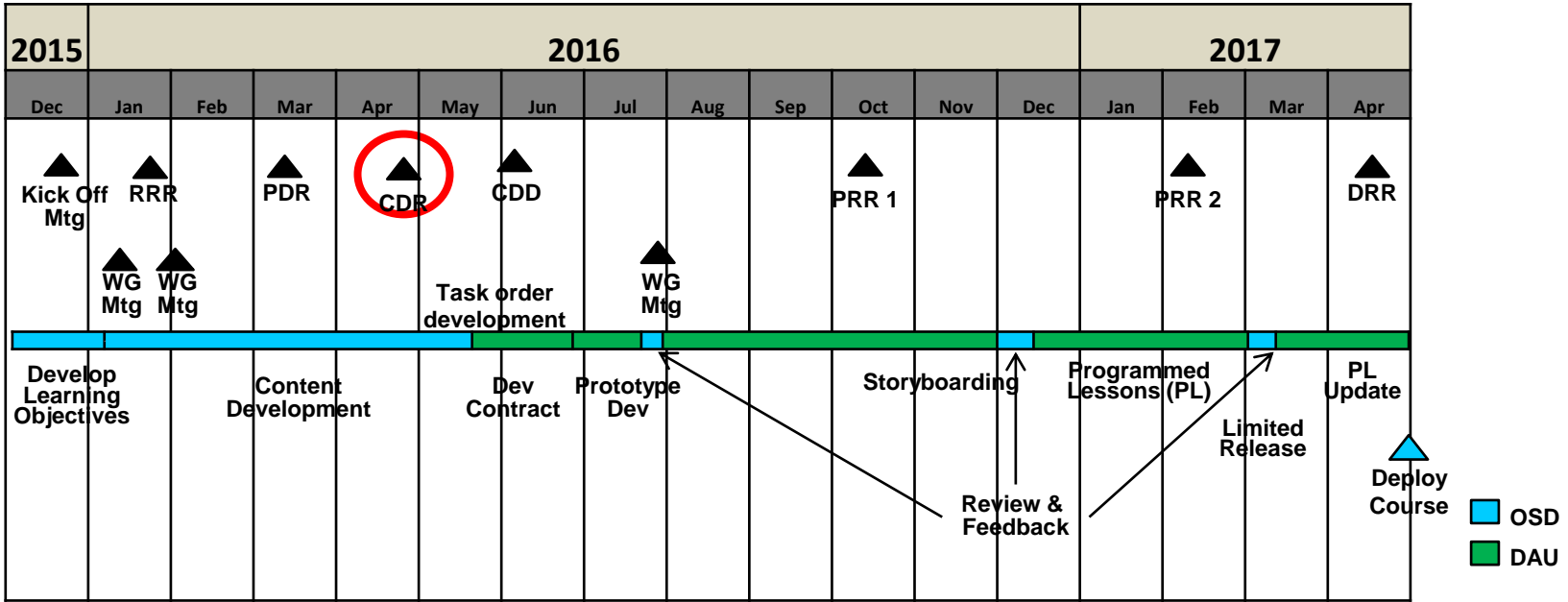
Cohesively using digital artifacts throughout the lifecycle is critical

Next Steps

Upcoming Milestones

Deliver Storyboards	30 Nov 2016
Deliver Limited Release Course	28 Feb 2017
Full Deployment	28 Apr 2017

Timeline chart showing milestones from 2015 to 2017:
- 2015 Dec: Kick Off Mtg
- 2016 Jan: RRR, WG Mtg
- Feb: WG Mtg
- Mar: PDR
- Apr: CDR (circled)
- Jun: CDD
- Jul: WG Mtg
- Oct: PRR 1
- 2017 Feb: PRR 2
- Apr: DRR

Phases: Develop Learning Objectives, Content Development, Task order development, Dev Contract, Prototype Dev, Storyboarding, Programmed Lessons (PL), PL Update, Review & Feedback, Limited Release, Deploy Course

Legend: OSD (blue), DAU (green)

Requesting volunteers to serve as beta testers

Additional Digital Engineering Activities

- **Journal of Defense Modeling and Simulation**
  - Special issue paper with three focus areas: Digital Engineering, Engineered Resilient Systems, and Modular Open Systems Approach. Includes OSD, Services, and Systems Engineering Research perspectives.
  - February 2017 Publication

- **Digital System Model Taxonomy**
  - Provide the foundational framework for organizing and communicating technical data

- **Digital Engineering Strategy**
  - Instantiate strategic goals, objectives, and recommendations to realize the DoD Digital Engineering Vision

- **Digital Engineering Working Group (DEWG)**

- **Digital Engineering Website**
  - http://www.acq.osd.mil/se/initiatives/init_de.html

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Systems Engineering:
Critical to Defense Acquisition

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