Test and Evaluation (Part I)

TOPIC LEARNING OBJECTIVES

Upon successful completion of this topic, the student will be able to:

1. Recognize the fundamentals of Test and Evaluation (T&E).
2. Identify how T&E supports risk management by milestone decision authorities.
3. Recognize how T&E supports the Systems Engineering Process.
4. Identify the characteristics and purposes of the different types of T&E and the organizations responsible for each.
5. Identify the key T&E support organizations within DoD.
6. Identify the role of modeling and simulation as a tool in the systems engineering process.
7. Recognize the importance of modeling and simulation in the defense acquisition process.
8. Identify the regulation that dictates the development of a Test and Evaluation Master Plan (TEMP) and recognize why there is a need to develop a TEMP for most programs.
9. Recognize how the TEMP generation, staffing and approval process integrates all functional disciplines throughout the acquisition life-cycle.
10. Identify issues affecting T&E resource requirements, test planning, and test execution activities in support of a program's acquisition strategy.
11. Identify the requirements for interoperability testing.
12. Identify the key Operational Test & Evaluation (OT&E) activities that must be coordinated with the Director Operational Test & Evaluation (DOT&E) staff and the Operational Test Agencies.

STUDENT PREPARATION

Student Support Material

1. Department of the Navy Test & Evaluation. Total Training catalog and Career guide

Primary References

1. DoD 5000.89 Series
2. SECNAV 5000.2
3. USD(R&E) and OPTEVFOR T&E Enterprise Guidebook
4. COMOPTEVFORINST 3980.2I
5. DOT&E Extranet (https://extranet.dote.osd.mil/Oversight/index.html)

Additional References

1. None

Overview

- Introduction
- T&E Types and Organizations
- Test and Evaluation Master Plan (TEMP)
- TEMP Considerations
- Modeling and Simulation

What is T&E?

- Test and Evaluation (T&E) is the process by which a system or components are compared against requirements and specifications through testing. The results are evaluated to assess progress through design, performance, and supportability
- T&E exercises a system or component(s) and analyzes results to provide performance-related information to:
    - Identify risks
    - Reduce cost, schedule and performance risk
    - Validate models & simulation
    - Determine effectiveness, suitability, survivability and/or lethality
    - Demonstrate exit criteria needed for milestones and decisions
    - Help predict program deviations
    - Assist in trade studies

The fundamental purpose of T&E is to enable the DoD to acquire systems that work

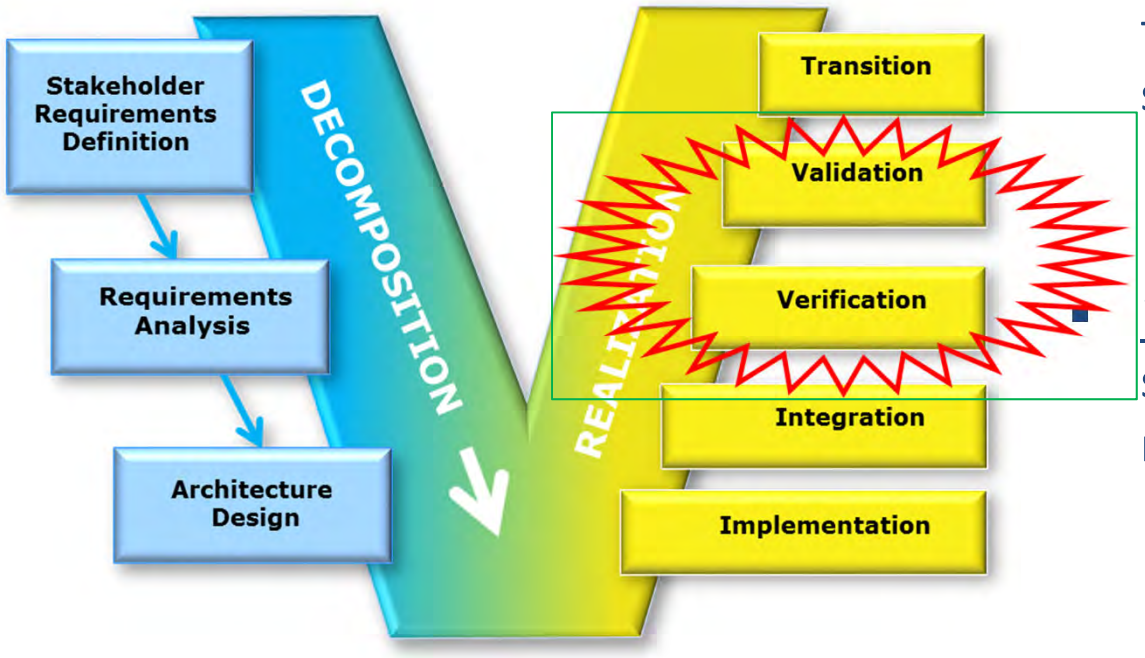
Why Test?

T&E Terminology

- Test – a program, procedure, or process to obtain, verify, or provide data for determining the degree to which a system (or subsystem) meets, exceeds, or fails to meet its stated capabilities
- Evaluation – the review, analysis, and assessment of data obtained from testing used to project system performance under operational conditions
- Difference between Testing and Evaluation:

Testing	Evaluation
Obtains raw data	Produces analyzed information from test data, modeling and simulation, or other sources
Measures specific, individual performance factors	Draws conclusions by looking at how the data interact
Is resource intensive	Is intellectually intensive

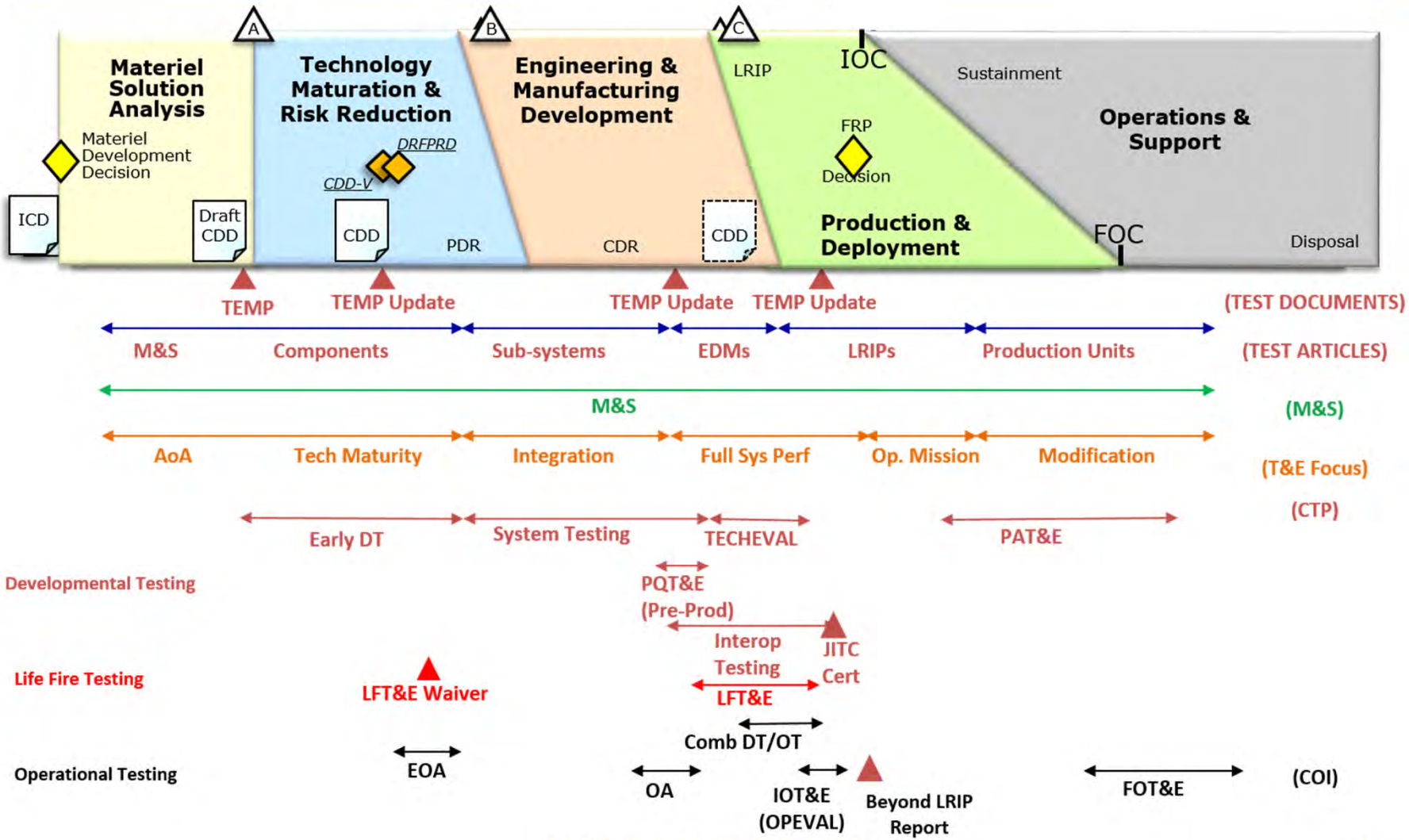
Systems Engineering Process



- ***Verification*** – ensures that the solution meets the specified requirements
  - Did we build it right?
- ***Validation*** – ensures that the solution meets the user's needs
  - Did we build the right thing?

T&E is the primary method to verify the design meets requirements and validate solution meets user's needs

Test and Evaluation



Statutory Requirements

- WEAPON SYSTEMS ACQUISITION REFORM ACT of 2009 (WSARA 2009):
  - SEC. 102
    - Created position of Director of Developmental Test and Evaluation; and Director of Systems Engineering
  - SEC. 104
    - Requires the periodic reporting by Director of Developmental Test and Evaluation of the technological maturity and integration risk of critical technologies of the major defense acquisition programs of the Department of Defense
  - Director of Defense Research and Engineering submits an annual report to Congressional defense committees describing additional resources that may be required for:
    - The annual report on the technological maturity and integration risk of critical technologies of major defense acquisition programs
    - The technological maturity assessments required by section 2366b(a) (renumbered 4251 and 4252) of Title 10, United States Code
    - The requirements of Department of Defense Instruction 5000, as revised

Statutory Requirements

- WEAPON SYSTEMS ACQUISITION REFORM ACT of 2009 (WSARA 2009):
  - Director of Defense Research and Engineering, in consultation with the Director of Developmental Test
    - Shall develop knowledge-based standards against which to measure the technological maturity and integration risk of critical technologies at key stages in the acquisition process for purposes of conducting the reviews and assessments of major defense acquisition programs required by subsection (c) of section 139a of Title 10, United States Code
  - Secretary of Defense approves Independent Technical Risk Assessments (ITRA) before milestone A or B per sections 4251 and 4252, respectively, of title 10, U.S. Code. 10 U.S.C. §4272
    - Secretary of Defense delegated this responsibility, to OUSD(R&E) per DoDI 5000.88, Engineering of Defense Systems, 18 Nov 2020
- 10 U.S.C. 2366a (renumbered 4251) Major defense acquisition programs; certification required before Milestone A approval
- 10 U.S.C. 2366b (renumbered 4252) Major defense acquisition programs; certification required before Milestone B approval
- 10 U.S.C. 2399 (renumbered 4171) Operational test and evaluation of defense acquisition programs

Statutory Requirements

- Director, Operational Test and Evaluation (DOT&E) position created in OSD
  - Direct reporting position to SECDEF
  - Annual Operational Test and Evaluation Report to Congress
- Independent, dedicated IOT&E required for ACAT I & II programs
  - No system development Contractor involvement in IOT&E
  - Note: While Integrated DT/OT is recommended, the Contractor's ability to influence Operational Test (OT) results must be avoided
- Beyond LRIP Report (BLRIP) required prior to Full Rate Production
  - For ACAT I programs
  - Addresses OT
  - Is system ***effective & suitable*** for combat?
- Independent OSD Live Fire Test Report required prior to FRP for covered systems
  - For applicable ACAT I & II programs
  - Addresses ***survivability & lethality***
- Position, Navigation, and Timing testing required by Public Law 115-232
  - Collect T&E data, lessons learned, and design solutions

Overview

- Introduction
- T&E Types and Organizations
- Test and Evaluation Master Plan (TEMP)
- TEMP Considerations
- Modeling and Simulation

T&E Types

- Developmental Test and Evaluation (DT&E)
  - Conducted throughout the acquisition process to assist in engineering design and development
  - Used to verify component and system technical performance specifications have been met
  - Controlled by Government PMO
  - Performed by Government labs (e.g., NSWC) and/or Contractor teams
  - Helps identify & control design technical risk
  - DASD DT&E may oversee
- Interoperability Testing
  - Required by CJCSI 3170.01H and 6212.01F
    - Interoperability and Supportability of Information Technology (IT) and National Security Systems (NSS)
  - Certified by Joint Interoperability Test Command (JITC)
    - Conducted during DT and OT
  - Determines latency, information assurance, Joint interoperability, and supportability of IT and NSS systems

T&E Types

- OT&E – Operational Test and Evaluation
  - Assesses the system performance against the user's requirements as stated in the capability documents
  - Determines system ***effectiveness and suitability*** for use in combat by typical military users
  - Performed by Warfighters in operational environment under realistic operational conditions
  - Controlled by Operational Test Agency (OTA)
    - Navy: Commander Operational Test & Evaluation Force (COMOPTEVFOR or COTF)
  - May be overseen by DOT&E and SECDEF (ACAT I and designated programs)
  - Independent from the developer

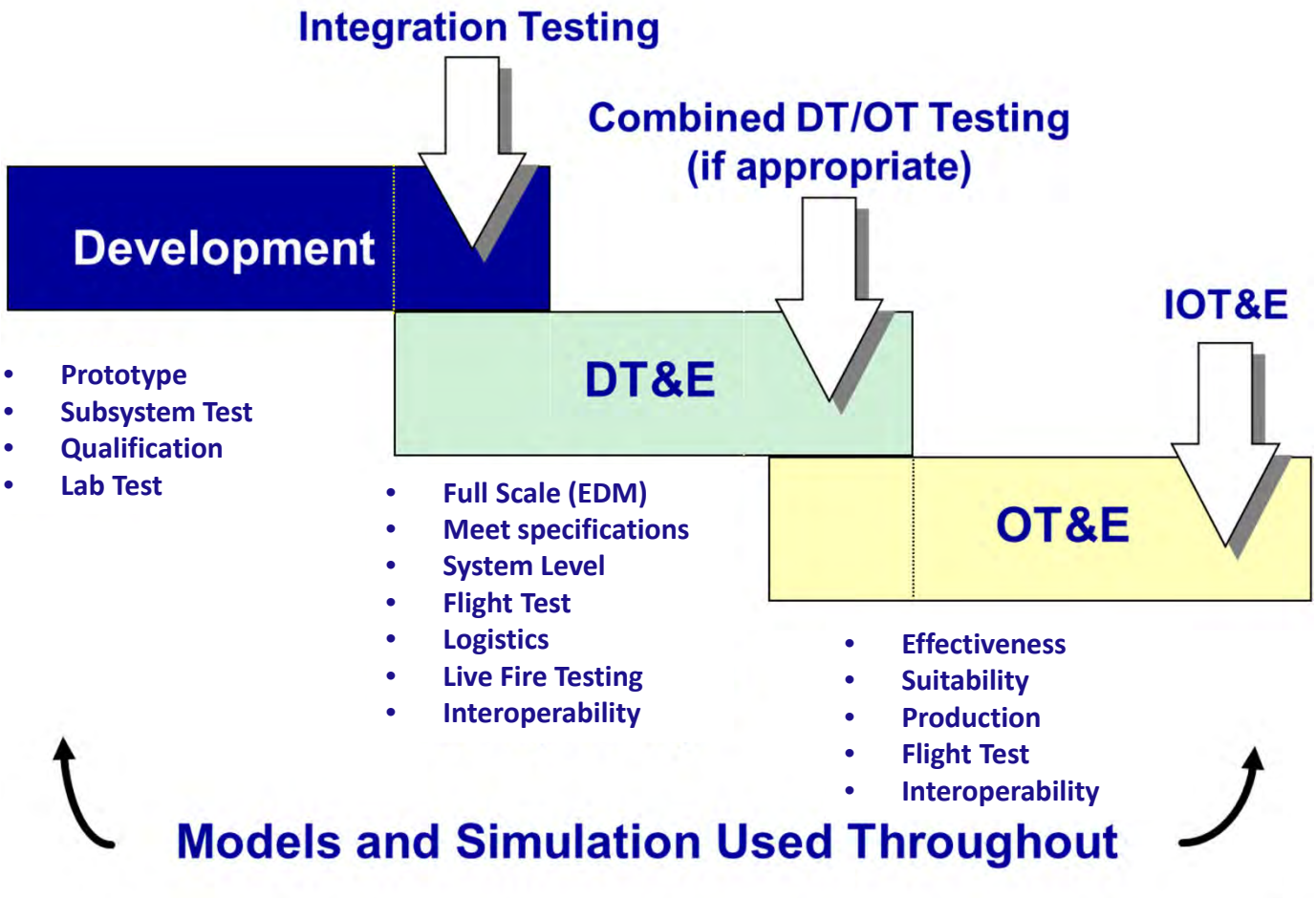
- LFT&E – Live Fire Test and Evaluation
  - Overseen by Director Operation Test and Evaluation (DOT&E)
    - DOT&E approves LFT&E Strategy prior to M/S B
  - Performed by Government labs (e.g., Aberdeen Proving Grounds, NAWC WD, White Sands Missile Range) and/or Contractor teams
  - Determines ***lethality and vulnerability***

DT&E vs OT&E

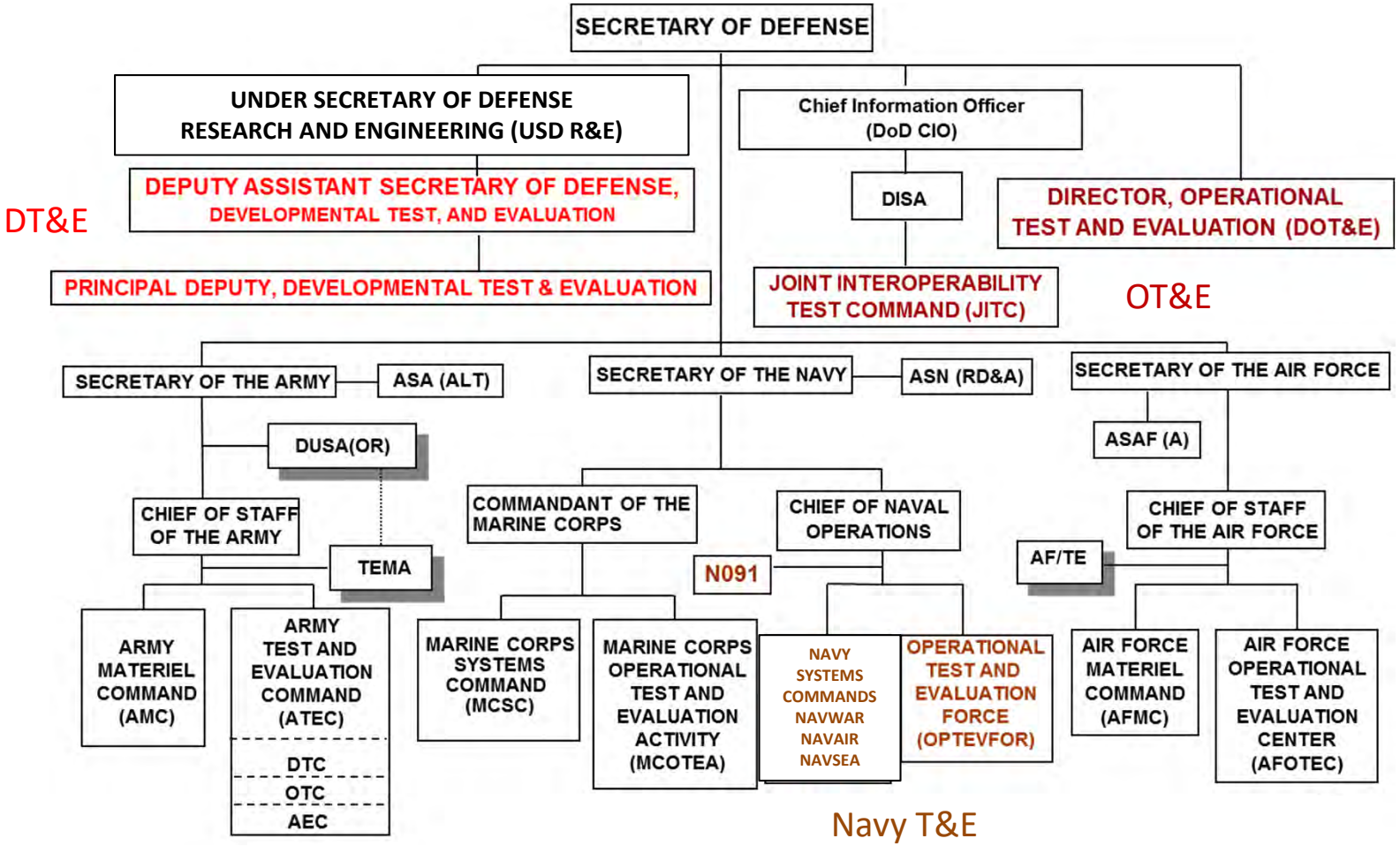
	DT&E	OT&E
What is tested?	Measures technical performance against the design specifications.	Determines operational effectiveness and suitability as defined in the Capability Development Document (CDD) and Capability Production
Who conducts test?	Government and contractor	Government
Who is responsible?	Program Manager	Independent Operational Testing Agency (OTA)
Where is test conducted?	Controlled Environment	Field Environment

- Interoperability certification testing by DISA/JITC is part of DT&E and Operational Assessment (OA) prior to M/S C as well as IOT&E after M/S C
- DOT&E requires testing of cybersecurity during OT&E
- LFT&E is also accomplished in both OT&E and DT&E

Typical Test Sequence



DoD T&E Organization



Director Operational Test & Evaluation (DOT&E)

- Responsibilities outlined in Title 10, United States Code
- Responsible for OT&E and LFT&E within DoD
  - Responsible for evaluating OT&E capability within DoD
    - Oversees activities by Operations Test Agencies (OTA)
    - Approves OT and LFT&E testing plans for Oversight List programs
      - Programs on the Oversight list are ACAT I and smaller programs with Joint impact that are of concern
  - Prepares reports required for Full Rate Production (FRP) decision:
    - Beyond Low-Rate Initial Production (BLRIP) report
    - LFT&E report
  - Prepares annual report to Congress

Deputy Assistant Secretary of Defense for Developmental Test & Evaluation (DASD DT&E)

- Responsibilities outlined in Title 10, United States Code
- Principal advisor to USD (A&S) for DT&E-related matters
  - Responsible for evaluating DT&E capability within DoD
    - Program oversight
    - Policy & guidance
    - Test & Evaluation Master Plan (TEMP) approval (with DOT&E)
  - Collaborative partner with DOT&E to ensure acquisition decisions are supported with appropriate T&E information
  - Partner with Component Acquisition Executive (CAE) to ensure each acquisition program is supported by an appropriate DT&E Strategy
  - Advocate for DT&E Acquisition workforce
  - Prepares annual report to Congress

Commander Operation Test and Evaluation Force (COMOPTEVFOR)

- COMOPTEVFOR, also known as COTF, is the Navy's OTA
  - Created in 1945 to independently determine Operational Effectiveness and Suitability under realistic conditions
- Operational Testing includes:
  1. Early Operational Assessment (EOA)
  2. Operational Assessment (OA)
  3. Operational Evaluation
     a) Initial OT&E (IOT&E)
     b) Verification of Correction of Deficiency (VCD)
     c) Follow-on OT&E (FOT&E)
- COTF derives testable parameters from CDD

PMO must coordinate Operational Testing conducted by COTF and (possibly) overseen by DOT&E

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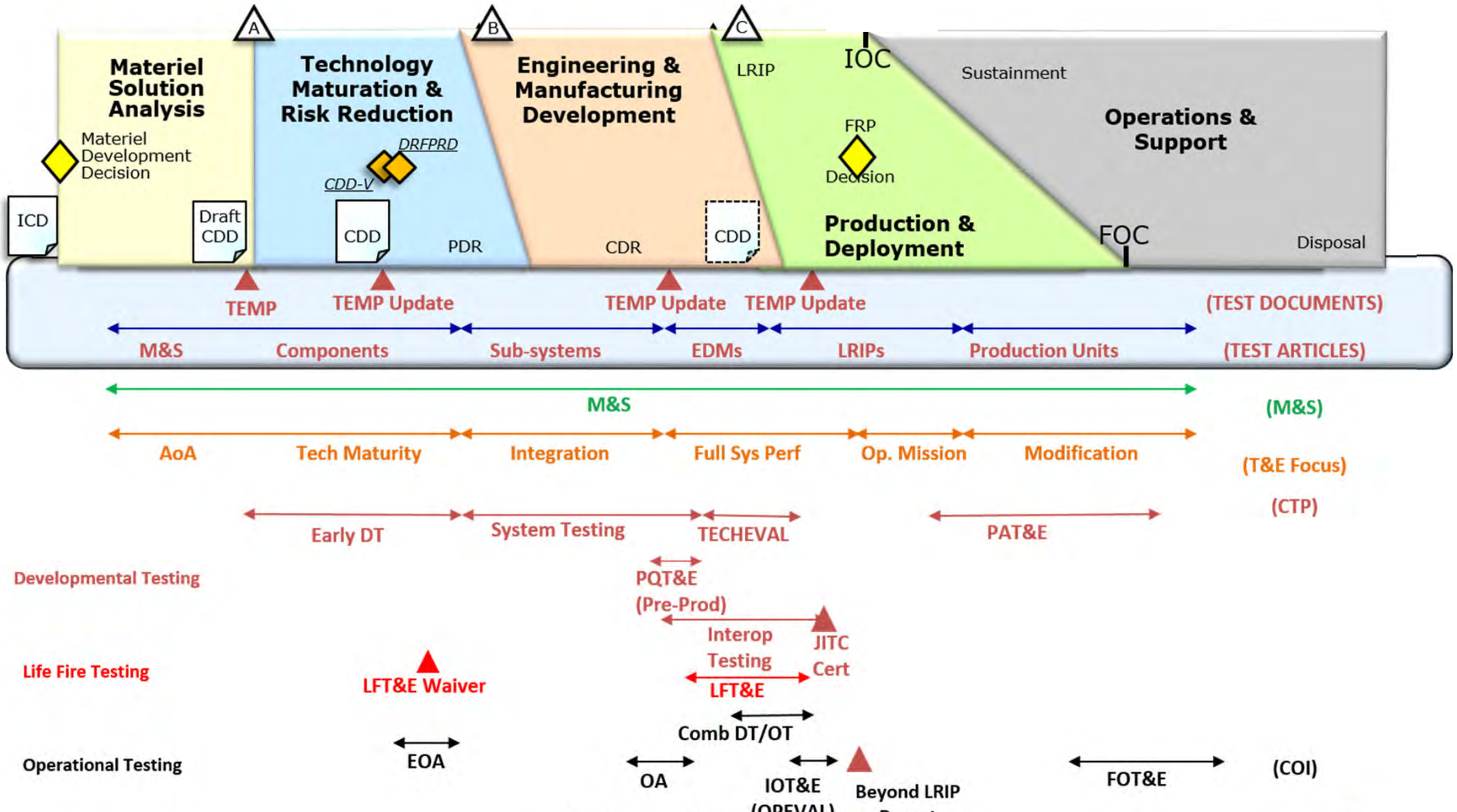
Test & Evaluation



Test & Evaluation Master Plan

- Test and Evaluation Master Plan (TEMP) provides an overall test management plan and framework within which detailed T&E plans are contained
- The TEMP must:
  - Integrate T&E with the overall Acquisition Strategy, reflect the user's capability needs and describe how these capability needs will be tested in DT&E, LFT&E, and OT&E
  - Document the T&E program for the entire life-cycle
  - Specify personnel, funding, and test range support requirements
  - Be developed prior to M/S A Review and updated before each subsequent Program Decision Review
  - Must include strategy and resources for cybersecurity T&E
- TEMP may be waived, or other tailored test strategy documentation be specified, for certain acquisition pathways
  - In cases where the TEMP is not needed, early briefings to Service stakeholders, as well as USD (R&E)
  - TEMP may be waived, or other tailored test strategy documentation be specified, for certain acquisition pathways
- DoDI 5000.89 is the guiding document for TEMP development

TEMP Source Documents

- AcqStrat - Acquisition Strategy
- AoA - Analysis of Alternatives
- APB - Acquisition Program Baseline
- ICD - Initial Capabilities Document
- CDD - Capability Design Document
- VOLT - Validated Online Life-cycle Threat assessment

Capability Documents *are the prime sources of testable parameters for OT&E*

Mandatory TEMP Format

- Part I - System Introduction
- Part II - Test Program Management and Schedule
- Part III - Test and Evaluation Strategy
- Part IV - Test and Evaluation Resource Summary

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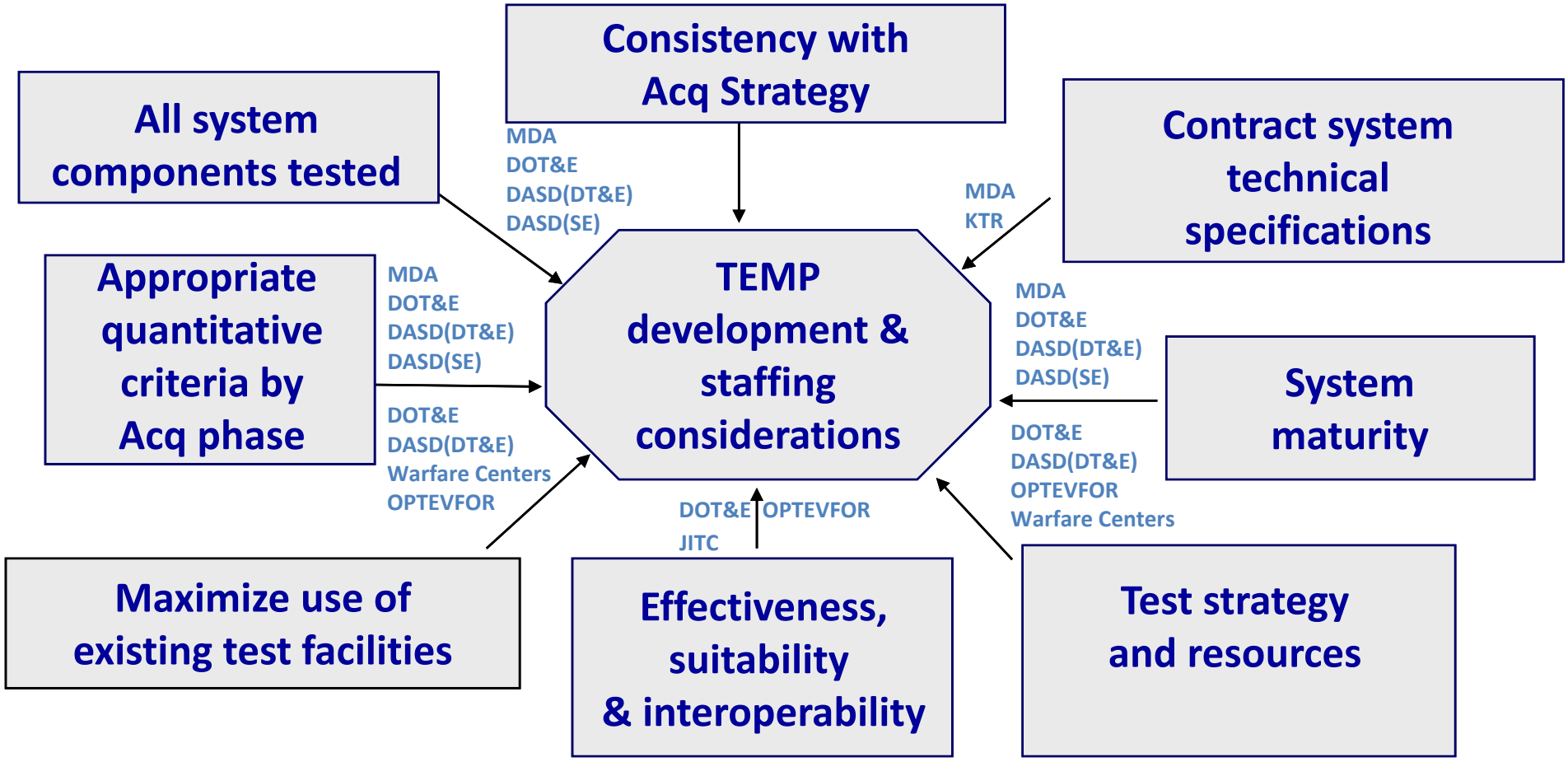
TEMP Planning Considerations



Numerous considerations must be balanced for T&E planning and execution. This is best accomplished via an IPT approach throughout the acquisition life-cycle

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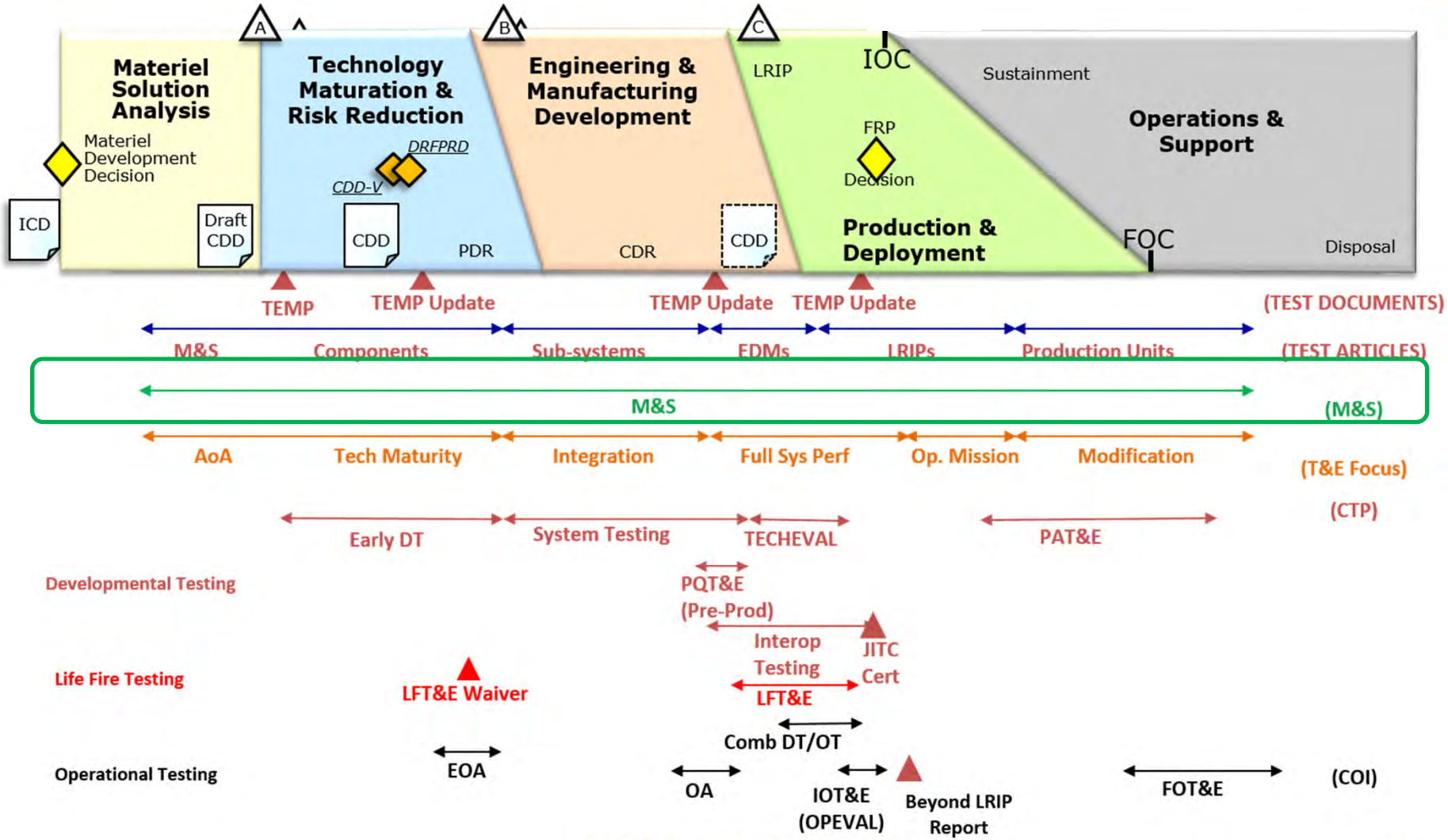
Test and Evaluation



What is Modeling and Simulation?

- Model – ***A representation of an actual or conceptual system*** that can be used to predict how the system might perform or survive under various conditions
- Simulation – ***A method for implementing a model***. Conducting experiments with a model for the purpose of understanding the behavior of the system under selected conditions or of evaluating various strategies for the operation of the system. Military exercises and war games are also simulations
- Some M&S Types
  - Software in the loop (SWIL)
  - Hardware in the loop (HWIL)
  - Human-in-the-loop (HITL)
  - Constructive simulation

Model - static representation of system or process
Simulation - dynamic application of model(s) through time

Modeling and Simulation Example

M&S in Systems Engineering

- M&S can represent the system-of-systems environment for systems engineering to design, develop, and test individual systems
  - Cost precludes the development of full-scale prototypes merely to provide proof of concept
  - Cost of testing events limits the number of tests that can be conducted
  - Do not rely solely on M&S, actual testing must be conducted to catch potential problems
- M&S Through the Acquisition Phases
  - **Pre-Acquisition Concepts, Experimentation, and Prototyping** - Use M&S to: Model CONOPS, perform cost, schedule, and performance trades, discover system interoperability
  - **Materiel Solution Analysis Phase** – Use M&S to: Assess materiel solutions, estimate life cycle costs, model CONOPS and mission context, model interoperability and warfighter integration, conduct industrial and manufacturing capability analysis, model supportability and sustainment
  - **Technology Maturation and Risk Reduction Phase** - Use M&S to: Conduct trade studies, model system threat integration, model environment and demonstrate technology, conduct interoperability and supportability analysis, model operational suitability and affordability, assess industrial and manufacturing readiness, estimate manpower and cost, model system-to-performance specifications, plan T&E activities, prototype human interfaces

M&S in Systems Engineering

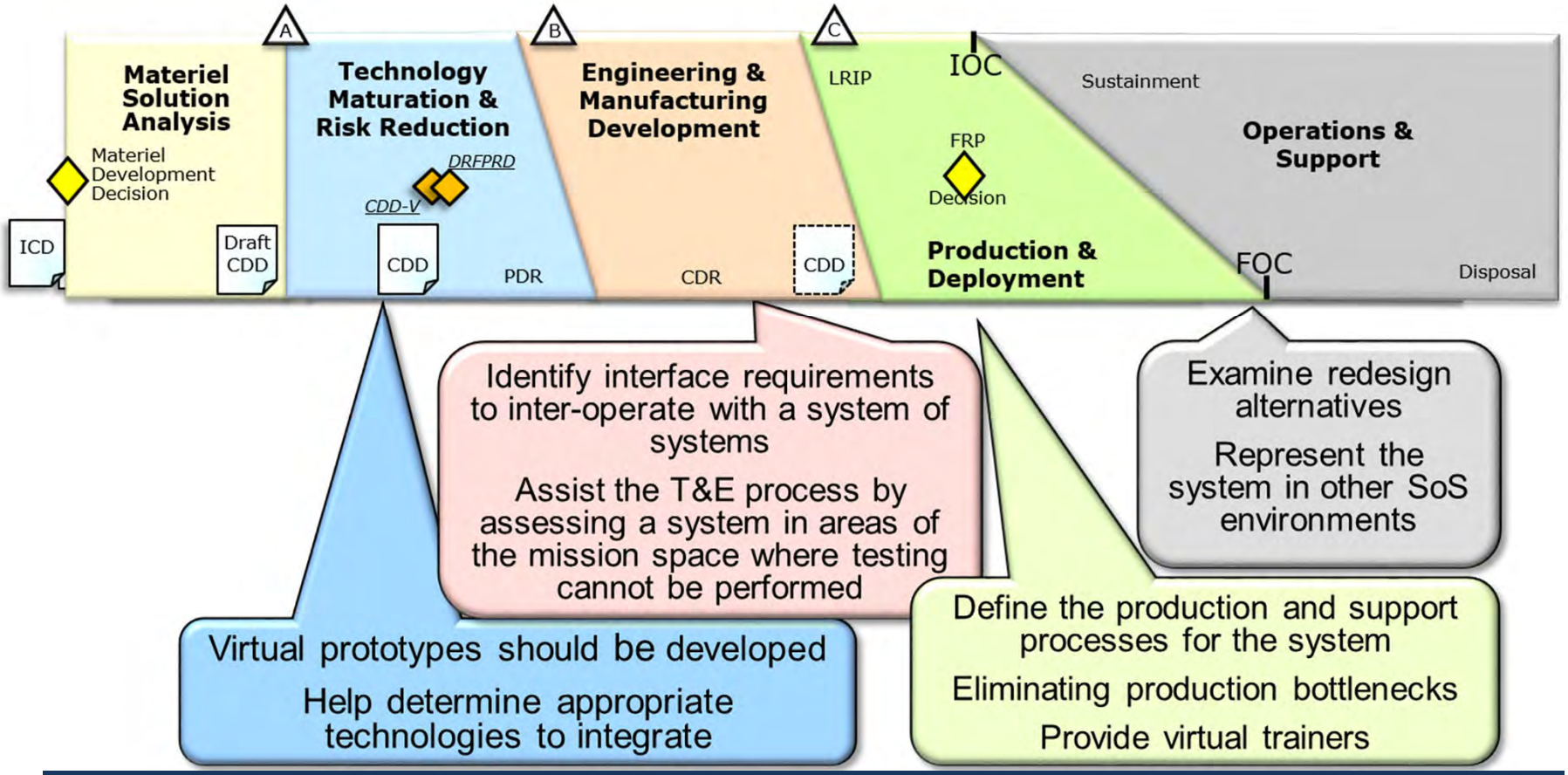
- M&S through the Acquisition Phases (cont.)
  - **Engineering, Manufacturing and Development Phase** - Use M&S to: Model operational supportability, model logistics footprints, analyze survivability, model human systems integration, design for producibility, demonstrate system safety, verify functionality and performance to specifications/needs, estimate manpower
  - **Production and Deployment Phase** – Use M&S to: Assess industrial/manufacturing readiness, model environment, safety, and occupational health, determine military equipment valuation, model corrosion prevention and control, refine the life-cycle, sustainment plan, test production quality, V&V production configuration, conduct economic analysis
  - **Operations and Support Phase** - Use M&S to: Model supply chain management, monitory performance and adjust product support, assess supportability, validate failures and determine root causes, determine system risk and hazard severity, analyze ECP impact

M&S supports the systems engineering decision process by supporting systems design, trade studies, financial analysis, sustainment, and performance assessments

DOD Modeling and Simulation Verification, Validation, and Accreditation (VV&A) - DoDI 5000.61

- Verification – the model accurately represents the developer's conceptual description
- Validation – process of determining the degree to which a model is an accurate representation of the real world
- Accreditation – the official certification of M&S for a specific purpose
- DoD policy that models, simulations, and associated data used to support DoD processes, products, and decisions shall undergo verification and validation (V&V) throughout their life-cycles
- Each DoD Component shall be final authority for validation of representations of its forces and capabilities in models, simulations, and associated data, and shall be responsive to other DoD Components to ensure those forces and capabilities are appropriately represented.
  - OPTEVFOR for Navy

M&S in Acquisition



M&S can assist acquisition by controlling variables to provide a repeatable audit trail to support decision processes

Summary

- T&E is exercising a system or components and analyzing results to provide:
- T&E supports MDA risk management by providing:
- T&E is the primary method to design meets requirements and solution meets user's needs
- Three types of T&E and responsible organizations are:
- The key T&E support organizations within the Navy are
- Key OT&E activities coordinated with DOT&E are

Summary

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Summary

- Independent agencies conduct OT&E to provide:
- The Role of M&S is to:
- M&S is used throughout to support acquisition decisions