



Mission-Based T&E

Tutorial, 2 March 2009

**25th Annual NDIA
T&E Conference**

Chris Wilcox

US Army Evaluation Center

410-306-0475

chris.wilcox1@us.army.mil



Purpose

- To present and overview the MBT&E methodology (framework and process).
- To engage in question/answer discussions on the MBT&E methodology.
- To obtain audience feedback on the MBT&E methodology.



Agenda

1330: Mission-Based T&E Background

1340: MBT&E Framework

1400: Case Study Introduction

1415: Steps 1-5: Understand the Mission

1500-1515: Afternoon Break

1515: Steps 6-8: Understand the System

1545: Steps 9-15: Design the T&E

1615: Steps 16-19: Determine & Report the Results

1630: Discussions/Questions/Answers



Background - Why MBT&E?

- Because we were asked to...
 - DA/OSD-level guidance:
 - Address recent policy initiatives, such as: Section 231 Report; DOT&E/OUUSD(AT&L) *T&E Policy Revisions* memo; etc.
 - “Show impact of materiel system strengths/weaknesses on the operational capabilities.”
 - “Integrate DT and OT and make use of all available data.”
 - Address goals, strategies and initiatives in DUSA-TEO Strategic Plan, 2007.
 - “Continuously improve T&E policy and procedures.”
 - “Increase operational realism in developmental tests to improve the likelihood of successful operational tests.”
 - New TEMP format and DoD 5000 changes.
 - “Integrated T&E” chapter vs. DT and OT chapters.

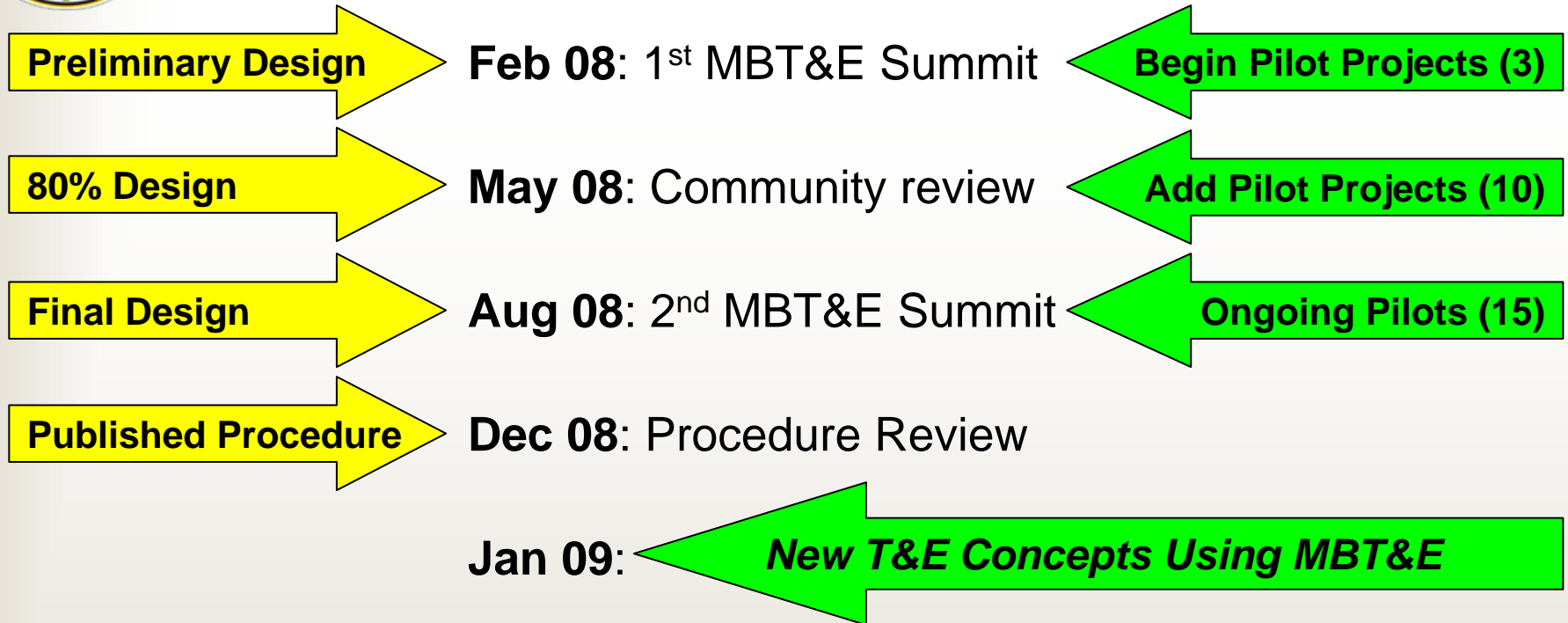


Background - Why MBT&E?

- Because we want to improve:
 - The way we do our job...
 - Enable robust T&E strategy development for Joint networked system-of-systems.
 - The way we support the warfighter...
 - Answer the “so what” question. (Complete feedback loop to Capability-Based Analysis.)
 - Develop way to link system performance to unit and higher unit task capabilities.
 - The way we support the materiel developer...
 - Scope T&E effort earlier in the acquisition cycle.



MBT&E Implementation



Lessons Learned:

- MBT&E framework providing context of operational capability.
- MBT&E process is executable with current personnel skill set.
- Efficiencies can be increased through:
 - Improved tools (templates, IT, training, etc.); and
 - Combat and materiel developer participation.



Background – MBT&E Overview

Mission-Based Test and Evaluation

is a methodology that focuses T&E on the **capabilities** provided to the warfighter. It provides a framework, procedure and complexity constraint strategies to:

- **link capabilities to the attributes** of the materiel system-of-systems;
- develop evaluation measures that **assess capabilities and attributes**;
- and link the evaluation measures to all **available data sources**.



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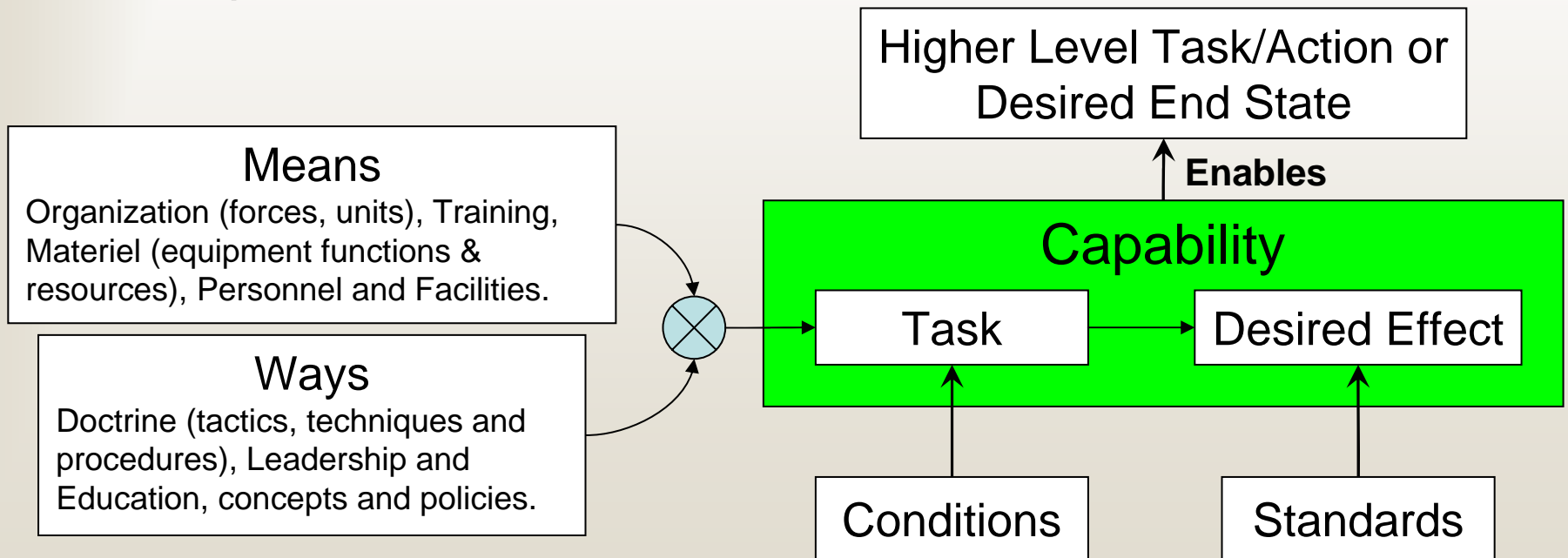
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Framework Building Block

Capability¹ – The ability to achieve a **desired effect** [or result, outcome, or consequence of a task²] ...

- under specified **standards and conditions**
- through a combination of **means and ways**
- to perform a set of tasks.



1. CJCSI 3170.01F, May 2007

2. Taken from JP1-02, Mar 2007, definition of effect.



Framework - Task Hierarchy



MBT&E Framework – v2

$$\text{Capability} = \text{Set of Tasks} + \text{Desired Result}$$

Process/Products

Commander's Task to Subordinates

Desired End State

Transition to Allocating Mission Means

Mission Analysis
 • Higher Commander's Intent
 • Restated Mission
 • Task to Subordinates

Operations (Mission Tasks)
 • UJTLs
 • Service TLs
 • Implied Tasks

Desired Mission Task Results

Enables

High Level Tasks/Results

Commander's Task to Subordinates

Mission Task Capability

Mission Analysis
 • Higher Commander's Intent
 • Restated Mission
 • Task to Subordinates

System-of-Systems Tasks
 • Service TLs
 • Implied Tasks
 • Collective/Individual Tasks

Desired SoS Task Results

Enables

Tasks/Results Specific to System

System Attributes

SoS Task Capability

Transition to Allocating Materiel Means

Systems Engineering
 • Functional Baseline
 • Allocated Baseline
 • Product Baseline

System Performance
 • Functions (shall do)
 • "shall be's"

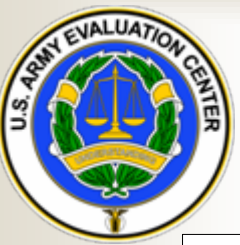
Desired System Performance Results

Enables

System Functions

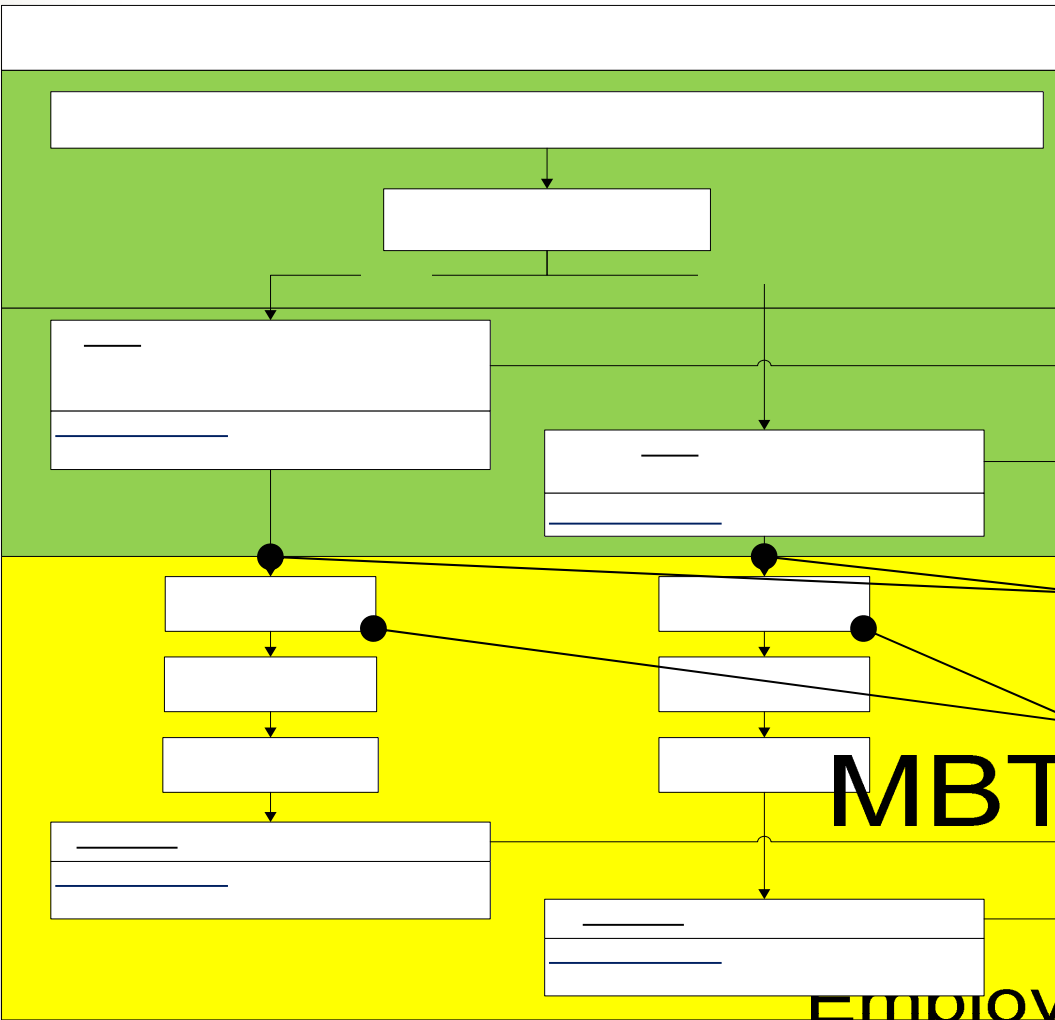
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MBT&E Framework Example

Task Capability Linked to System Performance
 T&E Planning
 T&E Execution



All Available Data Used

			X
X	X		X

Attributes Linked to Capabilities

SoS Identified

X			X
X	X		

MBT&E Inthread

Employ Fires to Influence

T&E Planning T&E Execution

Capability and Performance Linked to Integrated T&E



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Case Study Introduction



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Procedure - Overview

- 19 steps divided into 5 major purpose areas.
 - 1 Pre-step to collect information.

PLANNING

UNDERSTAND THE MISSION • 4 steps to understand the military operations, tasks, task capabilities and mission context.

UNDERSTAND THE SYSTEM • 2 steps to understand the components and attributes of the materiel system-of-systems.

- 1 additional step to understand the mission and system linkages.

DESIGN THE T&E • 7 steps to design the T&E given the mission and system understanding.

DETERMINE THE RESULTS • 3 steps to generate, collect, analyze, and evaluate the data.

REPORT THE RESULTS • 1 step to format and report the results.

EXECUTING & REPORTING

11-12



Procedure - Collect Information (Step 1)

Purpose: Collect available information to gain understanding of:

- initiating capability gaps,
- mission context and operational conditions,
- mission tasks and capabilities,
- system-of-systems design and materiel system required attributes.

What do I do?

- Work through capabilities developer and materiel developer to obtain the available information.
 - Functional Area, Needs & Solution Analyses, Analysis of Alternatives, Requirements Documents (DoDAF Views), Threat Assessments, Acquisition Strategies, Performance Specifications, etc.

When am I done?

- Checklist of documents available/not available is completed.
- Available documents Archived.
- Actions to obtain copies of documents available, but not archived, are presented to appropriate IPTs.

12-13



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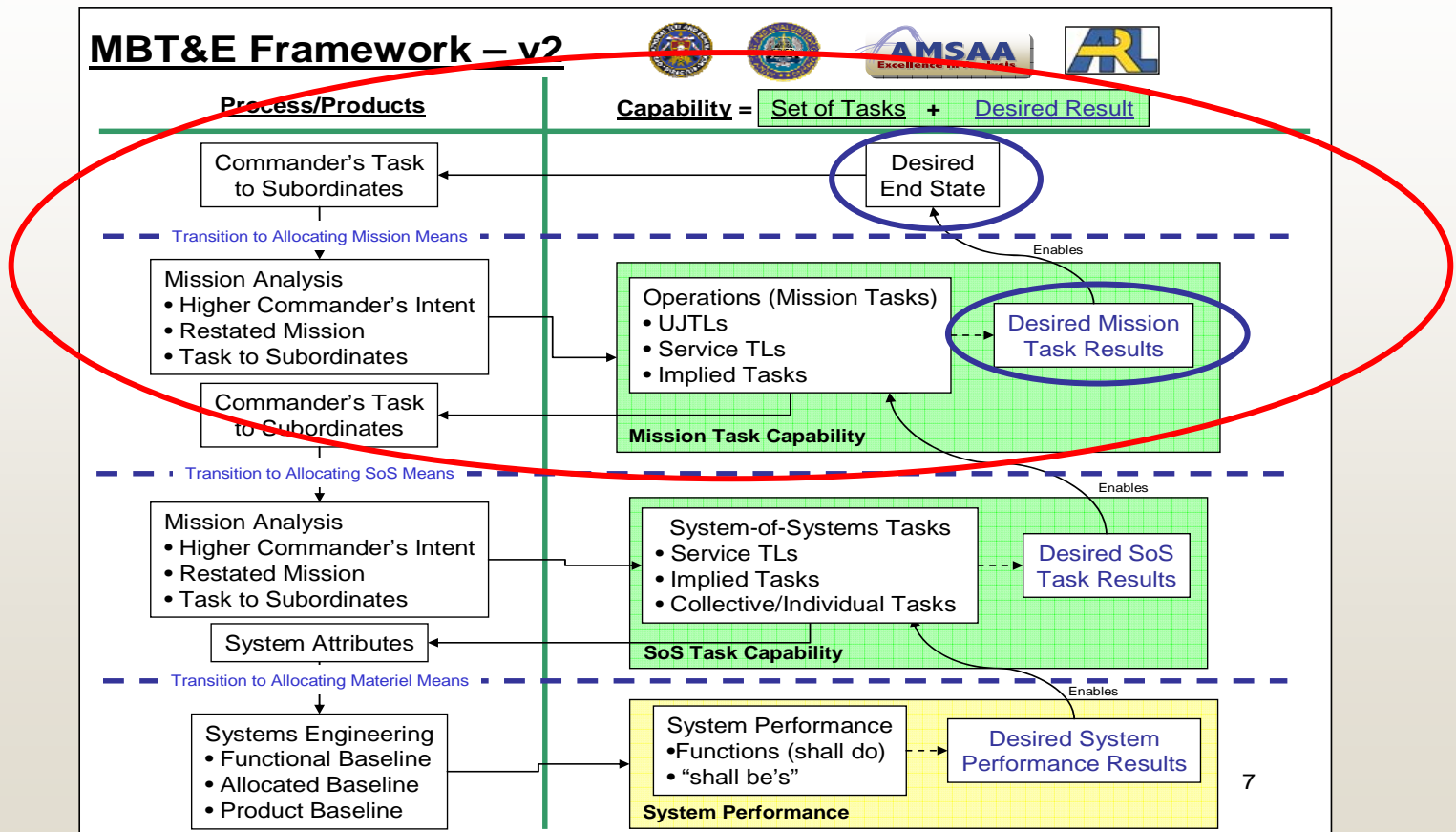
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- 1 step to format and report the results.



Define the Mission Context (Step 2) Relation to Framework

- High-level operations/mission/tasks.
- Task desired end states/results.





Define the Mission Context (Step 2)

Purpose: Define the overall mission area context that the proposed materiel solution is being developed to support.

What do I do?

- Determine Operations/Mission/Tasks
 - Develop a description of high-level operations/mission/tasks and their desired end states/results,
 - Determine Joint, network and SoS construct, and
 - Determine organizational and support unit construct.
- Determine Operational Conditions
 - Determine the essential elements of mission, enemy, terrain and weather, troops and support available, time available, and civil considerations (METT-TC).

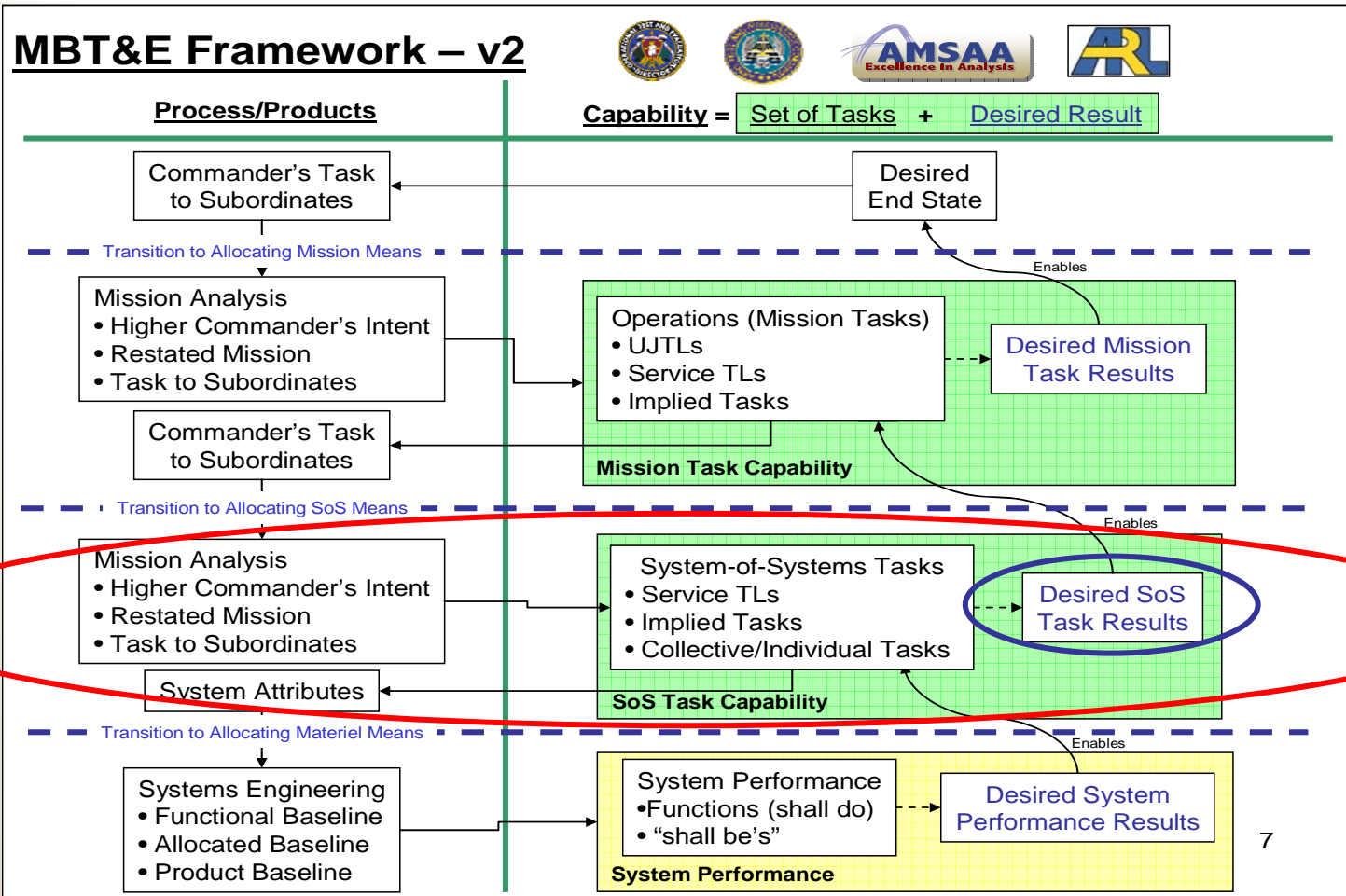
When am I done?

- High-level operations/missions/tasks with their desired end states/results are documented.
- Operational conditions (METT-TC factors) are documented.



Develop the Mission Tasks (Step 3) Relation to Framework

- SoS tasks and task threads.
- SoS Task desired end states/results.





Develop the Mission Tasks (Step 3) Mission Analysis References

- Reference authoritative task lists
 - Looking for most applicable task reference
 - Task Description
 - Conditions
 - Standards
- References used in case study
 - Universal Joint Task List (UJTL), CJCSM 3500.
 - Army Universal Task List (AUTL), FM 7-15.
 - Attack Helicopter Battalion Mission Training Plan, ARTEP 1-112-MTP.
 - Aircrew Training Manual, TC 1-251.



Develop the Mission Tasks (Step 3)

Purpose: Develop the required SoS mission tasks and link these tasks to authoritative tasks lists.

What do I do?

- Document/Conduct Mission Analysis
 - Develop SoS mission task threads and alternate task threads where applicable. (MS project or similar tool can be used.)
 - Determine task desired end states/results
- Link to Authoritative Task Lists
 - Develop linkages between the tasks identified above and the appropriate authoritative task lists. (UJTL, AUTL, unit Mission Training Plans, etc.)

When am I done?

- SoS mission tasks with their desired end states/results are documented.
- Links to associated authoritative tasks are documented.



Procedure

Develop Supporting Tasks (Step 4)

Purpose: Develop the required supporting tasks that enable the execution of the SoS mission tasks.

What do I do?

- Determine Conditional Tasks and their desired effects/results.
 - Conditional tasks are performed during a normal mission but are only **required due to some influencing condition**.
 - Examples: *avoid threat missile, extinguish engine fire, reset network node, etc.*
- Determine Enabling Tasks and their desired effects/results.
 - Mission enabling tasks are conducted in order to **enable the SoS mission tasks** (task developed in step (3)) **to be performed**.
 - Examples: *train, deploy, maintain, etc.*

When am I done?

- Conditional tasks, enabling tasks and their desired end states/results are documented.
- Links to associated authoritative tasks are documented.



Procedure

Identify Task Capabilities (Step 5)

Purpose: Identify and associate the capabilities required to execute the SoS, conditional and enabling tasks.

What do I do?

- Identify Required Capabilities
 - Identify the capabilities required to support each task with a reference to applicable requirements documents. (CDD, CPD, etc.)
- Associate Tasks with Capabilities
 - Link the capabilities determined above with the mission, conditional and enabling tasks determined in steps (3) and (4)

When am I done?

- Links between the (SoS, conditional and enabling tasks) and the requirements are documented.



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 - 1 Pre-step to understand the program context.

UNDERSTAND THE MISSION

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UNDERSTAND THE SYSTEM

- 2 steps to understand the components and attributes of the materiel system-of-systems.
- 1 additional step to understand the mission and system linkages.

DESIGN THE TEST AND EVALUATION

- 7 steps to design the T&E given the mission and system understanding.

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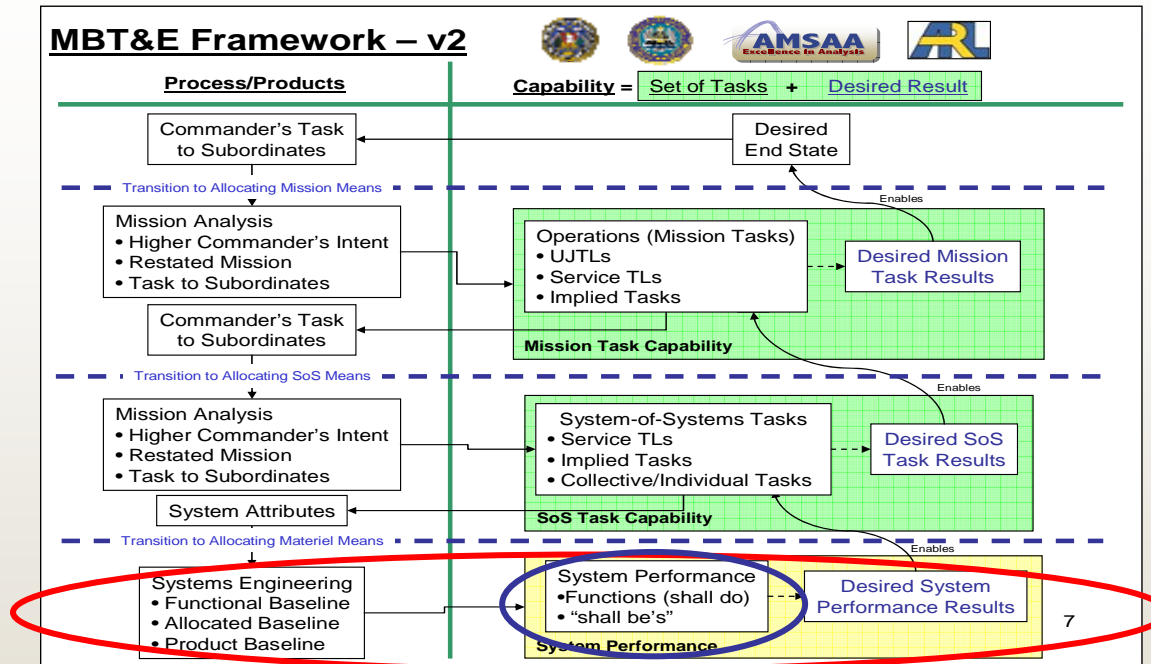
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Determine SoS Components (Step 6) Relation to Framework

- SoS Components
- SoS Component Functions & “Shall be’s”



Materiel System Functions: An activity or action the materiel system performs in support of a capability or part of a capability.

Materiel System “shall be”: An attribute the materiel system possesses that enables it to perform a function, for example, *reliability*.



Determine SoS Components (Step 6)

Purpose: Identify the physical components of the materiel system that support the mission tasks.

What do I do?

- Develop a materiel system description starting from the SoS level and breaking down into components.
 - Components at the lowest level should be able to be linked to identifiable functions (shall do's) and enabling attributes (shall be's).
- Identify the functions and “shall be's” of the materiel components.
- Option: Develop technology risk areas for pre-MS B systems.

When am I done?

– SoS components with their functions/shall be's are documented.



Procedure

Develop System Attributes (Step 7)

Purpose: Identify the materiel system attributes and associate them with the system components.

What do I do?

- Identify Attributes Required
 - Identify the materiel system's attributes required to support the component functions/shall be's with reference to applicable requirements documents. (CDD, CPD, Performance Specification, etc.)
- Associate Components with Attributes
 - Link the attributes determined above with the system components developed in step 6.

When am I done?

- Links between the SoS components and their required attributes are documented.



Procedure - Overview

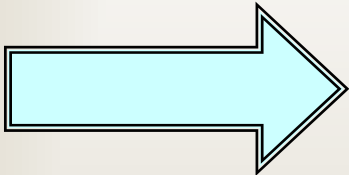
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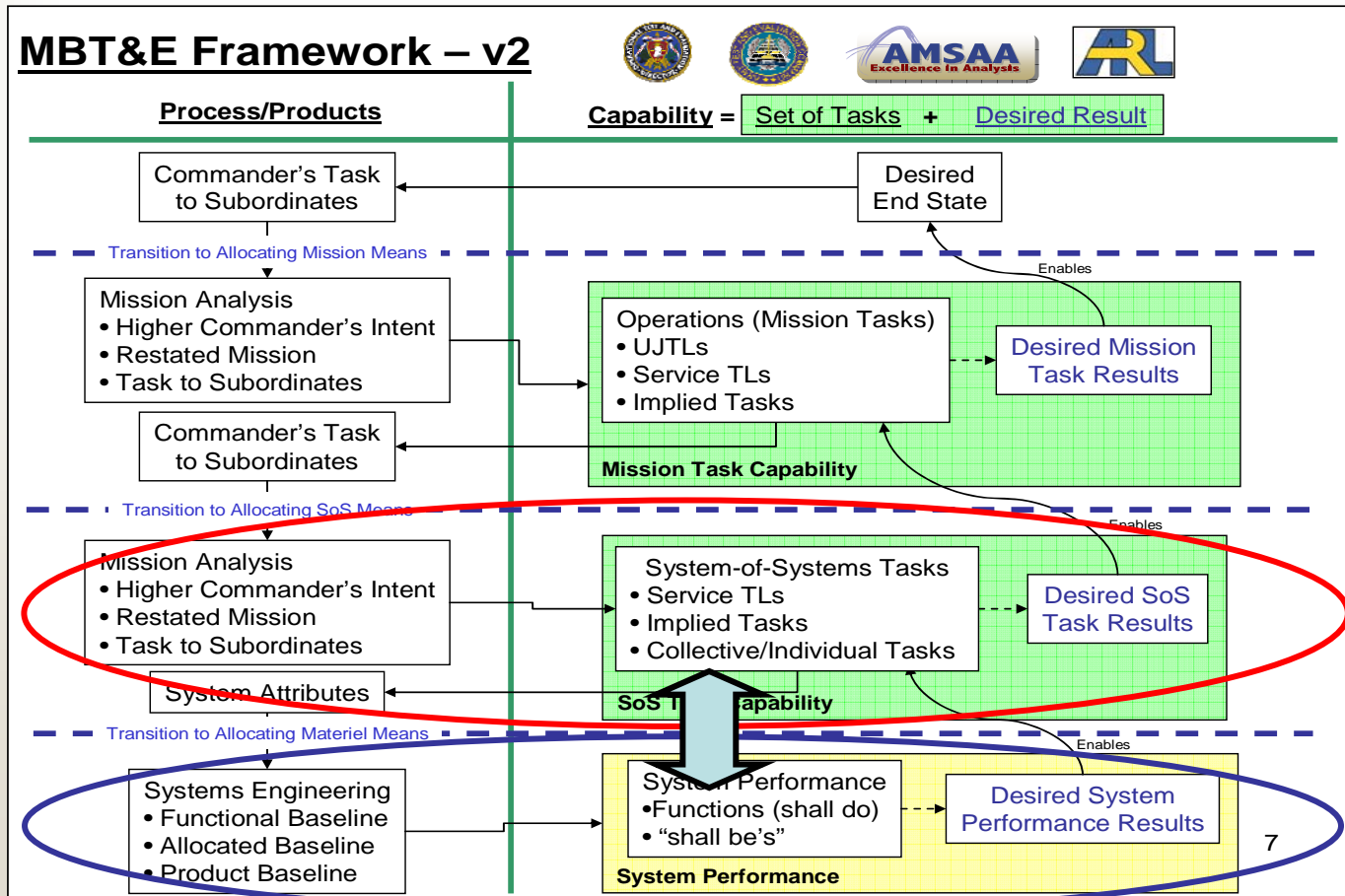
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Capabilities to Attributes – Relation to Framework

- Link **SoS mission task capabilities** to **SoS component attributes**.





Procedure

Associate Capabilities with Attributes (Step 8)

Purpose: Develop the linkages between the task capabilities identified in step (5) and the materiel system component attributes identified in step (7).

What do I do?

- Link the system attributes (functions/shall be's) to the task capabilities.
 - Determine how the system components support the task capability.
 - Determine redundant system support capability.
- Determine Mission Enabling Attributes
 - Mission Enabling Attributes are system enabling attributes that are not specific to a particular task capability – they address all tasks.

When am I done?

- Links between the system components and their supported tasks are documented.
- Enabling attributes of the SoS materiel components are documented.

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Procedure

Unconstrained Operational Conditions (Step 9)

Purpose: Develop the unconstrained operational conditions that must be addressed through test and evaluation.

What do I do?

- Determine the operational factors and conditions that T&E needs to address given:
 - the task capability required and
 - the system function/shall be.

When am I done?

- Operational conditions (for the intersection between mission task and system components are documented.

44-45



Process

Develop the Evaluation Strategy (Step 10)

Purpose: Develop a summary description of the evaluation to support an early strategy coordination and review.

What do I do?

- Develop the early strategy review brief from the mission, task, and system worksheets developed in steps (2) through (9).

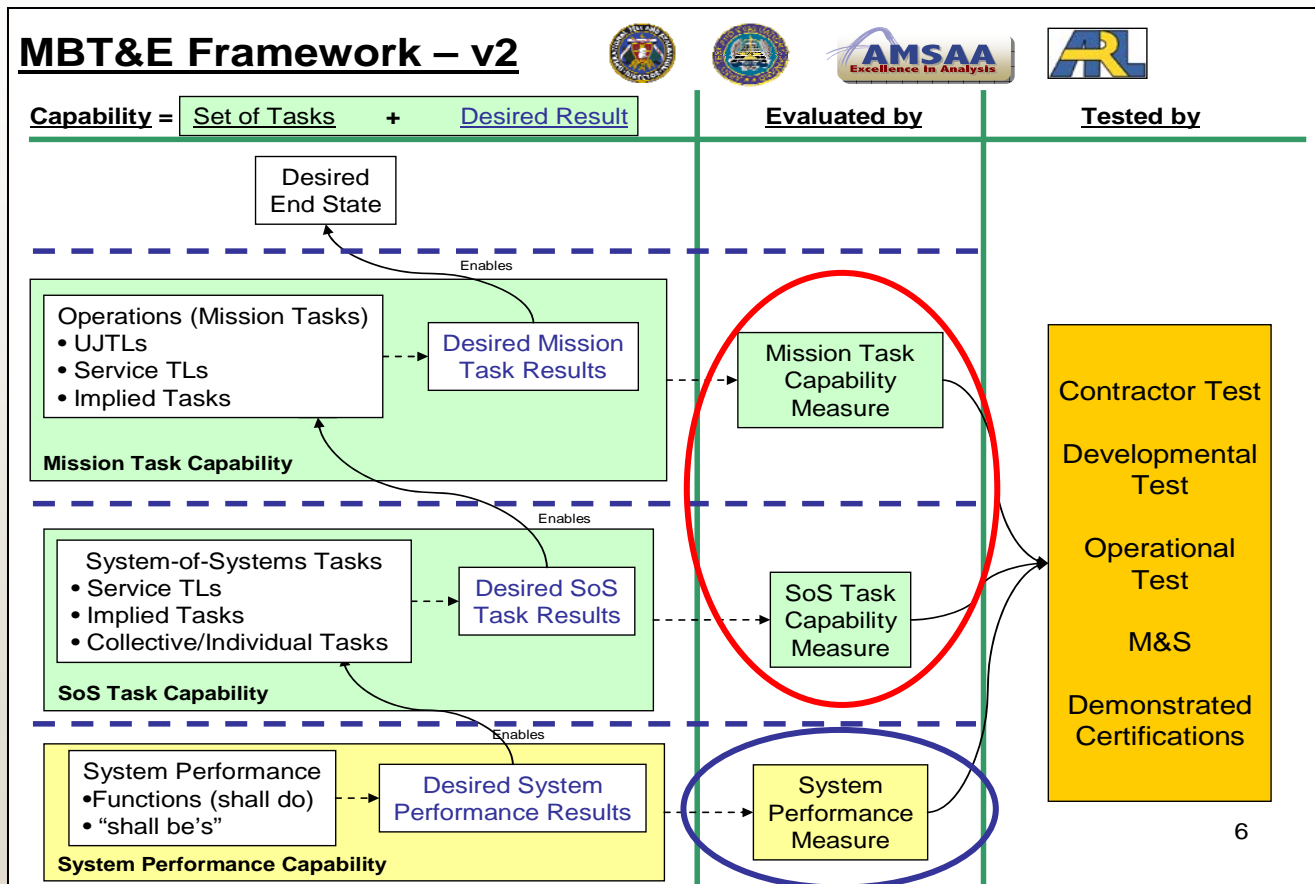
When am I done?

- Early strategy review brief is prepared.



Evaluation Measures – Relation to Framework

- **Task Capability Measures**
- **Materiel Performance Measures**





Process

Develop Evaluation Measures (Step 11)

Purpose: Develop the evaluation measures.

What do I do?

- Develop measures supporting the evaluation of:
 - task capabilities (task capability measures), and
 - system attributes (materiel performance measures).
- Complete linkages from measure -to- system -to- task.
- Develop linkages between measures and COIs/Criteria.

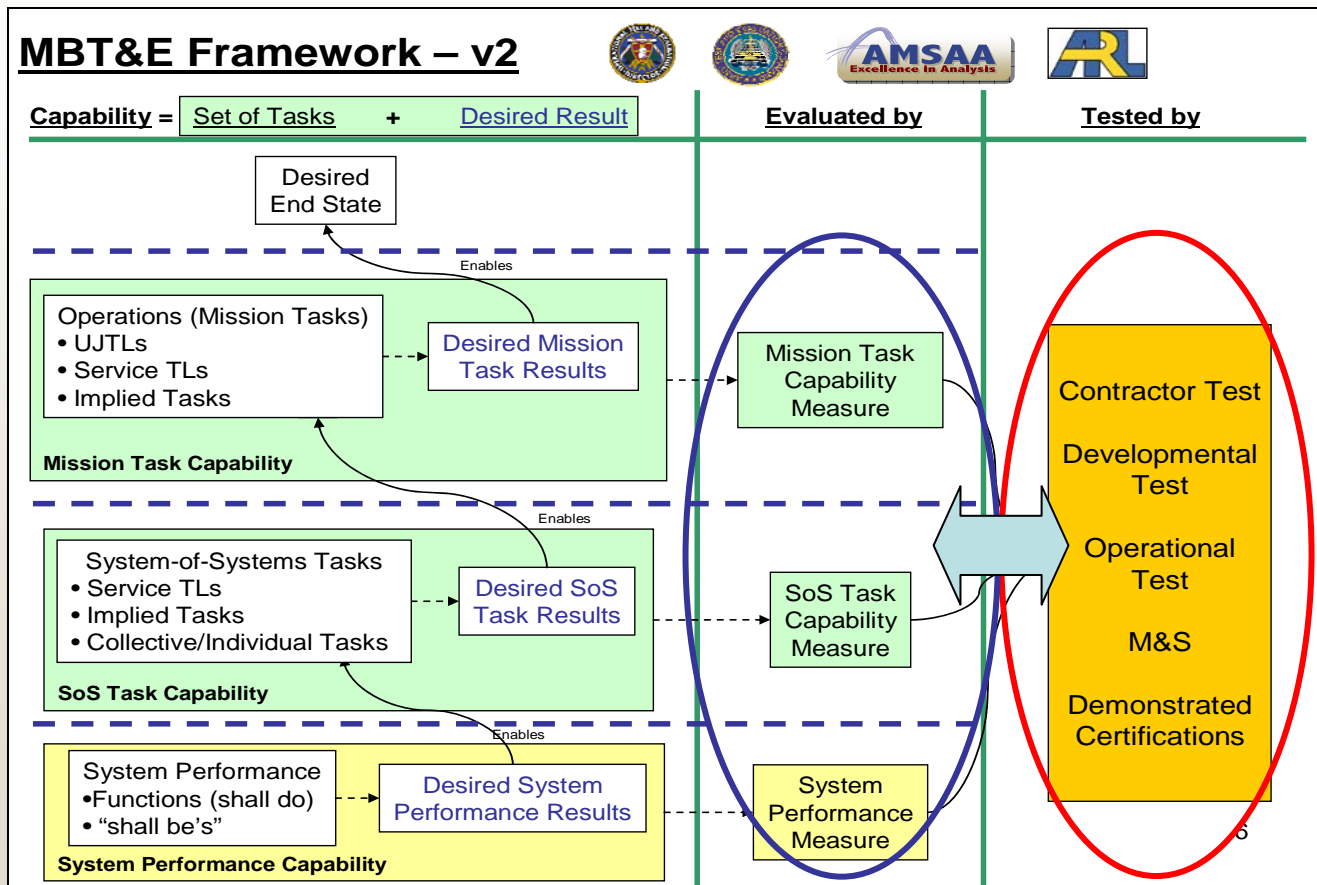
When am I done?

- Task capability and materiel performance measures are documented.
- Operational conditions pulled from task.



Data Sources - Relation to Framework

- **Data Sources**
- **Linked to Evaluation Measures**





Design the T&E Assign Measures to Data Sources (Step 12)

Purpose: Identify the sources of data to support the analysis of the evaluation measures.

What do I do?

- Assign one or more data sources to each evaluation measure.
- Review data source matrix to determine:
 - T&E execution risk by assessing critical data sources;
 - Developmental risk by assessing when critical technologies are demonstrated; and
 - Determine appropriate use of M&S.

When am I done?

- Data sources supporting each measure are documented.
- T&E effort and program execution risk issues are identified and coordinated with the appropriate IPTs.



Design the T&E Constrained Operational Conditions (Step 13)

Purpose: Develop the constrained operational conditions by looking at the conditions that can be addressed by the identified data sources.

What do I do?

- Determine the operational conditions that can be addressed by the identified data sources. These are the “constrained” operational conditions.
- Determine the T&E limitations by comparing the constrained vs. unconstrained conditions (step 9).

When am I done?

- T&E limitations caused by the lack of ability to address all operational conditions documented.
- Mitigation effort(s) to lesson impact of T&E limitations are documented.



Design the T&E

Develop Data Source Requirements (Step 14)

Purpose: Develop data elements from each linked data source.

What do I do?

- Develop detailed measure design.
- Determine data elements required from the data source.
- Determine the operational conditions required for each run, sortie or sample.

When am I done?

- Data source requirements documented and coordinated with the appropriate executing test agent (contractor, government range, independent test facility, M&S, etc.)

57-60



Design the T&E

Develop T&E Databases (Step 15)

Purpose: Develop database architecture to enable efficient delivery, formatting and analysis of delivered data.

What do I do?

- Develop an evaluation data model from the task description, enabling attribute, measure description worksheets.
 - The evaluation data model is a representation of the information and data assets required to evaluate the system expressed in terms of entities and relationships between entities.
- Provide evaluation data model results to the tester.
 - The evaluation data model will ensure properly documented data for communication between the evaluator and the tester..

When am I done?

- T&E database design is documented.



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Execution

(Steps 16 through 18)

CONDUCT TEST AND GATHER DATA (Step 16)

Purpose: Execute the planned data source activities and gather the data for analysis.

What do I do?

- Execute test, run M&S, record data.
- Review data for integrity and authentication.
- Adjust T&E program based on impacts of changes in schedule and system design.

PERFORM DATA ANALYSIS (Step 17)

What do I do?

- Data is analyzed according to the procedures identified in step 11 and 14.
- Performance results are compared to standards identified in steps 5 (task capabilities) and 7 (system attributes).

GENERATE EVALUATION RESULTS (Step 18)

What do I do?

- Determine materiel system attribute performance.
- Determine SoS task capabilities and limitations.
 - Determine task capability C&L directly from task capability measure results.
 - Determine task capability C&L based on system attribute measure results.
- Determine task C&L impact on high-level mission task capabilities.
 - Determine ability to achieve desired end state directly from capability measures.
 - Determine ability to achieve desired end state from SoS task capability C&Ls.

63-65



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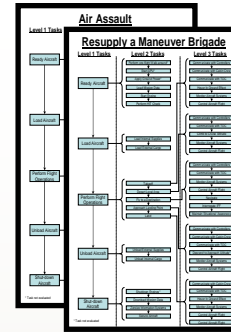
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Mission Element Task Type Definitions

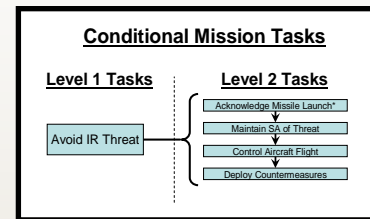
Mission execution tasks.

- Tasks that describe a discrete action that the unit (system and its operators) must perform in order to accomplish its main mission.



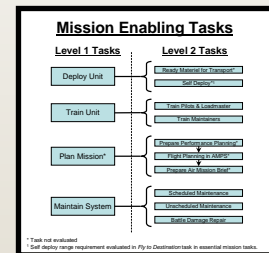
Conditional mission tasks.

- Tasks that are performed during the mission that become required due to some influencing condition.



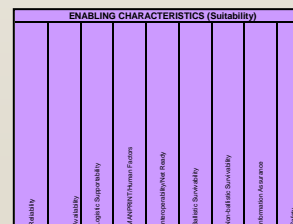
Mission enabling tasks.

- Tasks that enable the mission execution and conditional tasks to be performed. They usually occur before or after the mission.



Enabling Attributes

- System attributes that affect **all** tasks.



Normally aggregated into **Effectiveness** and **Survivability**

Normally aggregated into **Suitability**



Reporting

Generate Evaluation Report (Step 19)

Purpose: To generate the evaluation report which will document the evaluation conclusions.

What do I do?

- Generate system performance and SoS task C&L conclusions.
- Generate summary of key C&Ls.
- Generate effectiveness, suitability and survivability conclusions.

When am I done?

- System performance, (strengths and weaknesses), and the impact they had on the task capabilities are documented.
- SoS task C&Ls and high-level task C&Ls are documented.
- Overall summary of effectiveness, suitability and survivability is documented.



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MBT&E Tutorial

Discussions

-

Questions

-

Answers

