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

1415: Procedure – Steps 1-5

1500-1515: Afternoon Break

1515: Procedure – Steps 6-8

1545: Procedure – Steps 9-15

1615: Procedure – Steps 16-19

1630: Discussions/Questions/Answers

MBT&E Background

Background - Why MBT&E?

- Because we were asked to…
  - DA/OSD-level guidance:
    - Address recent policy initiatives, such as: Section 231 Report; DOT&E/OUSD(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.

How is MBT&E Implemented?

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 mission task **capabilities** provided to the warfighter. It provides a *framework* and *procedure* 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**.

Agenda

1330: Introduction and Mission-Based T&E Background

1340: MBT&E Framework

1400: Case Study

1415: Procedure – Steps 1-5

1500-1515: Afternoon Break

1515: Procedure – Steps 6-8

1545: Procedure – Steps 9-15

1615: Procedure – Steps 16-19

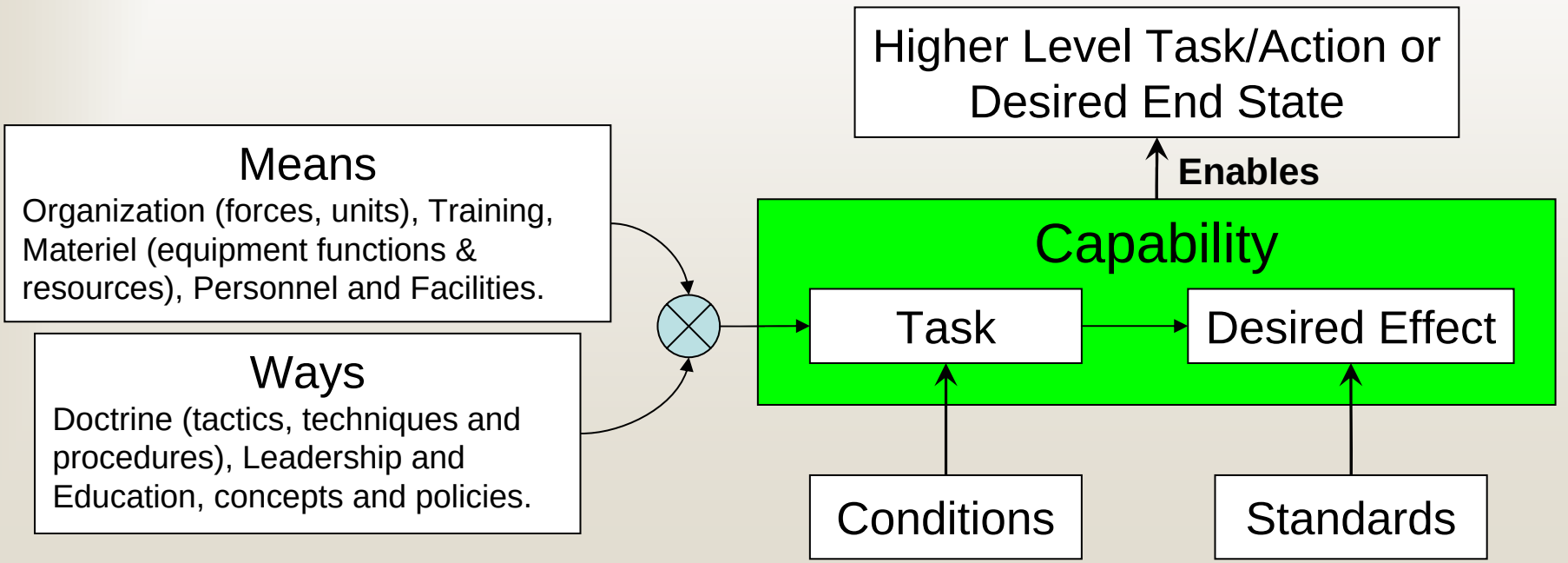
1630: Discussions/Questions/Answers

MBT&E Framework

Framework Building Block

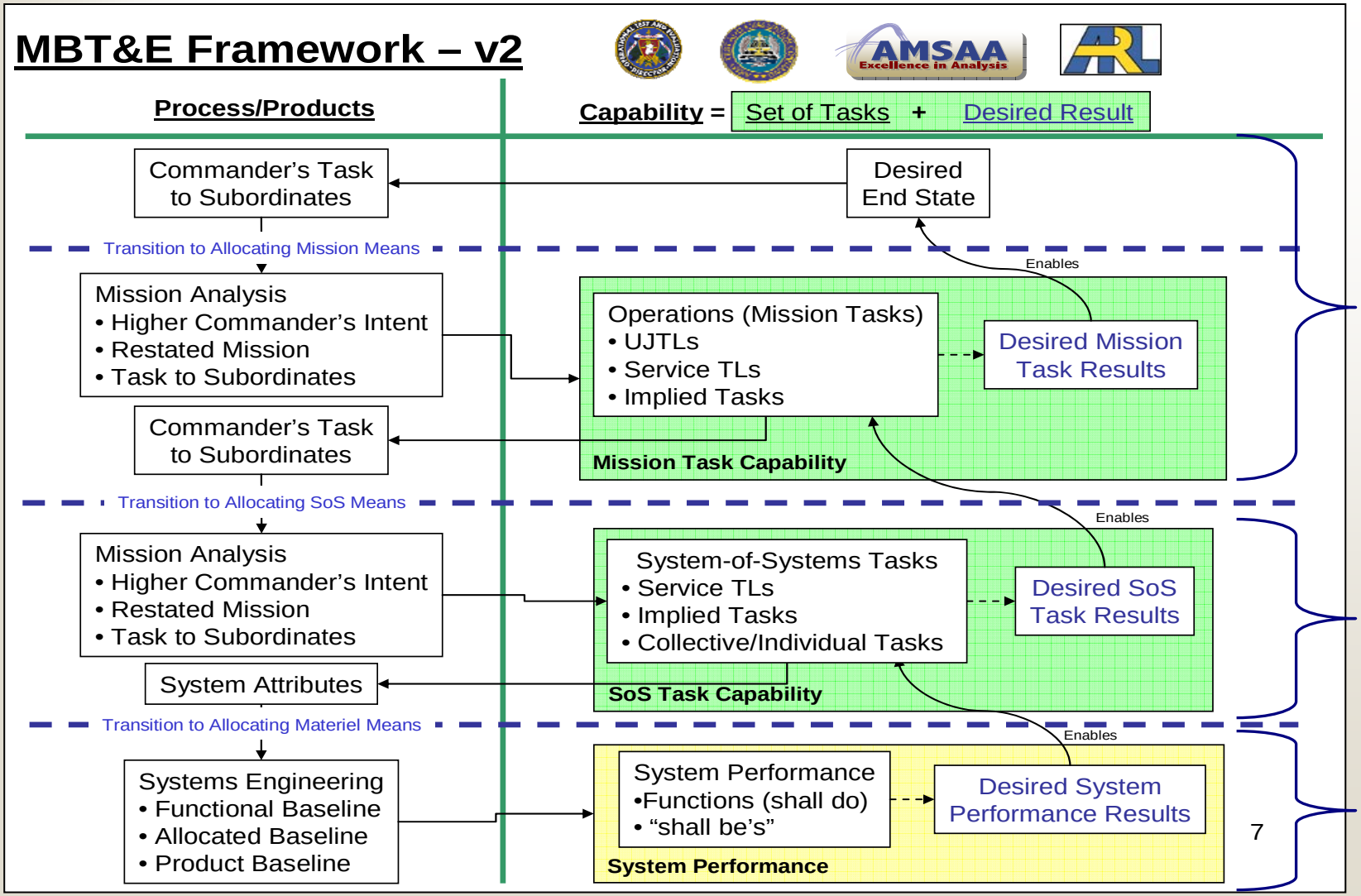
Capability[1] – The ability to achieve a **desired effect** [or result, outcome, or consequence of a task[2]] …

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

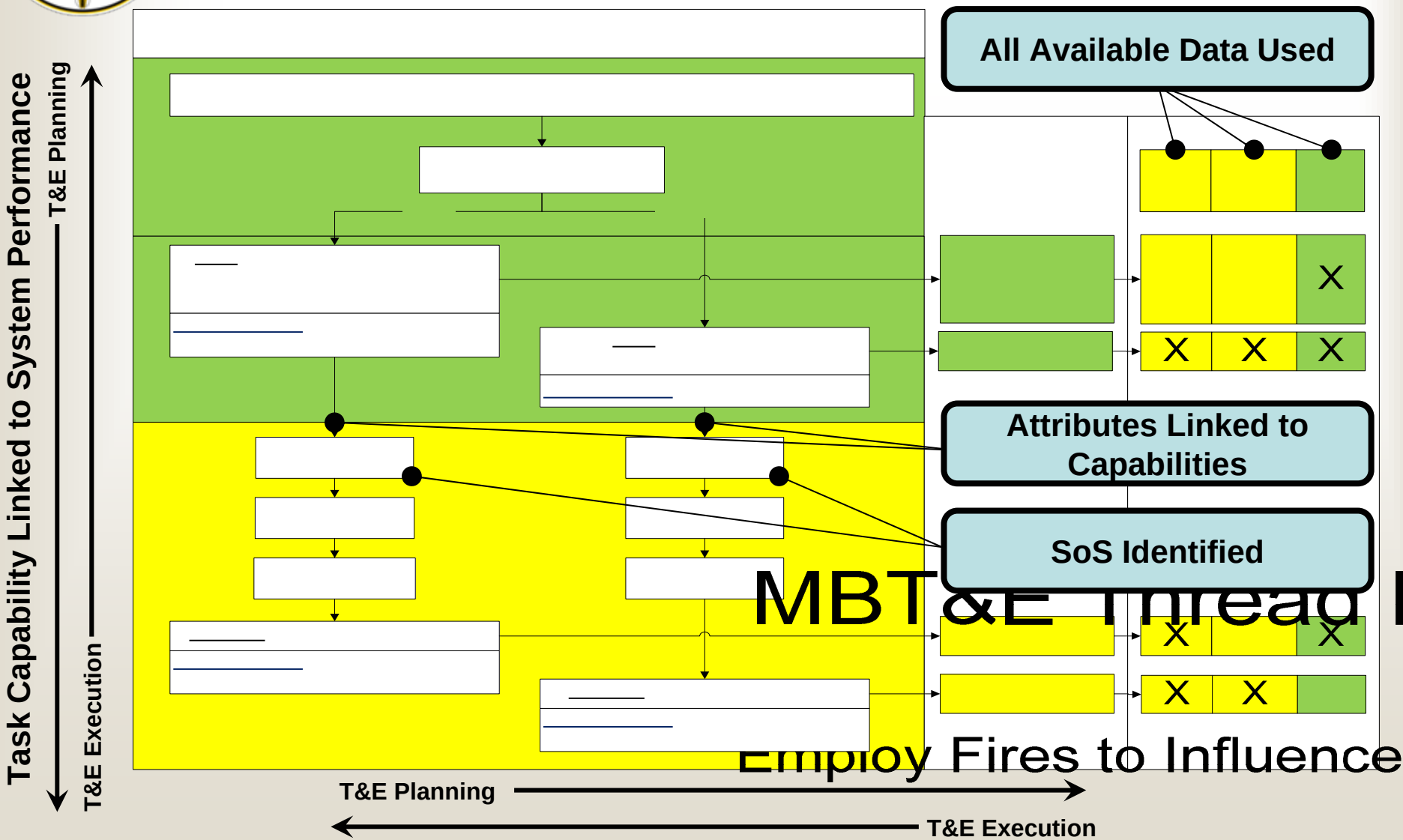


1. CJCSI 3170.01F, May 2007
2. Taken from JP 1-02, Mar 2007, definition of effect.

Framework - Task Hierarchy



MBT&E Framework Example



Agenda

1330: Introduction and Mission-Based T&E Background

1340: MBT&E Framework

1400: Case Study

1415: Procedure – Steps 1-5

1500-1515: Afternoon Break

1515: Procedure – Steps 6-8

1545: Procedure – Steps 9-15

1615: Procedure – Steps 16-19

1630: Discussions/Questions/Answers

Agenda

1330: Introduction and Mission-Based T&E Background

1340: MBT&E Framework

1400: Case Study

1415: Procedure – Steps 1-5

1500-1515: Afternoon Break

1515: Procedure – Steps 6-8

1545: Procedure – Steps 9-15

1615: Procedure – Steps 16-19

1630: Discussions/Questions/Answers

MBT&E Procedure

Steps 1-5

Understand the Mission

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.

EXECUTING & REPORTING

DETERMINE THE RESULTS	• 3 steps to generate, collect, analyze, and evaluate the data.
REPORT THE RESULTS	• 1 step to format and report the results.

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.

Procedure - Collect Information (Step 1)

STEP 1

SIDE

Currently building/maintaining document list.

Document Title	Who to ask?	Mission Context	Operational Conditions	Unit Organization	Unit Tasks	Current Unit Capabilities	Capability Gaps	Desired Unit Capabilities	Mission Tasks/Task Threads	SoS Design	Existing Materiel System Attributes	Materiel Critical Technologies	Desired Materiel System Attributes	Materiel System Components	Materiel System Functions
Functional Area Analysis	TRADOC	X	m		X	X			m						
Functional Need Analysis	TRADOC	m	m		m	m	X		m						
Functional Solution Analysis	TRADOC	m	m		m	m	X	X	m						
Analysis of Alternatives	TRADOC							X	m		X	m	X		
Operational Mode Summary/Mission Profile	TRADOC	X	X		X				X						
Initial Capabilities Document	TRADOC	X	m					X		X			X		
DoDAF OV-1 (Appendix A)		X								X			X		
Capabilities Documents	TRADOC	X	X	X	X				X	X			X		X
DoDAF OV-1 (Appendix A)		X								X			X		
DoDAF OV-2 (Appendix A)										X					
DoDAF OV-4 (Appendix A)				X											
DoDAF OV-5 (Appendix A)					X				X						
DoDAF OV-6C (Appendix A)					X					X					
DoDAF SV-2 (Appendix A)										X					
DoDAF SV-4 (Appendix A)															X
DoDAF SV-5 (Appendix A)					X										X
DoDAF SV-6 (Appendix A)										X					
COI/Cs	TRADOC				X			X					X		
Army Universal Task List, FM 7-15	HQDA				X										
Unit Mission Training Plan	TRADOC/School House				X										
Support Unit Mission Training Plans	TRADOC/School House				X										
Universal Joint Task List, CJCSM 3500	Joint Staff (online)				X										
System Threat Assessment Report	PM		X												
Technology Development Strategy	PM							m				X		X	
Acquisition Strategy	PM							m				X		X	
Work Breakdown Structure														X	
Materiel Fielding Plan	PM													X	
System Performance Specification	PM													X	X

X = provides
m = may provide

Procedure - Overview

- 19 steps divided into 5 major purpose areas.
  - 1 Pre-step to understand the program context.

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 TEST AND EVALUATION	• 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.

Procedure -
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?

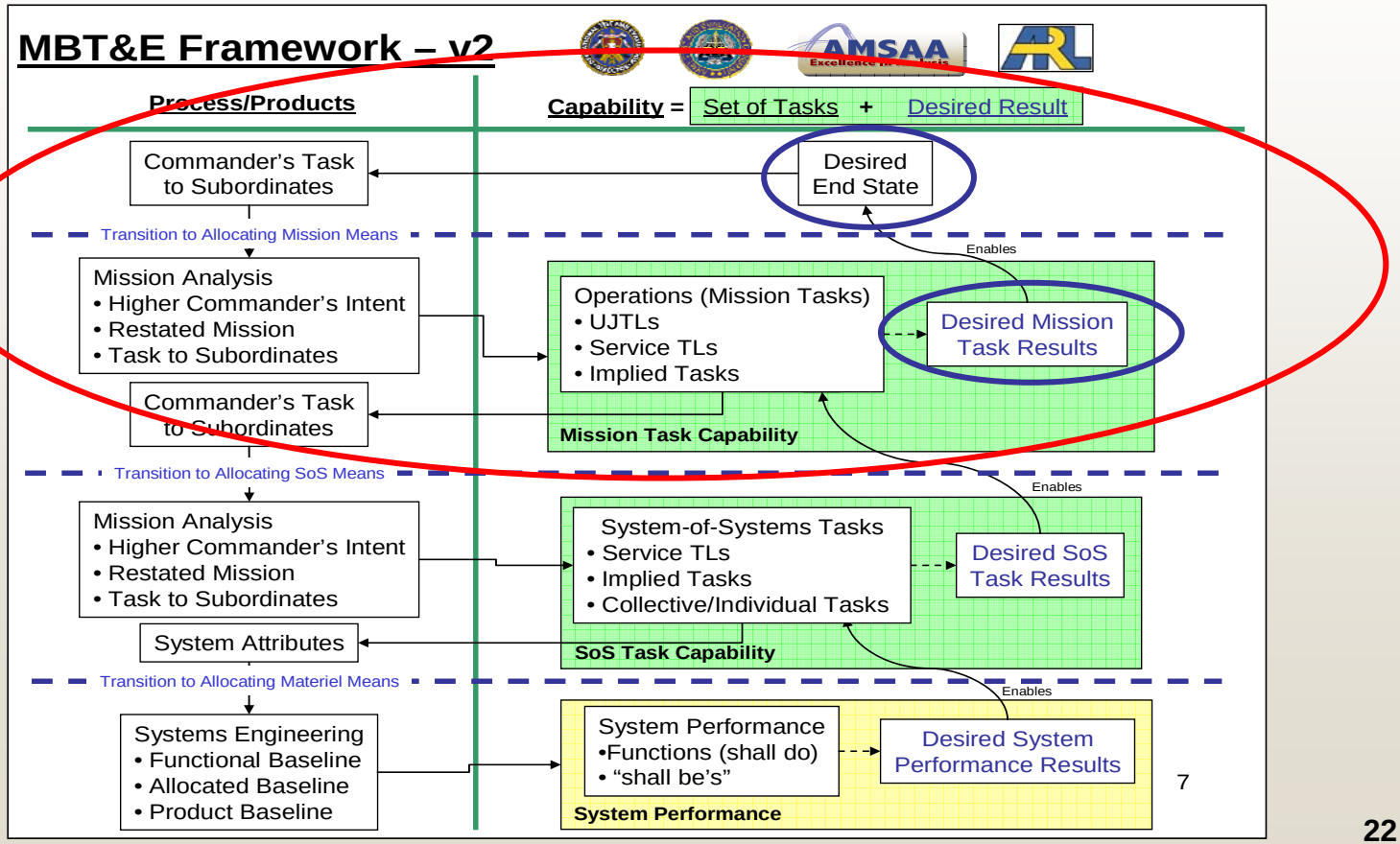
- Determine Operations/Mission/Tasks
  - Develop a description of high-level operations/mission/tasks and their desired end states/results,
  - Determine Joint, network and SoS construct, and
  - Determine organizational and support unit construct.
- Determine Operational Conditions
  - Determine the 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.

Mission Context – Relation to Framework

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



Procedure

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?

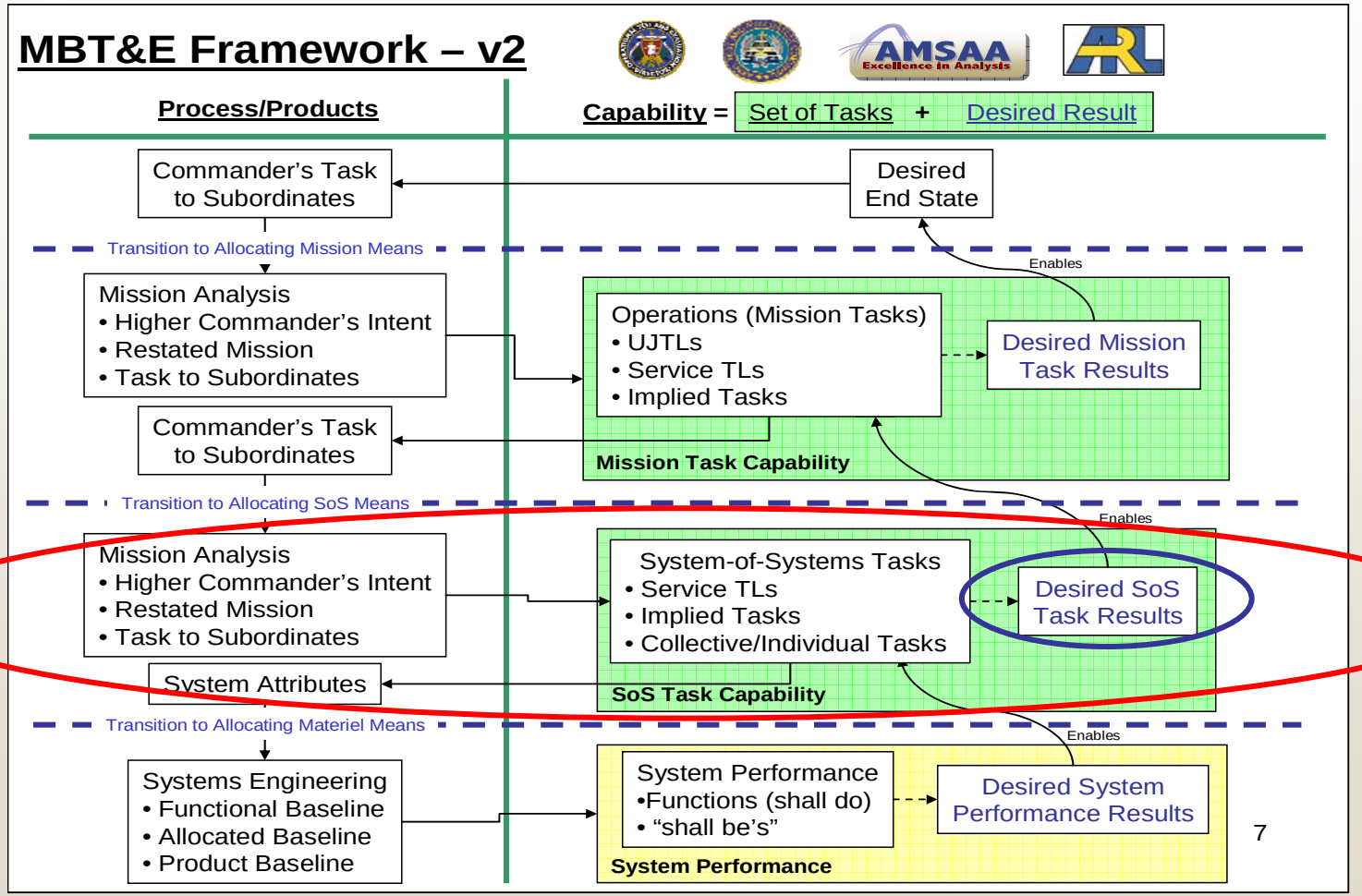
- Document/Conduct Mission Analysis
  - Develop SoS mission task threads and alternate task threads where applicable. (MS project or similar tool can be used.)
  - Determine task desired end states/results
- Link to Authoritative Task Lists
  - Develop linkages between the tasks identified above and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

Mission Tasks – Relation to Framework

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



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.

MBT&E Procedure
Steps 6-8
Understand the System

Procedure - Overview

- 19 steps divided into 5 major purpose areas.
  - 1 Pre-step to understand the program context.

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 TEST AND EVALUATION	• 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.

Procedure

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.

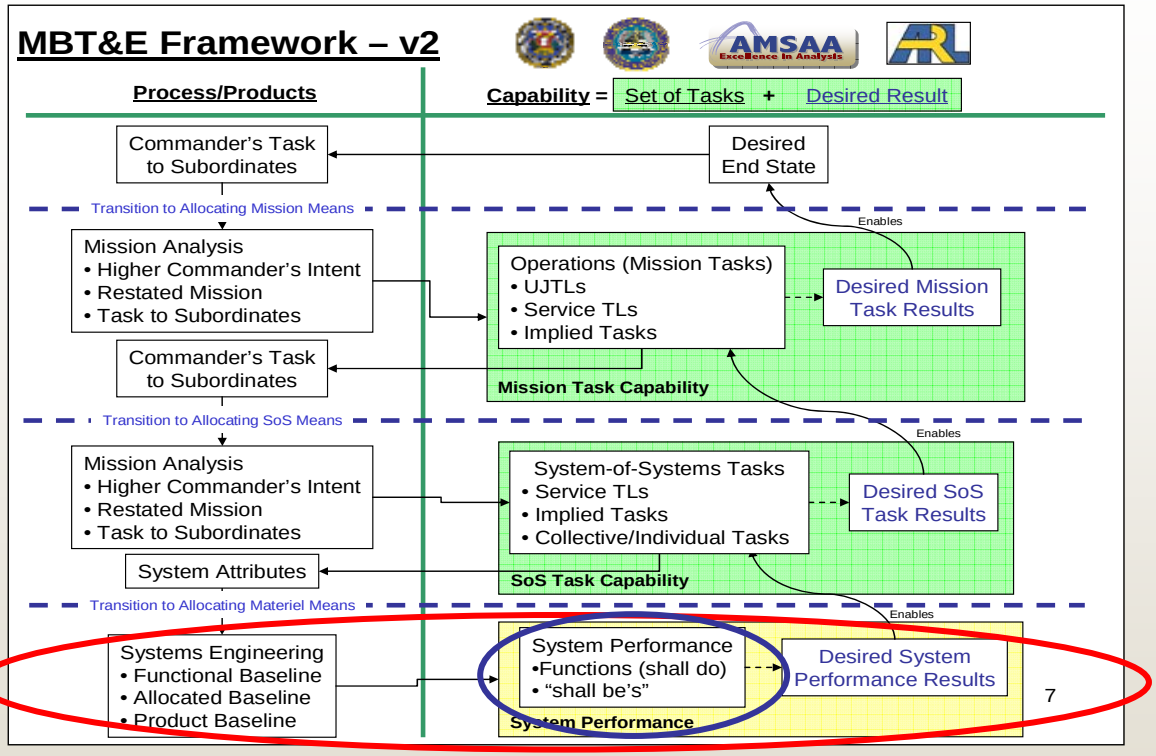
- Option: Develop technology risk areas for pre-MS B systems.

When am I done?

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

SoS Components – 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*.

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.)

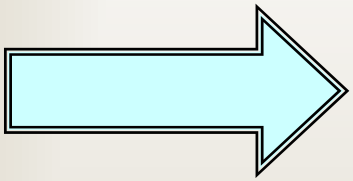
- Associate Components with Attributes
  - Link the attributes determined above with the system components developed in step 6.

When am I done?

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

Procedure - Overview

- 19 steps divided into 5 major purpose areas.
  - 1 Pre-step to understand the program context.

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 TEST AND EVALUATION	• 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.

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.

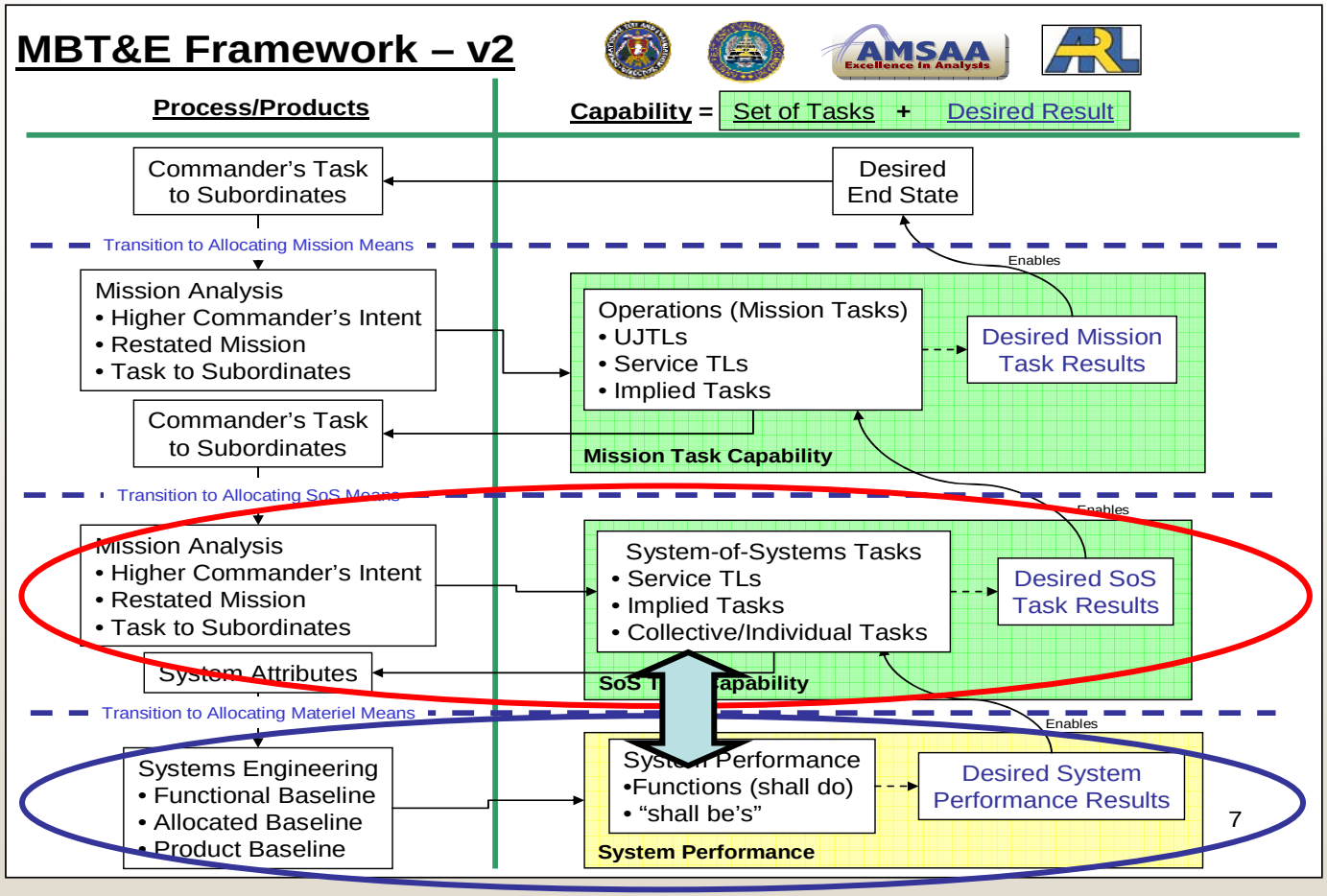
- Determine Mission Enabling Attributes
  - Mission Enabling Attributes are system enabling attributes that are not specific to a particular task capability – they address all tasks.

When am I done?

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

Capabilities to Attributes – Relation to Framework

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



Agenda

1330: Introduction and Mission-Based T&E Background

1340: MBT&E Framework

1400: Case Study

1415: Procedure – Steps 1-5

1500-1515: Afternoon Break

1515: Procedure – Steps 6-8

1545: Procedure – Steps 9-15

1615: Procedure – Steps 16-19

1630: Discussions/Questions/Answers

MBT&E Procedure
Steps 9-15
Design the T&E

Procedure - Overview

- 19 steps divided into 5 major purpose areas.
  - 1 Pre-step to understand the program context.

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 TEST AND EVALUATION	• 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.

Procedure

Unconstrained Operational Conditions (Step 9)

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

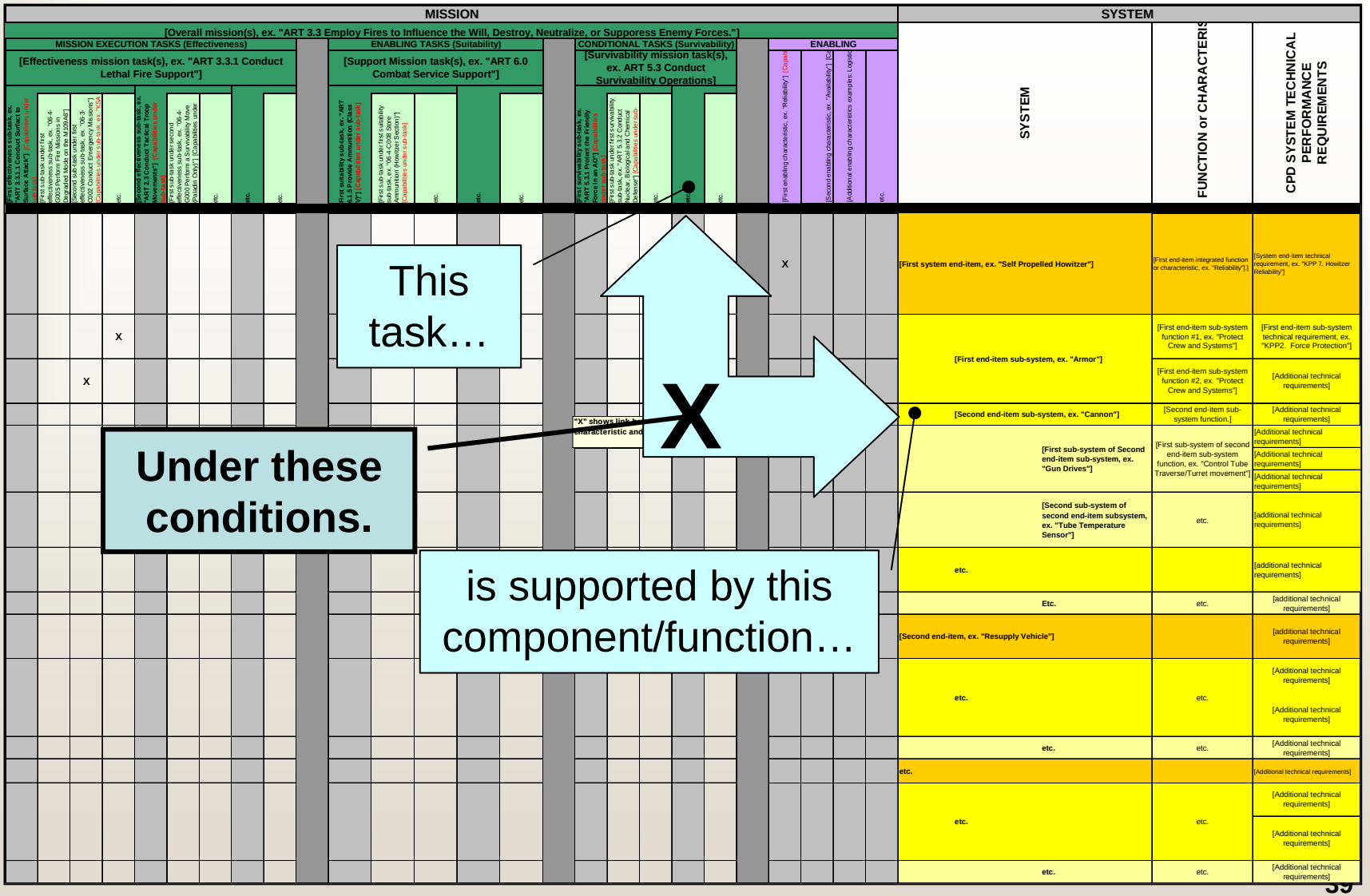
What do I do?

- 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.

Operational Conditions – Linking with the Matrix



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.

Process
Develop Evaluation Measures (Step 11)

Purpose: Develop the evaluation measures.

What do I do?

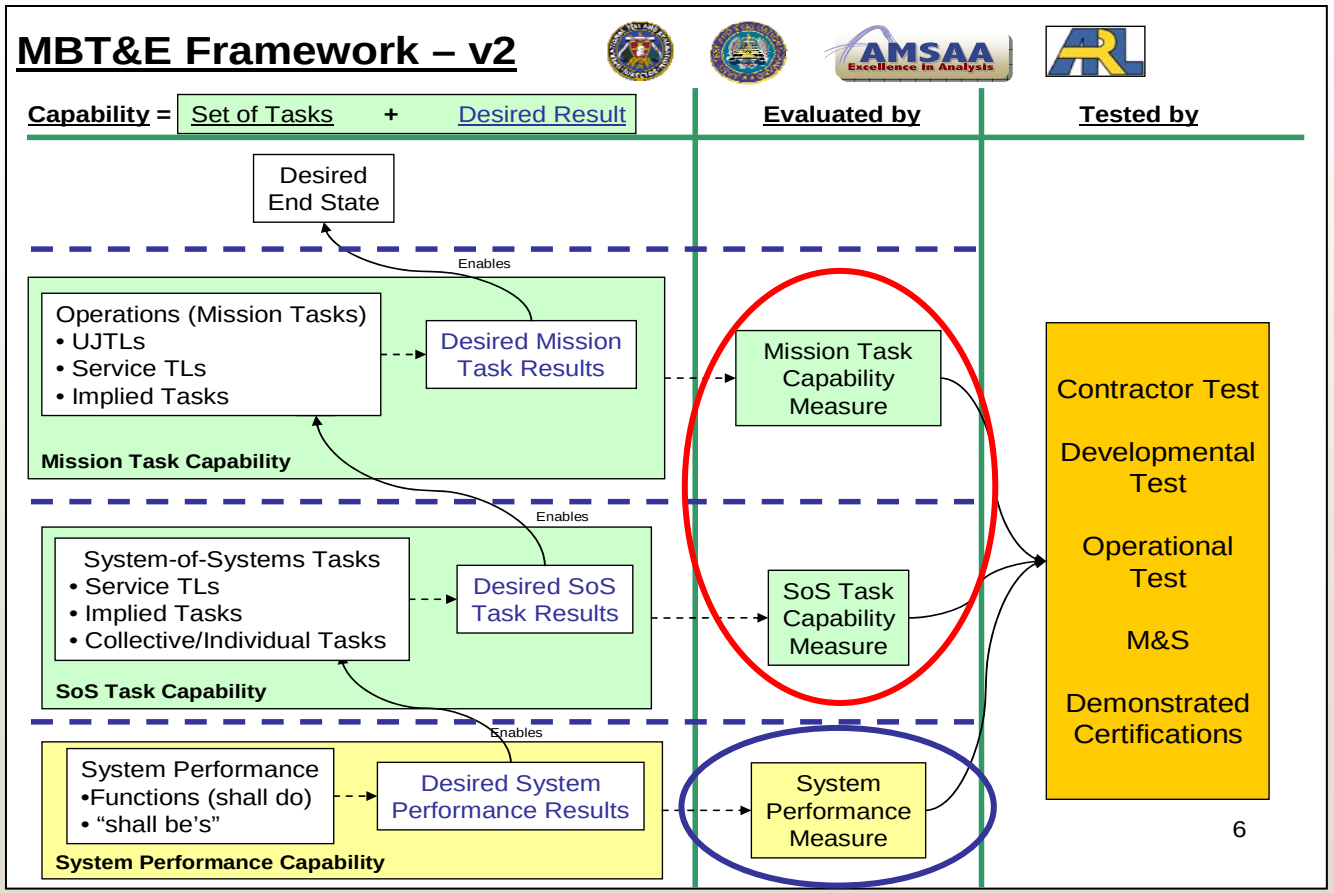
- Develop measures supporting the evaluation of:
  - task capabilities (task capability measures), and
  - system attributes (materiel performance measures).
- Complete linkages from measure -to- system -to- task.
- Develop linkages between measures and COIs/Criteria.

When am I done?

– Task capability and materiel performance measures are documented.

Evaluation Measures – Relation to Framework

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



Operational Measures

SIDE

- Describe operational T&E measures linked to the tasks.
- Describe how operational conditions are used to define data requirements

Technical Measures

SIDE

- Describe technical T&E measures linked to the materiel system attributes (functions and characteristics).
- Describe how operational conditions are used to define data requirements

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?

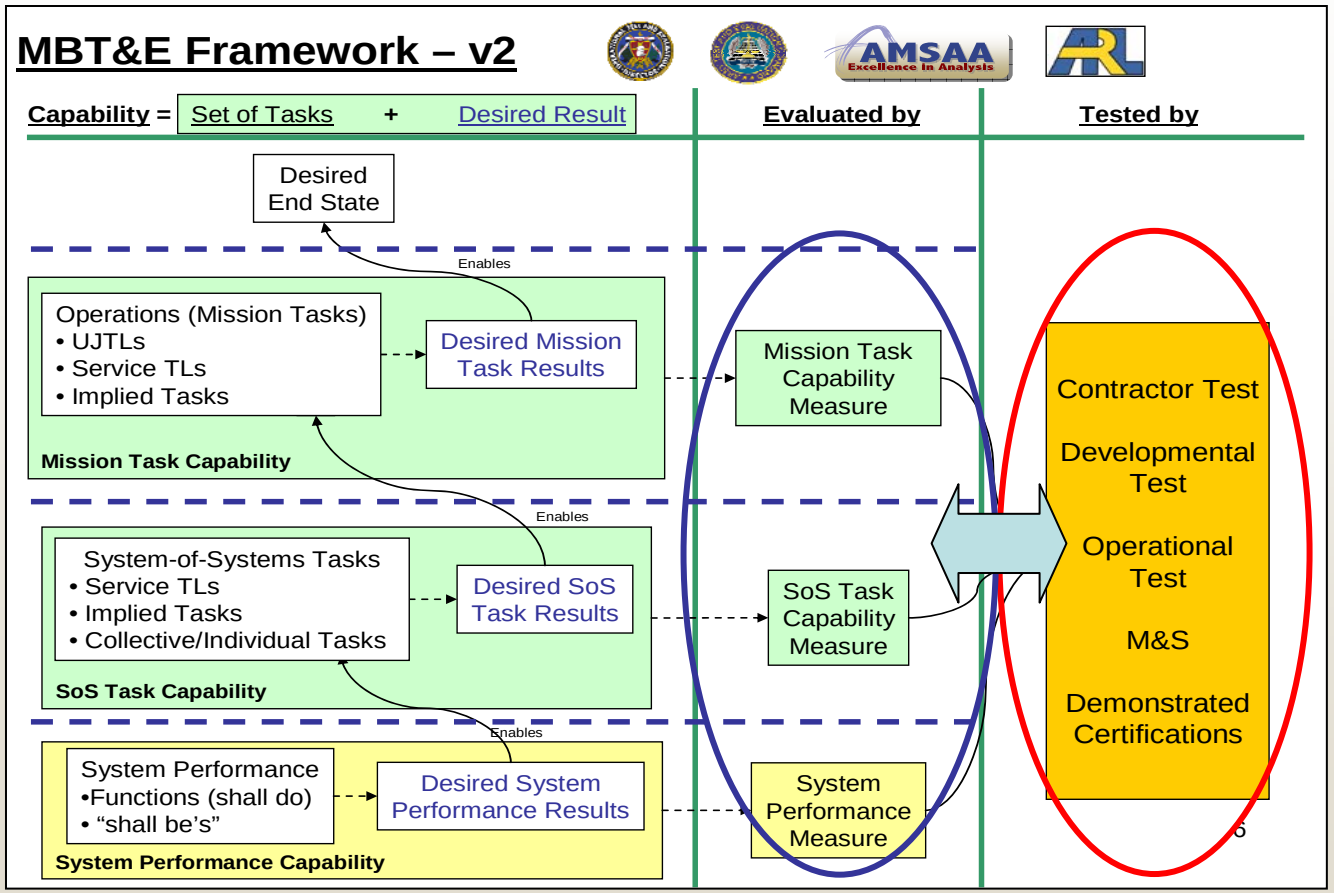
- Assign one or more data sources to each evaluation measure.
- Review data source matrix to determine:
  - T&E execution risk by assessing critical data sources;
  - Developmental risk by assessing when critical technologies are demonstrated; and
  - Determine appropriate use of M&S.

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.

Data Sources – Relation to Framework

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



Link to Data Sources

SIDE

- Describe the process used to link the evaluation measures to the appropriate data sources.
- Describe how to do first cut on what operational conditions are provided by the tests (data sources).

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 operational 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.)

Constrained Op Conditions

SIDE

- Describe DOE

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.

MBT&E Current Toolbox

MBT&E Worksheets

- Used to build test and evaluation plan.

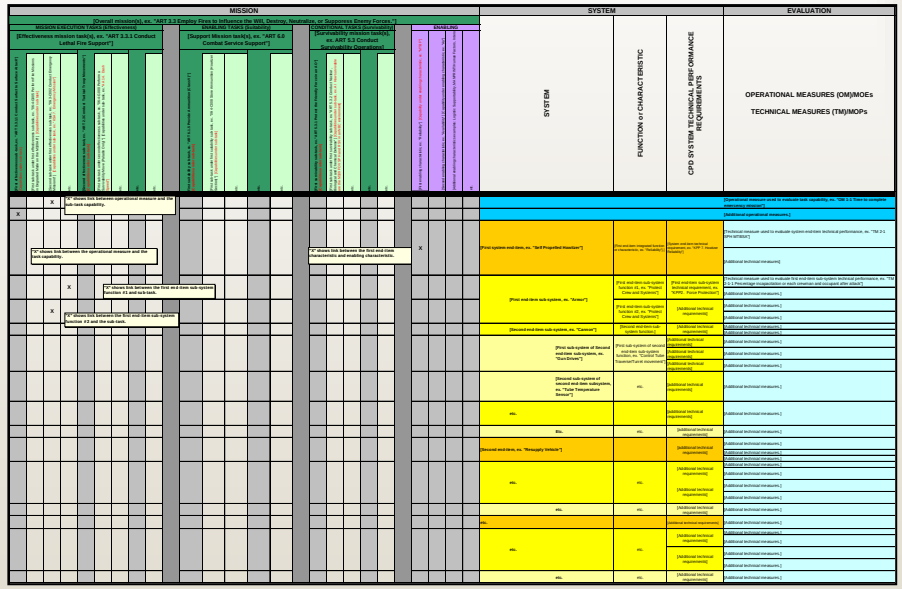
Mission Summary

Task and Enabling Attribute Descriptions

Evaluation Measure Description

MBT&E Matrix

- Maintains status and tracks changes during execution.



Agenda

1330: Introduction and Mission-Based T&E Background

1340: MBT&E Framework

1400: Case Study

1415: Procedure – Steps 1-5

1500-1515: Afternoon Break

1515: Procedure – Steps 6-8

1545: Procedure – Steps 9-15

1615: Procedure – Steps 16-19

1630: Discussions/Questions/Answers

MBT&E Procedure
Steps 16-19
Determine and Report the Results

Procedure - Overview

- 19 steps divided into 5 major purpose areas.
  - 1 Pre-step to understand the program context.

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 TEST AND EVALUATION	• 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.

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).

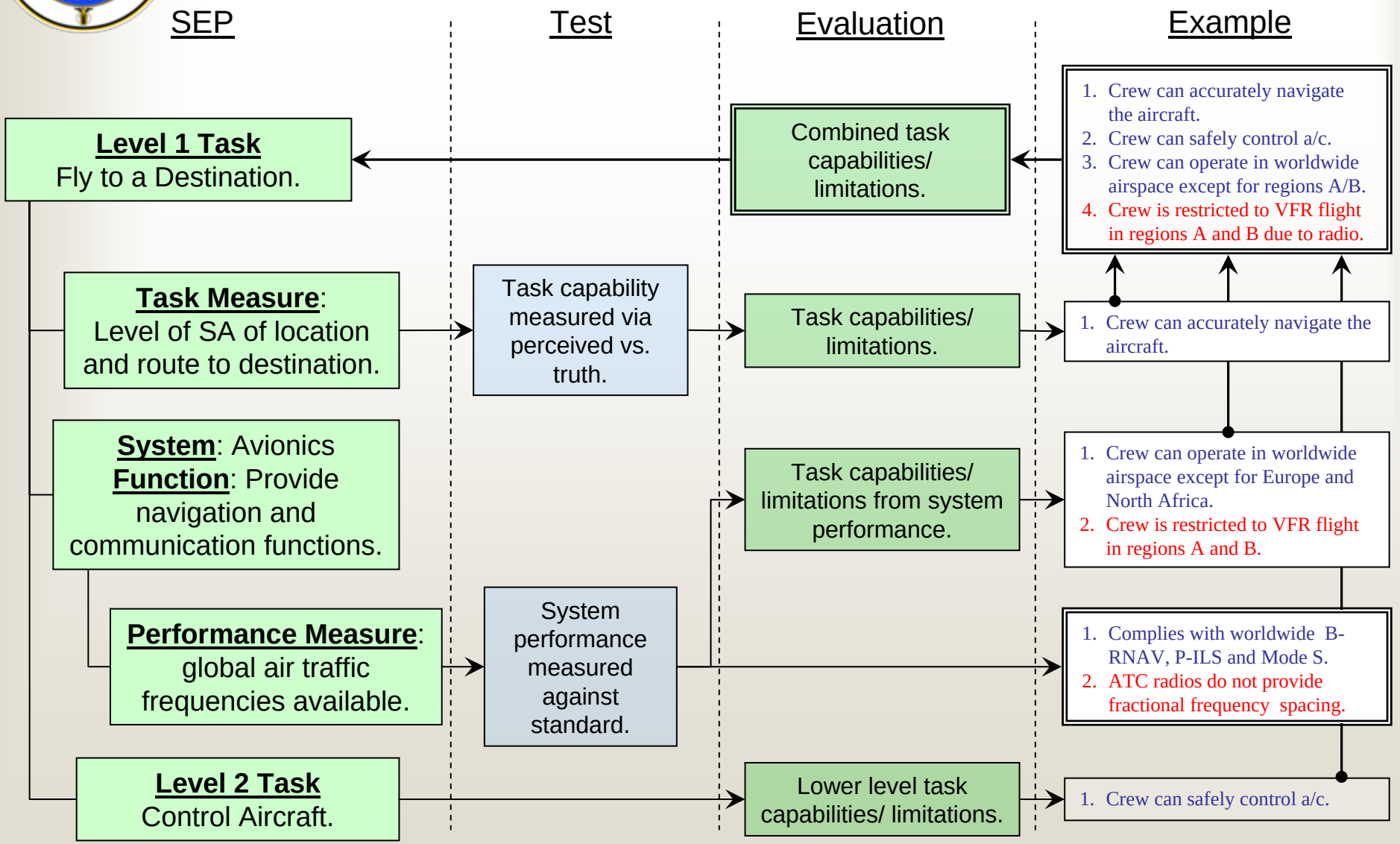
GENERATE EVALUATION RESULTS (Step 18)

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.

Generate Evaluation Results

Validation Example



Procedure - Overview

- 19 steps divided into 5 major purpose areas.
  - 1 Pre-step to understand the program context.

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 TEST AND EVALUATION	• 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.

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-leve task C&Ls are documented.
- Overall summary of effectiveness, suitability and survivability is documented.

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.

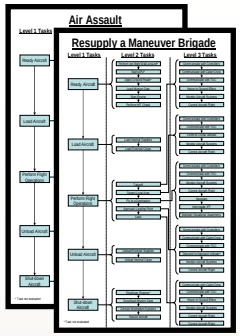
- Tasks that are performed during the mission that become required due to some influencing condition.

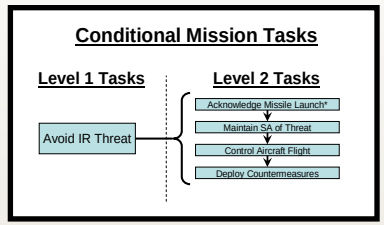
Mission enabling tasks.

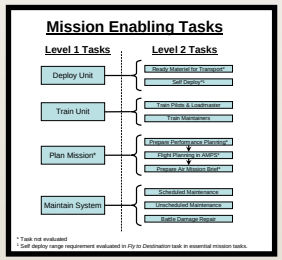
- Tasks that enable the mission execution and conditional tasks to be performed. They usually occur before or after the mission.

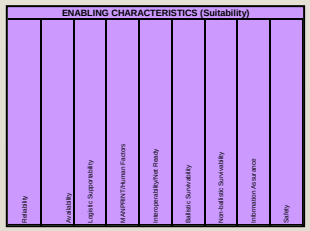
Enabling Attributes

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









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

Normally aggregated into **Suitability**

Evaluation Report

SIDE

- Describe reporting of overall capabilities and limitations
- Describe roll-up into effectiveness, suitability and survivability

Agenda

1330: Introduction and Mission-Based T&E Background

1340: MBT&E Framework

1400: Case Study

1415: Procedure – Steps 1-5

1500-1515: Afternoon Break

1515: Procedure – Steps 6-8

1545: Procedure – Steps 9-15

1615: Procedure – Steps 16-19

1630: Discussions/Questions/Answers

Discussions

-

Questions

-

Answers

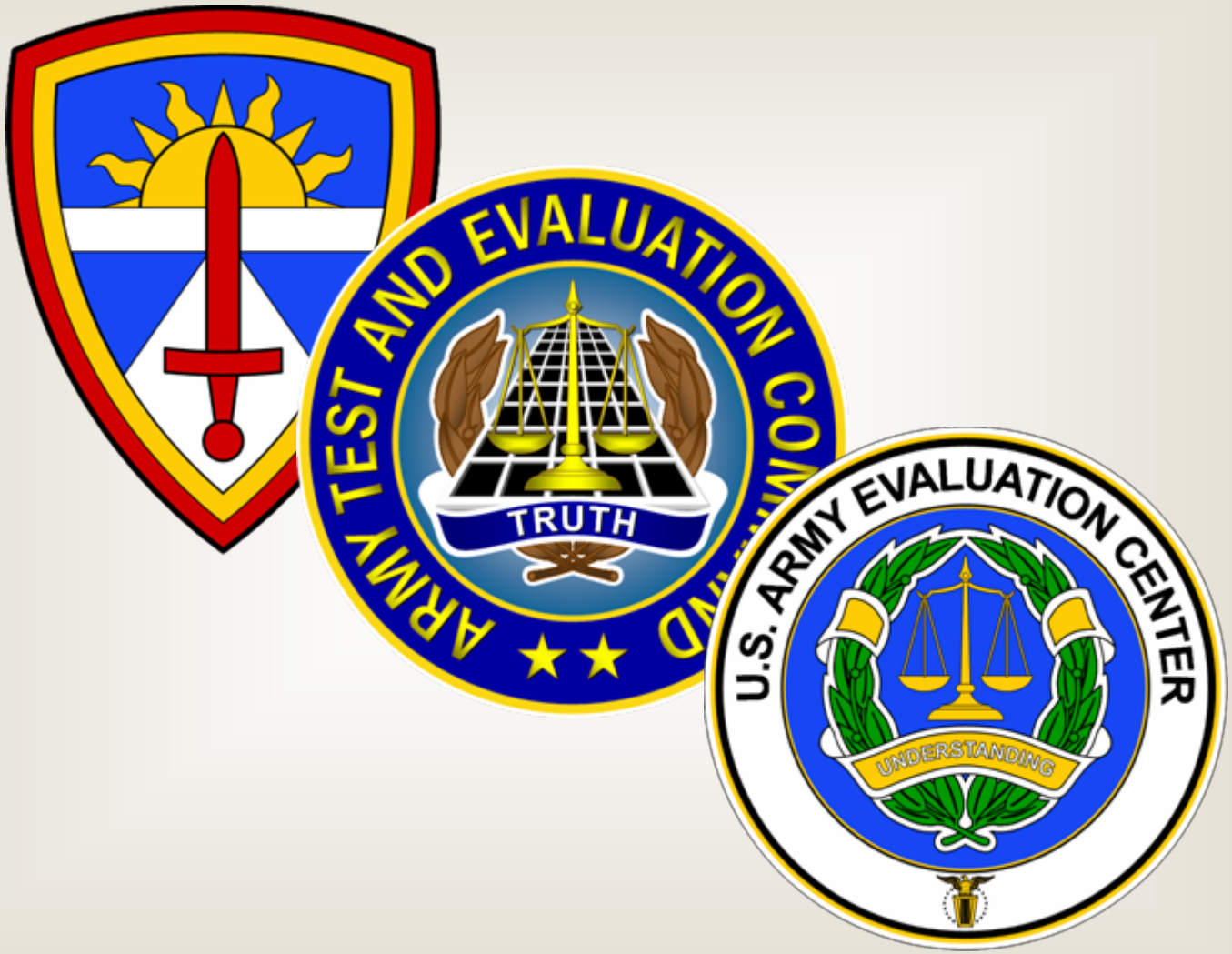
MBT&E Point of Contact

Christopher Wilcox

US Army Evaluation Center
ATTN: TEAE-AVA (Mr. Chris Wilcox)
4120 Susquehanna Ave.
Aberdeen Proving Ground, MD 21005

Office: (410) 306-0475
Mobile: (410) 652-0168
Fax: (410) 306-0398

chris.wilcox1@us.army.mil


ARMY TEST AND EVALUATION COMMAND
TRUTH
U.S. ARMY EVALUATION CENTER
UNDERSTANDING

Backup slides