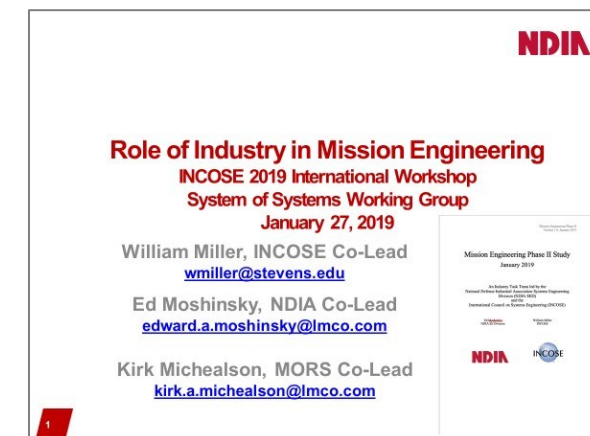
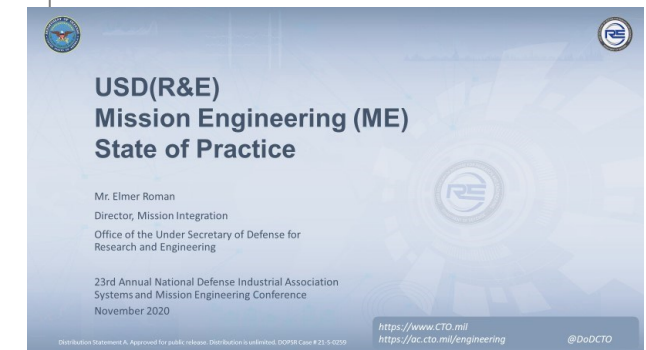
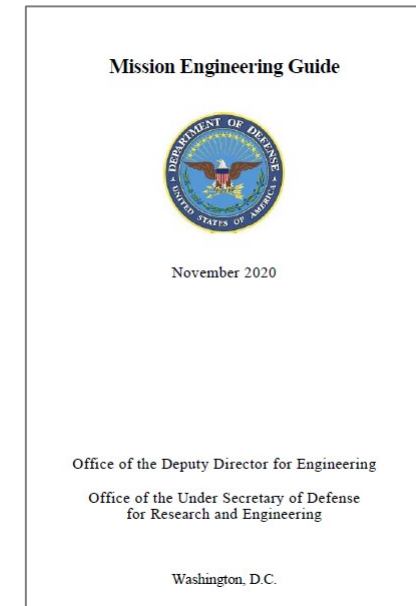


Kickoff
NDIA SE Division
2021 Mission Engineering Initiative

May 24, 2021

Purpose and Topics

- Purpose of this meeting is to kickoff a new initiative on **Mission Engineering**
- Topics:
 - **Mission Engineering (ME) today** – based on the current ME Guide published by OUSD R&E in November 2020 and R&E NDIA ME/SE conference presentation
https://ac.cto.mil/wp-content/uploads/2020/12/MEG-v40_20201130_shm.pdf
 - Summary of **initial discussions with OUSD R&E**, DoD ME lead, on partnership for this initiative
 - Review the results of the last **NDIA ME Task Team** results – based on presentation to INCOSE SoSE Working Group, January 2019
 - **Open discussion** of topics of interest as starting point for initiative
 - **Next steps?** NDIA SE/ME Workshop?



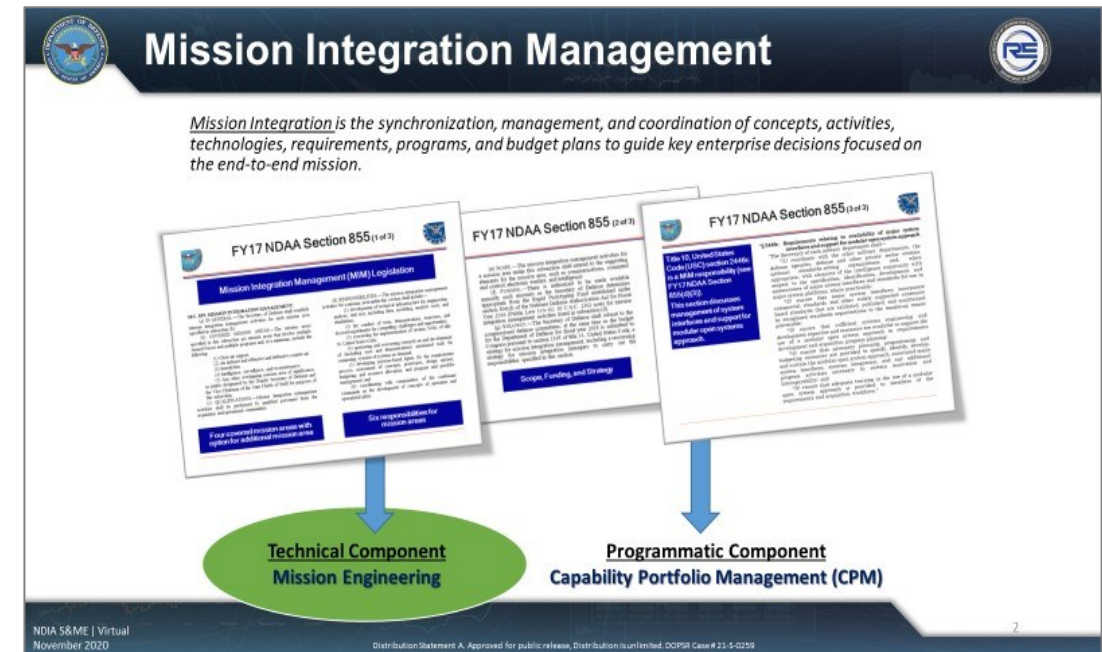
Follow-up engagement with R&E Engineering to share R&E perspective and result of this meeting

Mission Engineering Today

Background

- The National Defense Authorization Act (NDAA) for Fiscal Year 2017, Section 855, directed DoD to establish **Mission Integration Management (MIM)** as a core activity within the acquisition, engineering, and operational communities to focus on the integration of elements that are all centered around the mission.
- The DoD Joint Publication 3-0 (Joint Operations) defines *mission* as *the task, together with the purpose, that clearly indicates the action to be taken and the reason thereby*. More simply, a mission is a duty assigned to an individual or unit.
- OUSD(R&E) defines MIM as *the synchronization, management, and coordination of concepts, activities, technologies, requirements, programs, and budget plans to guide key decisions focused on the end-to-end mission*.

DoD ME Guide, 2020, p1



Roman Presentation, NDIA SE ME Conference, 2020, p2

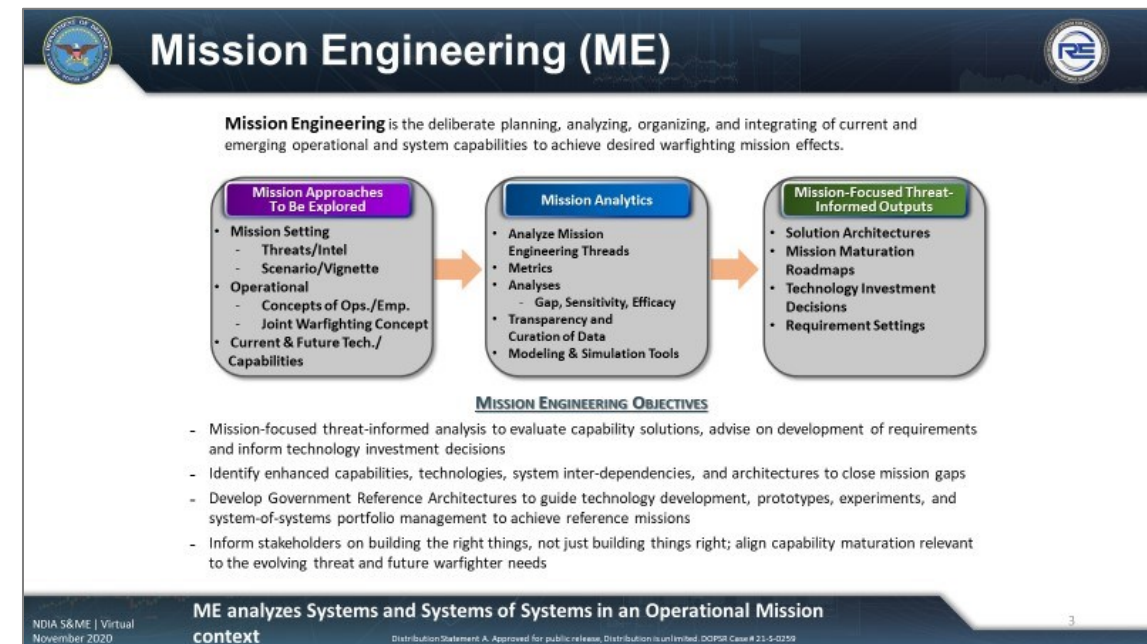
- ME is the technical sub-element of MIM as a **means** to provide engineered mission-based outputs to the requirements process, guide prototypes, provide design options, and inform investment decisions.

DoD ME Guide, 2020, p1

Mission Engineering

- Defense Acquisition Guidebook (DAG) defines ME as
 - the deliberate planning, analyzing, organizing, and integrating of current and emerging operational and system capabilities to achieve desired warfighting mission effects.
- ME is a top-down approach that delivers **engineering results** to identify
 - enhanced capabilities, technologies, system interdependencies, and architectures to **guide**
 - development, prototypes, experiments, and SoS to achieve reference missions and close mission capability gaps.

DoD ME Guide, 2020, p2





- ME uses systems and SoS in an operational mission context to inform stakeholders about **building the right things**, not just **building things right**, by guiding capability maturation to address **warfighter mission needs**.

Mission Engineering Guide

ME Guide Purpose

- Speaks to a novice that is required to conduct ME
- Invokes critical thinking throughout the ME process
- Provides overarching guidance and information on ME by:
 - Explaining what is and what is not ME
 - Describing the best practices, principles, and attributes for ME
 - Elaborating on the benefits of using ME
 - Establishing a set of common terms and definitions
 - Provides standardized artifact templates used to present conclusions
- Enables practitioners to formulate problems and build a firm understanding of the main principles involved in performing analysis in a mission context
- Provides users with insight as to how to document and portray results or conclusions via a set of products that help inform key decisions (e.g., Government [Mission or Capability] Reference Architectures)
- OUSD(R&E) will promulgate ME guidance
 - This ME Guide will replace the draft version of the OUSD A&S Mission Engineering and Integration (ME&I) Guidebook
 - Additional efforts include development of ME training material

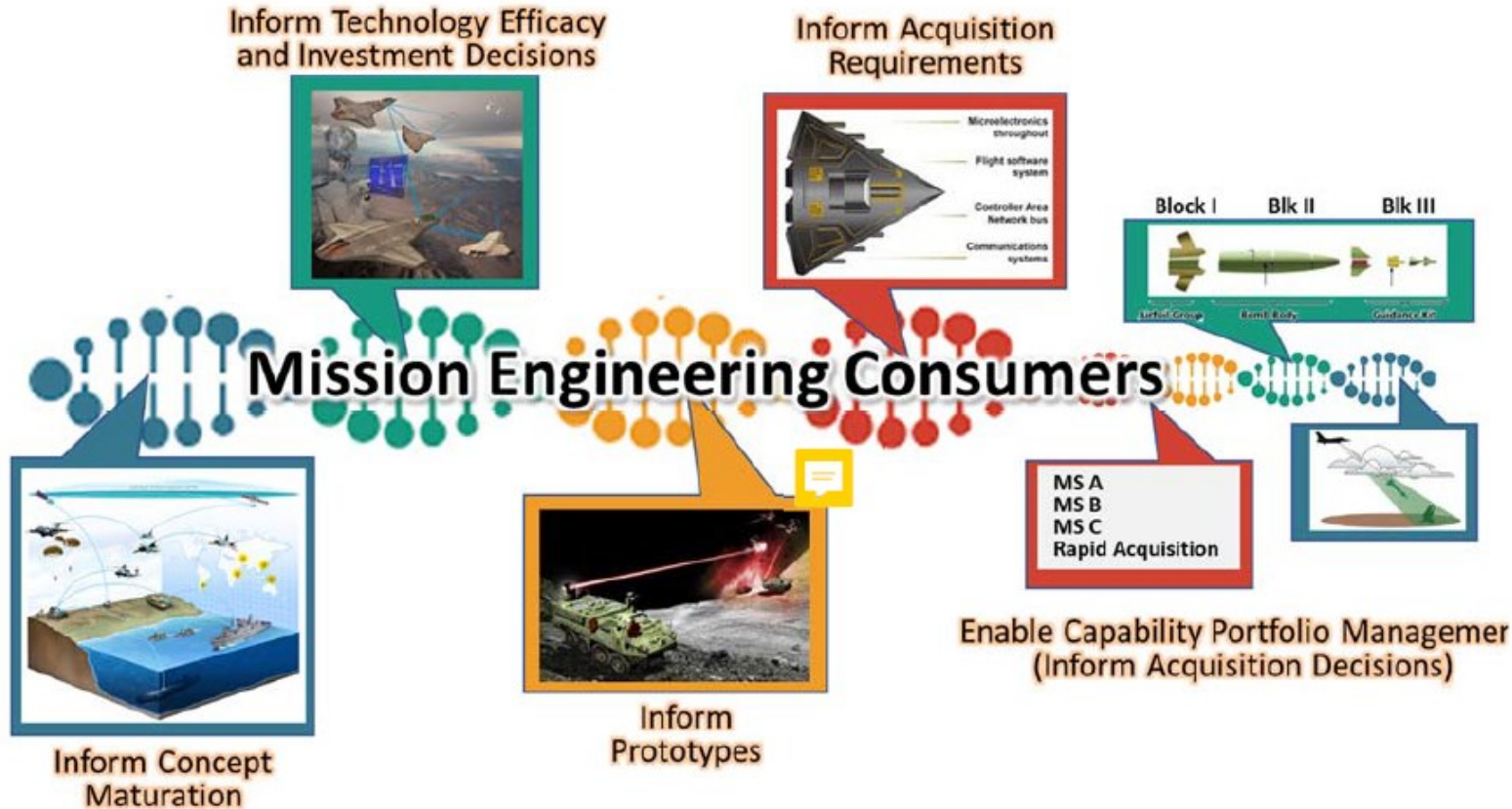
NDIA S&ME | Virtual November 2020
 Distribution Statement A. Approved for public release, Distribution is unlimited. DCPSR Case # 21-5-0259

Initial version of guide (released November 2020) “will:

- Describe the main attributes of DoD ME and how to apply them to add technical and engineering rigor into the ME analysis process;
- Enable practitioners to formulate problems, and build understanding of the main principles involved in performing analysis in a mission context; and
- Provide users with insight as to how to document and portray results or conclusions in a set of products that help inform key decisions.”

Review and update of Guide is planned for later in 2021

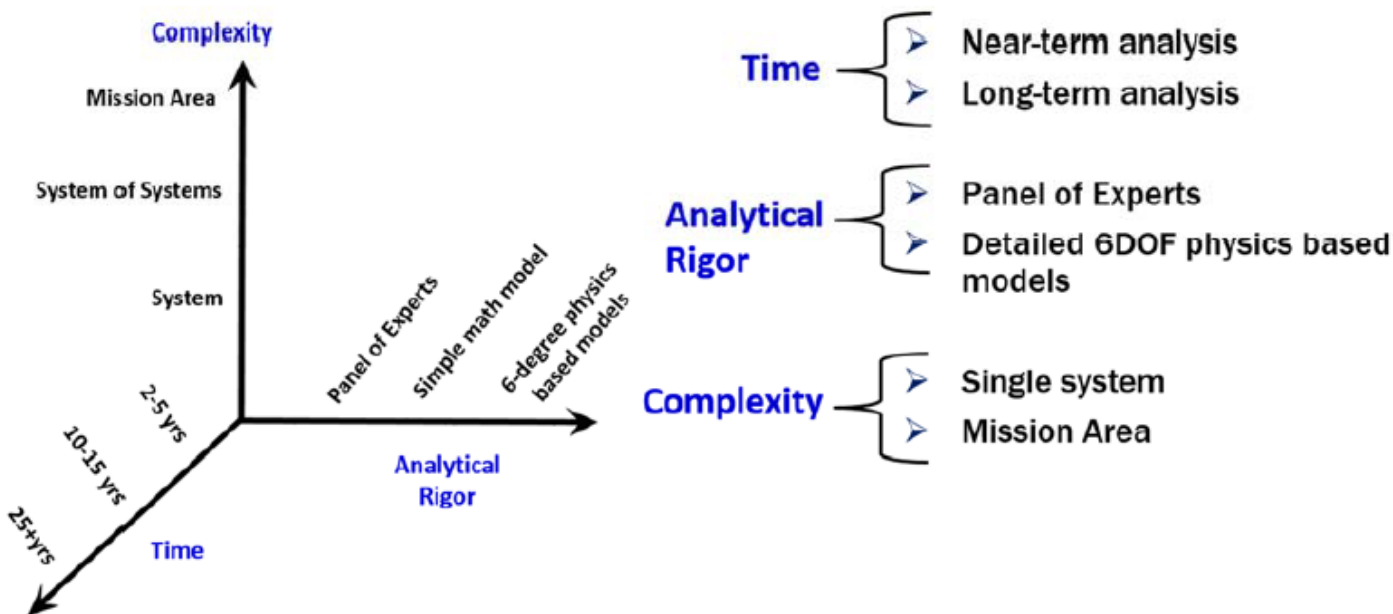
Consumers of ME



- ME uses validated mission definitions and trustworthy and curated data sets as the basis for analyses to answer a set of operational or tactical questions. Shared assessments of conclusions and understanding of analysis inputs helps leadership pursue the best course of action for decisions in support of the warfighter and joint mission.

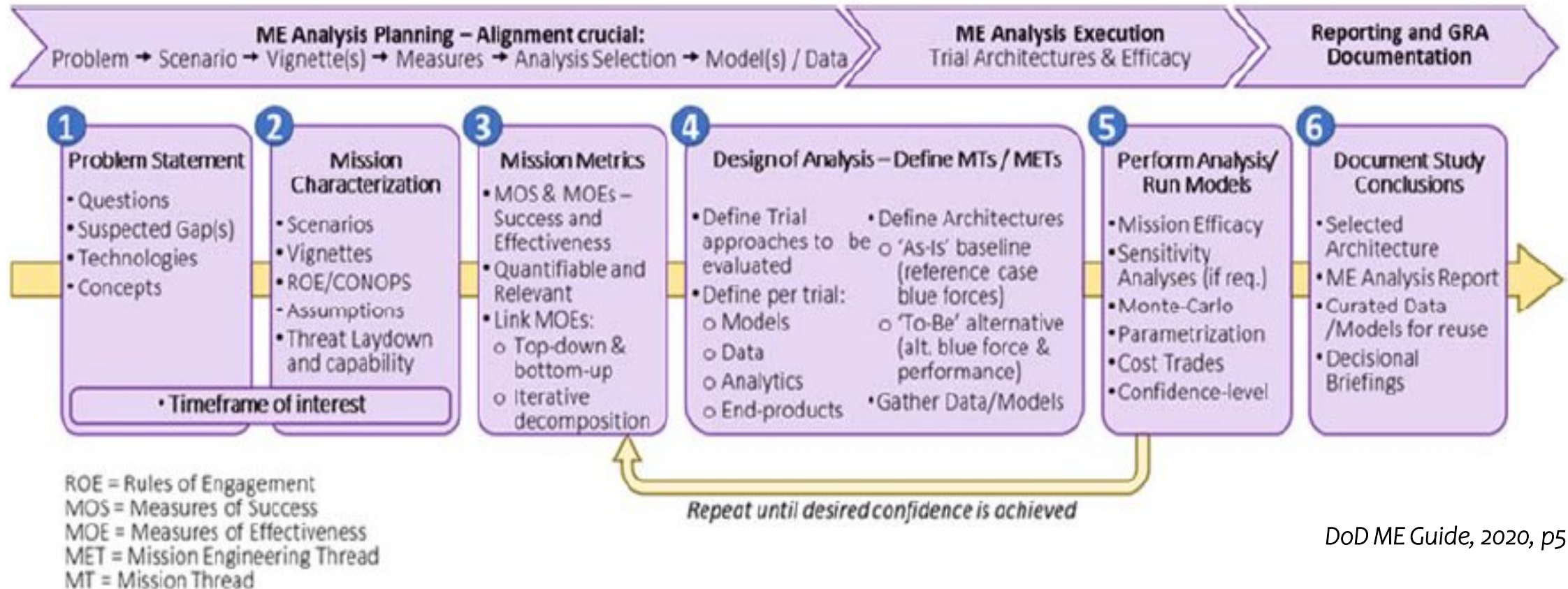
Three Axes of ME

Mission Engineering Performed at Many Levels



- ME is a balancing act among the time frame, analytical rigor to be used, and the complexity of the problem to be addressed.
- Reaching too far in one or more dimensions, say predicting outcomes 50 years in the future or increasing the complexity of the mission to be addressed, will impact the confidence-level that can be expected in the ME products.
- It can also affect the rigor and validity of the analytics based on the availability and accessibility of data.

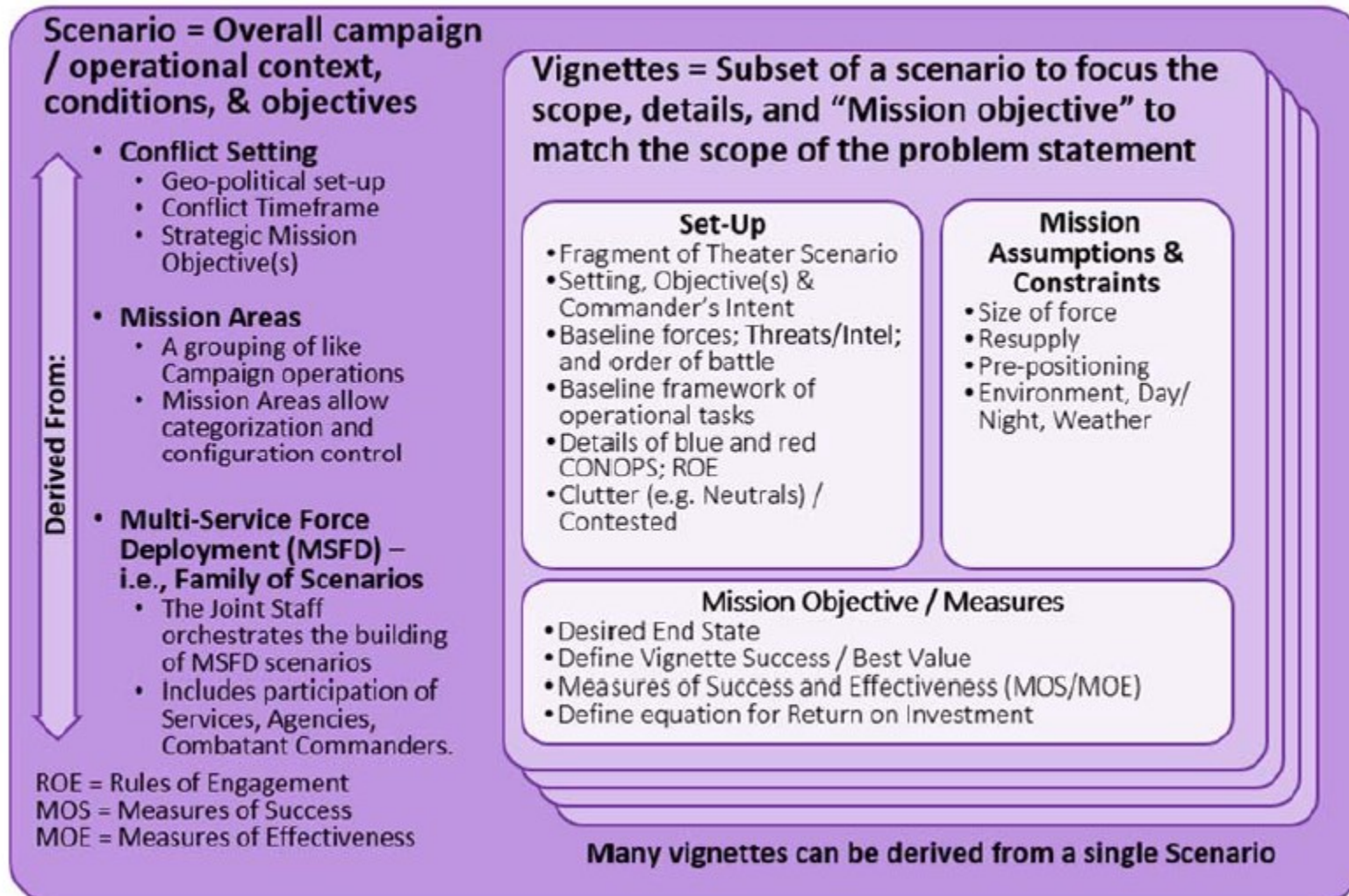
ME Approach and Methodology



DoD ME Guide, 2020, p5

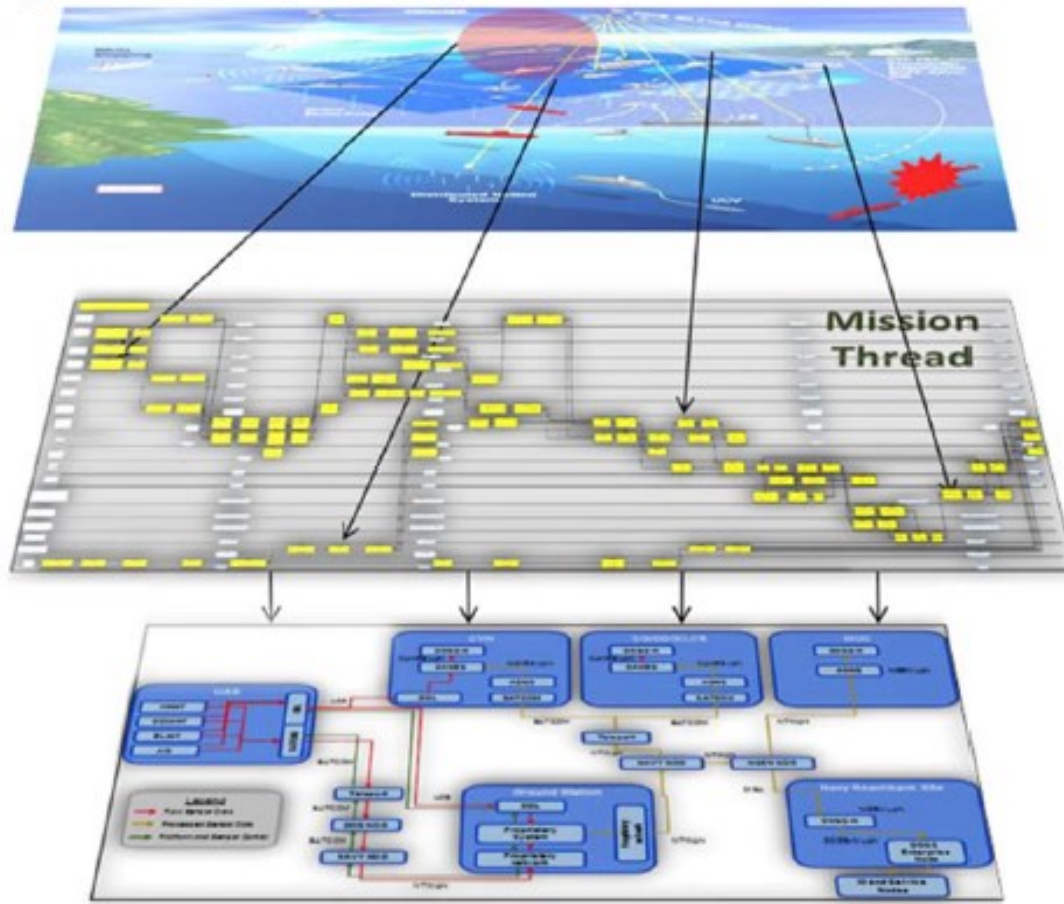
ME process begins with the end in mind, a carefully articulated problem statement, the characterization of the mission and identification of metrics, and working through the collection of data and models needed to analyze the mission and document the output results.

Mission Characterization and Mission Metrics



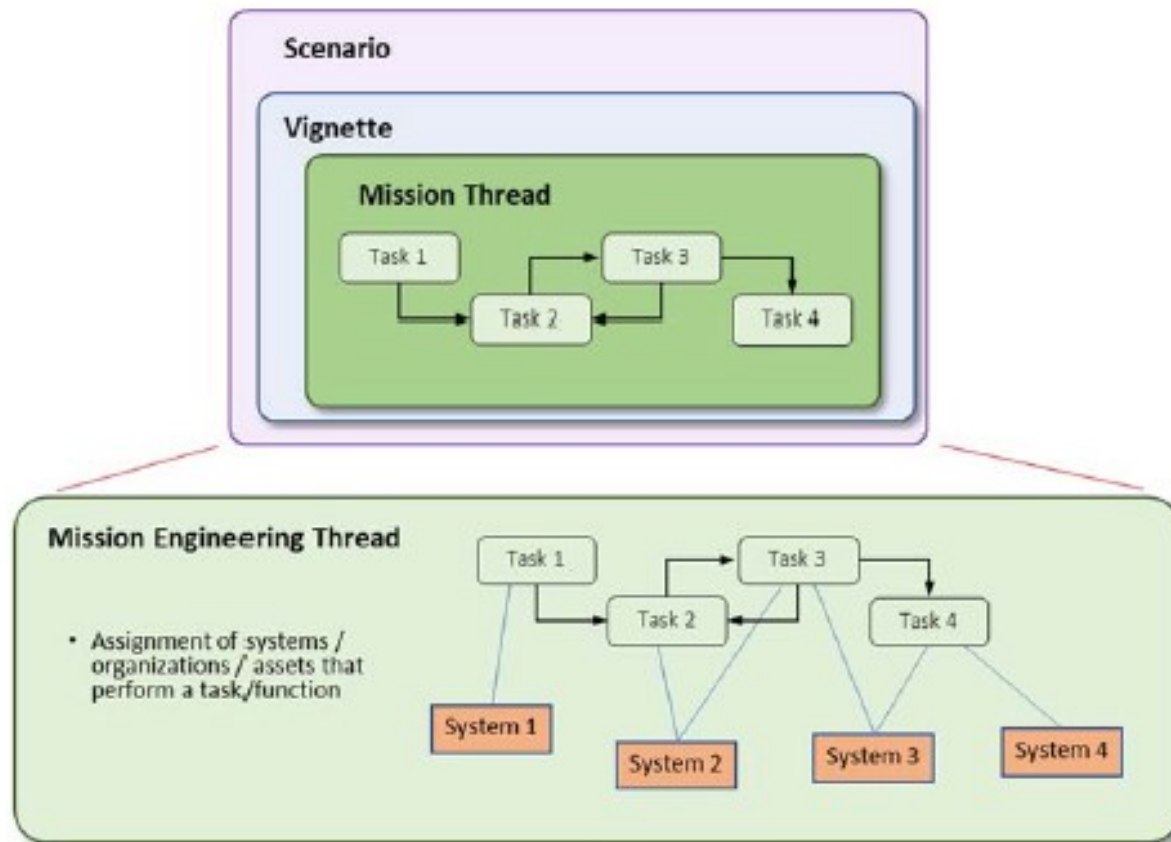
A mission includes all the details necessary to frame the objectives, operational environment, assumptions, and constraints that impact operational approaches and systems to be used.

Mission Architecture



- A **Mission Architecture** is a conceptual modeling of concepts, approaches, and systems of systems that enables details of the process flow, timing, interactions, data, capabilities, and performance to be examined in relation to the other processes, entities, and systems that contribute to achieving the mission objective. ...
- A **Mission Architecture** can address an overall campaign of many concurrent processes and entities or narrowly focus on just one entity and flow.
- A **Mission Architecture** is represented by a series of “views” to illustrate/highlight specific details.

Mission Threads and Mission Engineering Threads



Mission Thread (MTs)

- the tasks to be executed to conduct or carry out the mission to satisfy a defined objective.
- Threads define the task execution sequence in a chain of events of how systems, people, data, methods, tactics, timing, and interfaces will interact to complete necessary tasks against threats and other variables to achieve mission objective(s).

Mission Engineering Threads (METs)

- As details associated with specific systems, technologies, or people are added, the generic MTs become METs.

Use of Analytic and Computational-Based Models

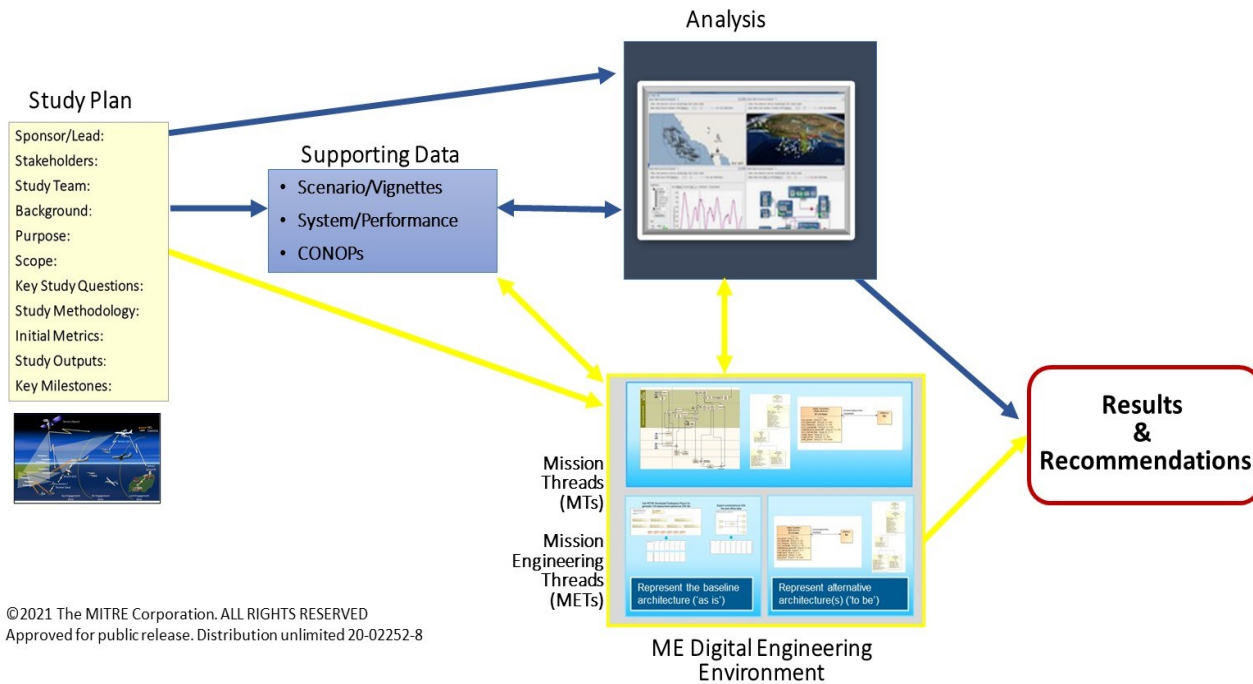


“The digital models that support ME are driven by the representation of data and the type of approach most suited to the analysis (i.e., physics-based, Monte-Carlo).”

- ME is facilitated by the use of analytical and computational-based models that aid in the representation of the operational and technical means to execute a mission.
- Use of models provides for consistency and reuse of analytical constructs among ME practitioners.
- Crucially, ME practitioners must take care to curate, or manage, the models they employ so that data elements, hypothetical realizations, and assumptions are captured and archived with traceability to authoritative sources.

R&E ME Study Approach

OUSD R&E ME Studies Implement ME Process To Assess Impact of Technologies to Impact Joint Mission Outcomes



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Study Plan

- The parameters of the study: stakeholders, background, problem statement, goals, approach, mission context, products

Supporting Data

- Detailed data on the mission scenario and vignette context for the study, threat, systems and their role in execution the mission, etc., assumptions

ME DEE

- Digital representation of the mission architecture (MTs, METs) for baseline and the alternatives

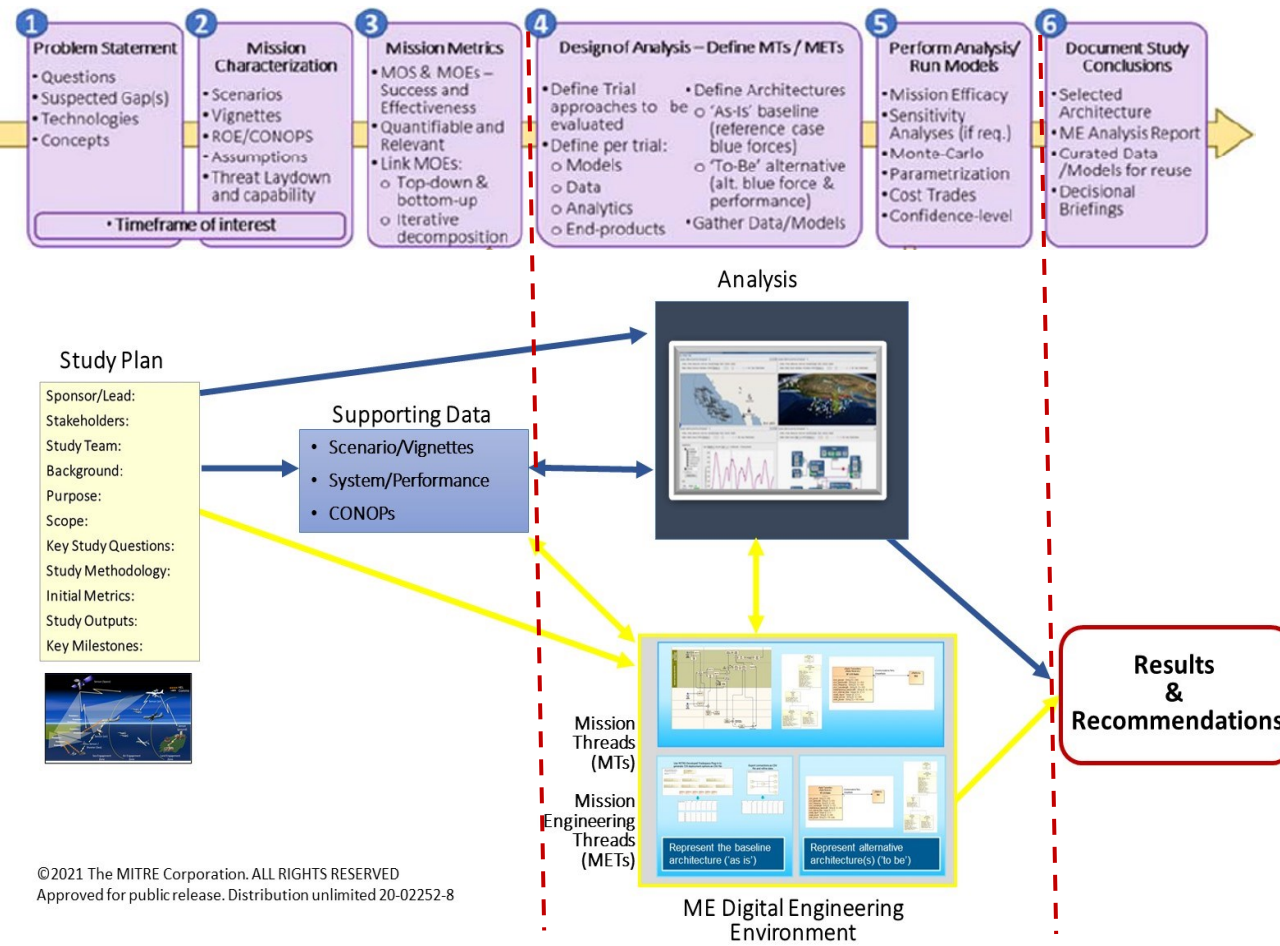
Mission Analysis

- Implementation of scenario, systems and activities in operational analysis tool(s)
- Metrics and analyses for baseline and alternatives

Results

- Study results and recommendations based on mission analysis

R&E ME Study Approach



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Study Plan

- The parameters of the study: stakeholders, background, problem statement, goals, approach, mission context, products

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Results

- Study results and recommendations based on mission analysis

Initial Discussions with OUSD R&E

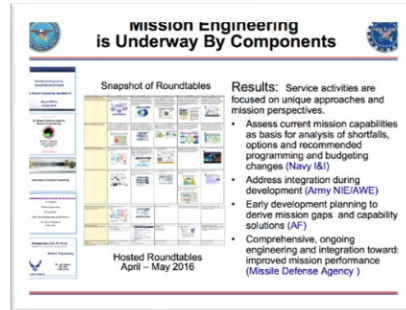
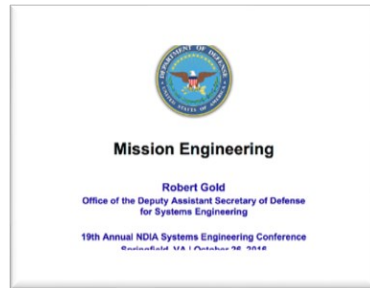
Key Actions – Intro Meeting with OSD R&E on ME

- Held introductory meeting with USD(R&E) Mission Engineering: Mr. Elmer Roman and Mr. Marc Goldenberg on 23 March 2021.
- Outcomes of meeting were overall agreement of USD(R&E) to participate in:
 - A Cross-Division effort led by the SoS ME committee including the Modeling and Simulation and Architecture committees as well as other interested SED members.
 - Use the current **ME Guide** to focus our activities including looking at ME terminology, methods and products as described in the current version of the guide, first to inform members of the current ME approaches and to solicit input on their ME efforts.
 - Engage SED members on the **models and tools** they use to Industry in conduct ME and to share experience with USD(R&E) to improve the ability to conduct ME.
 - Explore **methods/types of engagement** between DoD and industry on ME to better understand what DoD would like from industry and likewise what industry would like from ME.

2019 NDIA Task Team Mission Engineering Report

Context

- 2009 WSARA – real or perceived OCI of non-SETA contractors
- 2017 NDAA – mission engineering



NDIA 2016 Study Results

- 2018 Reorganization of OSD into R&E and A&S
- Undersecretary of Defense for R&E
 - Digital Engineering Strategy
 - Mission Engineering separate from Systems Engineering



Industry Support to Mission Analysis and Mission Engineering

BLUF

NDIA SED and INCOSE Offer to Lead Industry Task Team on Mission Engineering: (1) State of industry practice and (2) Role of industry

- Both government and industry are doing mission engineering with shared areas of interest, but:
 - Mission Engineering requires more definition,
 - There are challenges associated with Mission Engineering,
 - There is a need for the right enablers; such as practices, tools, modeling, and data, and
 - There is a need to hone Mission Analysis / Mission Engineering skills based on the items above
- Collaboration between DoD and industry can help ME effectiveness

The defense industry can be a key Mission Engineering partner to address the needs.

Unclassified 2

Industry Support to Mission Analysis and Mission Engineering

Conclusions

- Industry finds value in ME and MA
- Industry has much to offer
 - Large number of practitioners
 - Variety of tools and approaches
- Much more can be done if work collaboratively to:
 - Refine and understand the definition of ME
 - And relationship with Mission Analysis and SoSE
 - Address the common challenges
 - Share best practices, tools, and models
 - Find a means to provide access to relevant data
 - Share assets/resources for skill development
 - Explore other opportunities (e.g., additional modeling capabilities)
- Recommend establishing a joint action plan to move forward

Unclassified 22

Role of Industry – Issues

- Issue 1: In-Depth Industry Knowledge of Current Systems and Technology
- Issue 2: Industry IR&D on Innovative Mission Approaches & Systems Technologies
- Issue 3: Facilitating Cross-Industry Mission Engineering Engagement
- Issue 4: Technical Approaches to Mission Engineering and Analysis
- Issue 5: Government Actions to Incentivize Industry Mission Engineering Engagement

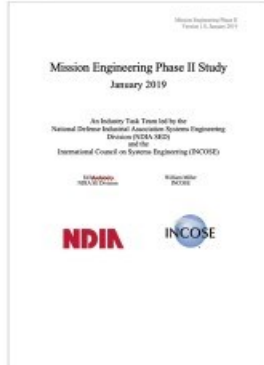


Role of Industry in Mission Engineering
INCOSE 2019 International Workshop
System of Systems Working Group
January 27, 2019

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Mission Engineering Phase II Study
January 2019

An Industry Task Team led by the
National Defense Industrial Association, Systems Engineering
Division (NSA-SEDC) and the
International Council on Systems Engineering (INCOSE)



1 - In-Depth Industry Knowledge of Current Systems and Technology

- **Questions**

- Under what circumstances will it be critical to have industry input to understand options and implications of making changes in how a system is used to support changes in the SoS supporting a mission?
- How would this type of engagement be structured?
- What would incentivize industry to participate?

- **Analysis**

Circumstances critical for industry involvement

- Industry capturing their own internal detailed knowledge
- Government developing a standard approach
- Obtaining information from the Government early

- **Recommendations**

Engagement Structure

- Developing Government / Industry engagement model
- Ability to review Government models

2 - Industry IR&D on Innovative Mission Approaches & Systems Technologies

- Questions

- How could industry IR&D contribute to new mission concepts and approaches or new systems techniques to foster improved mission effectiveness?
- What information or insights would industry need to enable this?
- What would incentivize industry to invest IR&D in these areas?
- What are the risks to industry (competition; IP)?

- Analysis

- Industry has demonstrated the capability to investigate innovative approaches to addressing challenging defense problems bringing a fresh perspective and novel approaches.
- This opens the possibility of industry contributions to new ways to improve mission effectiveness or new systems approaches to support mission adaption under the Industry IR&D efforts.

- Recommendations

- Industry IR&D Contributions
 - Government involving Industry earlier
 - Government providing directed IR&D
 - Developing a Government / Industry Governance Model
- Information and Insights
 - Government getting Industry involved earlier
 - Government defining their responsibilities

3 - Facilitating Cross-Industry Mission Engineering Engagement

- **Questions**

- What are the issues in getting industry teams drawn from multiple companies to work together to support ME initiatives?
- What are the incentives for industry?
- What models (e.g. MDA National team) exist and how could these be adapted to support ME?
- What are the pros and cons of different approaches?
- What are the risks to industry?

- **Analysis**

- Missions are supported by systems of systems which are developed by different industry providers.
- Mission engineering efforts involving industry will naturally need to include teams from different, often competing companies.
- To effectively engage industry in ME activities, there needs to be a way to facilitate constructive cross-industry engagement with a focus on operational mission outcomes.

- **Recommendations**

- Mitigating OCI
- Establishing teaming arrangements
- Developing the SoS architecture collaboratively
- Developing a national team-like concept of operations
- Assessing teaming considerations

4 - Technical Approaches to Mission Engineering and Analysis

- **Questions**

- What type of mission engineering related technical experience and resources does industry have which could benefit DoD mission engineering efforts?
- How can industry progress in digital engineering provide a foundation for mission engineering?
- How could these be shared with government?
- What is the incentive for industry to share these? What are the risks?

- **Analysis**

- The 2016 Industry Task Force report on ME indicated that industry conducts ME for various purposes and has a base of experience in ME technical modeling and analysis approaches which could benefit DoD ME efforts.
- These include environments which could be used for ME experimentation and analysis, technical digital approaches for representation of SoS, and analysis of mission impacts.
- This industry technical base could form a focus for government industry ME technical exchange and implementations.

- **Recommendations for Industry**

- Understanding Industry technical expertise and resources
- Presenting Industry technical expertise and resources
- Providing training on the digital engineering strategy
- Developing an input-output criteria framework
- Participating in the DEIX Working Group
- Contributing and participating in other activities
- Sharing with the Government

5 - Government Actions to Incentivize Industry Mission Engineering Engagement

- **Questions**
 - What set of incentives have been identified for the set of topics related to industry's role in ME?
 - What type of information or insights could government provide which would motivate industry to engage in ME?
 - What can government do to reduce risks for industry to engage in ME?
- **Analysis**
 - For industry to engage in an activity like ME, there needs to be some clear potential benefits.
 - It has been noted that if industry perceives that the government is committed to implementation of MIM and fund industry to develop capabilities resulting from MIM/ME efforts, they will be encouraged to commit time and effort to engage and support government efforts.
 - Questions of incentives have been raised for all the topics above, which could usefully be summarized under this topic, but beyond this, there may be general actions the government could take which would incentivize industry to support new ME efforts.
- **Recommendations for Government**
 - Applying modularity and openness principles
 - Conducting pre-work
 - Ensuring systems are mission effective
 - Providing links to industry
 - Working together with industry
 - Using the market place to share information
 - Providing clear definitions to OCI boundaries

Discussion of Topic for New 2021 ME Initiative

Open Discussion of Topics for 2021 Initiative

- Which (if any) of the 2019 issues should be carried forward?
 - What follow-on actions are needed?
- Topics identified in initial discussions with R&E
 - Use the current **ME Guide** to focus our activities including looking at ME terminology, methods and products as described in the current version of the guide, first to inform members of the current ME approaches and to solicit input on their ME efforts.
 - Engage SED members on the **models and tools** they use to Industry in conduct ME and to share experience with USD(R&E) to improve the ability to conduct ME.
 - Explore **methods/types of engagement** between DoD and industry on ME to better understand what DoD would like from industry and likewise what industry would like from ME.
- Which new issues should be included?

Next Steps

Discussion of Next Steps

- Summarize results of this meeting – document and share with members
 - What follow-on actions are needed?
- Share results with R&E
- Publicize August 10 R&E ME SoSECIE presentation (Mr. Elmer Roman, MI Director)
- Invite R&E to join next meeting to share their perspective
- Develop follow-up plan
 - Organize to address selected issues
 - Implement set of ME activities at October SE ME Conference (October 2021)
 - ME Tracks – Kicked off by presentation on 2021 ME initiative
 - Monday afternoon ME Initiative Workshop – expanded engagement on issues
 - Panel on Current ME Activities
- Other?

Backup

2019 Core Team and Workshop Participants

Name	Organization	
Browne	Daniel	Georgia Tech Research Institute
Buede	Dennis	Innovative Decisions, Inc.
Carroll	Stephanie	HQ DHS
Cherry	John	AFLCMC
Clark	Devon	Deloitte
Cougmenour	Michael	LM
Dahmann	Judith	MITRE
Daly	John	BAH
Deforest	Nathan	Boeing
Devino	Anthony	US Navy ASN(RD&A)
Draper	Geoff	Harris Corporation
Elm	Joseph	L-3
Elmazaj	Esmā	Harris Corporation
Epps	Bob	Lockheed Martin (Retired)
Forbe	Sherman	SAF/AQRE
Frost	Lydia	AFNWC/EZT
Gillespie	Stephen	USMA
Goldfarb	Oscar	DoD HPCMP/CREATE
Green	Mike	Naval Postgraduate School
Guba	Mike	DASD SE Support
Hand	Sonya	Skayl
Harrington	Bethany	DASD SE Support
Hart	Laura	MITRE
Heffner	Kenneth	Honeywell
Henry	Steve	DAU
Horne	Jennie	Raytheon
Horning	Matthew	Army TARDEC
Isreal	Gideon	Northrop Grumman
Jaggers	Terry	Decisive Analytics Corporation
Jones, Jr.	Leo	Institute for Defense Analysis
Jurkiewicz	David	Naval Sea Systems Command
Lenett	Blake	Honeywell
MacLaird	Steven	OMG/IIC/CISQ
Madni	Ayesha	USC
Madni	Azad	USC

Name	Organization	
Mason	Susan	DOE
Majette	Will	Harris Corporation
Mangra	Minal	SPAWARSYSCEN-PACIFIC
Maradik	Michael	Boeing
Mejias	William	AFLCMC/EZS
Michealson	Kirk	MORS
Miller	William	SERC
Moshinsky	Edward	Lockheed Martin
Muralidhar	Ajay	Navy
Nielsen	Paul	CMU/SEI
Olmstead	David	LM - MFC
Ourada	Gerry	LM - AERO
Patel	Radhika	US Army ARDEC
Poel	Rick	Boeing
Pramanik	Sarah	Northrop Grumman
Ray-Wever	Ryan	GD-OTS
Reilly	Matt	Northrop Grumman
Rivera	Gus	Navy
Roberts	Nataki	Engility
Rodriguez	Lucy	OASD(S)/DASD(ENV)
Roedler	Garry	Lockheed Martin
Rosenbluth	Gene	Northrop Grumman Mission Systems
Scheurer	Robert	Boeing
Sharper	Ceasar	OSD(USD(T&E))
Shea	Jill	BAE Systems
Sisson	Curtis	Boeing
Soo	Kelly	SMC/RSEM
Stern	Aaron	US Army ARDEC
Stobb	Dave	Rockwell Collins
Strosnider	Daniel	Boeing
Thelin	Steve	Raytheon
Torres	Marlene	SMC/LE
Waag	Gary	DASD SE Support
Wallhauser	Jonathan	Northrop Grumman
Willette	Scott	Innovative Decisions, Inc.