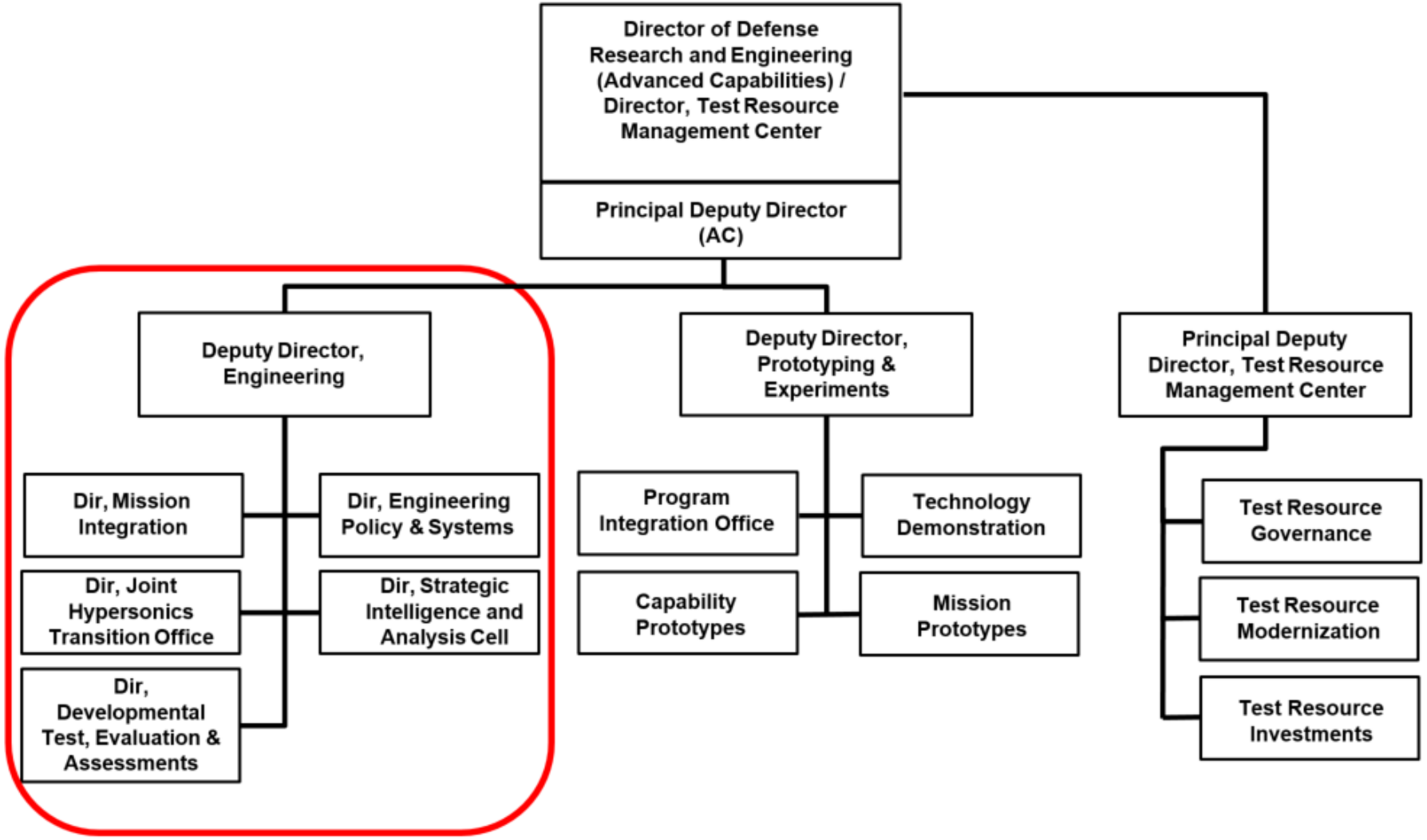
Office of the Under Secretary of Defense Engineering Overview Brief

Stephanie Possehl
Acting Deputy Director, Engineering
Director, Engineering Policy & Systems
OUSD (R&E) Advanced Capabilities
Stephanie.Possehl@mail.mil

Overall classification is: **UNCLASSIFIED**

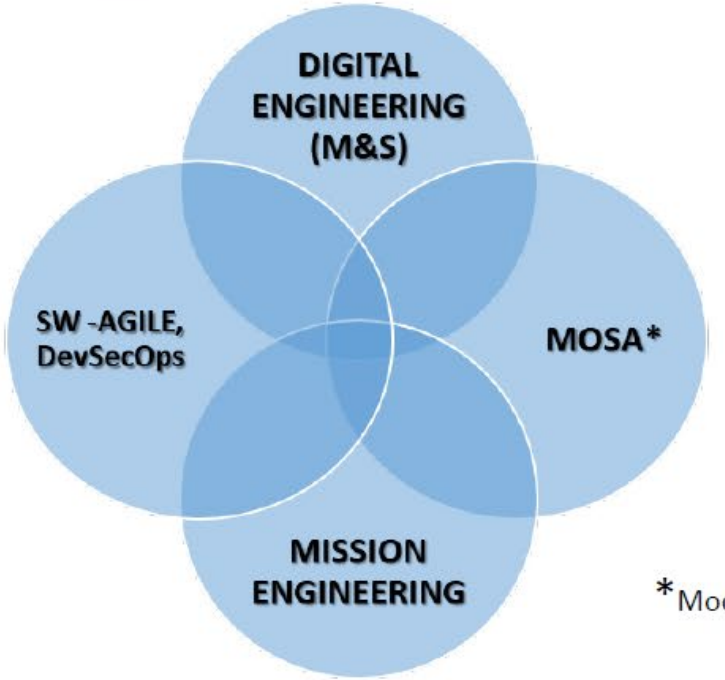
01/25/2022

DDR&E(AC): Organization



SE Modernization Focus Areas and Key Enablers

SE Modernization Focus Areas (Initial Scope)



*Modular Open Systems Approaches

Cross Cutting Key Enablers

Architecture	Modeling Mission & Platform levels, embracing Reference Architectures
Model Based Systems Engineering (MBSE)	Enterprise-wide implementation; models as Source of Truth
SOS/Enterprise Collaboration	Understand/Assess cross-platform capabilities
Engineering Workflow	Evolving SE processes/ techniques, including V&V
Workforce Culture	A focused approach to workforce initiatives that enable culture change

SE Mod Focus Areas Mapped to SED Committees

SE Mod Focus Area:

- MOSA
- Digital Engineering
- Mission Engineering
- SW – Agile, Dev Sec Ops

Steering Committee
Pete Larkin – GD, Electric Boat
vacant – Raytheon
Alana Murphy – L3Harris
Marilyn Pineda – Lockheed Martin
Mark Schaeffer – ManTech Int'l
Brian Maciel – Northrop Grumman
Kelly (Karolyn) Hauser – Boeing
William Luk – BAE Systems
David Schulte – SAIC
Angela Wallace – Booz Allen Hamilton
Everett Lewis – Rolls Royce

Division Executive Board

CHAIR
Holly Dunlap, Raytheon

VICE-CHAIR:
John Daly, Booz Allen Hamilton

VICE-CHAIR:
Chris Schreiber, Lockheed Martin

Sr. Government Participation
Nadine Geier – USD(R&E)/SE
vacant – USD(A&S)/SASA
J. Evans-Morgis – US Army
Marty Irvine – US Navy
Kristen Baldwin – USAF
vacant – ODASD C3/Cyber

NDIA Division Executive
Dave Chesebrough

ADAPT Committee
Scott Sinclair, Spectrum
Suzette Johnson, Northrop Grumman
Robin Yeman, Catalyst Campus

Architecture Committee
Robert Scheurer, Boeing
Ed Moshinsky, OUSD (R&E) SE

Automatic Test Committee
Dr. Pat Griffin, Clear Com
Howard Savage, SCI

DT&E Committee
Joe Manas, Raytheon

Education & Training Committee
Dr. Robert Raygan, DAU
Dr. Ken Nidiffer, GMU
Dr. John Snoderly, DAU

Enterprise Health Mg't Cmte
Chris Reisig, Boeing (St Louis)

ESOH Committee
David Schulte, SAIC
Tim Sheehan, Raytheon
Sherman Forbes, USAF

Human Systems Integration Cmte
Dr. Matthew Risser, Pacific S&E
Randi Rohrer, Boeing

Modeling & Simulation Committee
David Allsop, Boeing
Jon Backhaus, Lockheed Martin

Software Committee
Dr. Ken Nidiffer, GMU

Systems Engineering Effectiveness Committee
Paul Hershey, Raytheon

Advisory Board Committee
Garry Roedler, Retired
Joe Elm, Retired
Steve Henry, Retired / DAU
Bob Rassa, Retired
Geoff Draper, L3 Harris
Gene Rosenbluth, Northrop Grumman

Affiliate Groups
Gery Mras – AIA
Garry Roedler – INCOSE
Dr. Ken Nidiffer – IEEE Computer Soc.
Bob Rassa – IEEE AESS
Les Orlidge – IEEE SCC20
George Rebovich – MITRE
Dr. Jeff Boleng – SEI
Marilee Wheaton – Aerospace Corp

System-of-Systems Committee (w/ Interoperability & ME)
Rick Poel, Boeing
Dr. Judith Dahmann, MITRE
Jennie Horne, Raytheon
John Daly, Booz Allen Hamilton

Systems Security Engineering Committee
Holly Dunlap, Raytheon
Cory Ocker, Raytheon
Melinda Reed, USD(R&E)/STP&E

17-December-2021

SE Mod Key Enablers:

SE Workforce Development & Culture
- Education & Training Committee

SE Workflow
- SE Effectiveness Committee

Organization Chart Source: NDIA SE Division

SE Modernization Pain Points (Emerging)

- **Lack of Digital Processes and Products (Digital Acquisition/E-Program)**
  - "What does a Model Based Technical Assessment look like?"
- **Lack of an Enterprise Approach** to **Integrated** SE Focus Area Implementation
  - DE/MOSA/SW/ME maturing separately
  - Problems with data sharing and collaboration across DoD
  - Digital tools/methods is a critical enabler for SE Modernization
  - Role of Reference Architecture.
- Not enough **Use Cases and Examples of Artifacts** (processes/artifacts not yet mature)
  - "What does a Model Based Program SEP look like?"
- Not enough emphasis on **Ways and Means to Shift Culture**
- **Lack of Metrics** to measure impact of SE implementation success
- Lack of **common understanding between Government and Industry for collaboration and shared artifacts**
  - Maintain company competitive advantage while increasing transparency and collaboration through shared SE artifacts and processes (Related to Data Rights and Intellectual Property)
- **Lack of a Shared Ecosystem**

Mission Engineering

Marc Goldenberg

Chief Engineer Mission Engineering

(703) 692-6551 | Marc.J.Goldenberg.civ@mail.mil

Office of the Deputy Director for Engineering

Office of the Under Secretary of Defense for Research and Engineering

Bottom Line Up Front

Mission Engineering is the deliberate planning, analyzing, organizing, and integrating of current and emerging operational and system capabilities to achieve desired warfighting mission effects.

Goals & Objectives

- Provides an analytical and data-driven approach to decompose and analyze the constituent parts of a mission
- Involves collection of trustworthy data and use of models to analyze mission threads and mission engineering threads
- Recognizes that successful mission outcomes require systems of systems to effectively "work together"
- Maintains balance among the time frame, selected analytical rigor, and complexity of the problem to be addressed
- Delivers quantitative outputs – identifying measurable trade-offs and drawing conclusions
- Inform stakeholders on **building the right things, not just building things right**; align capability maturation relevant to the evolving threat and future warfighter needs

ME provides consistent methodology to deliver analytically and data-driven, mission-focused, threat-informed outputs to help guide future mission superiority

R&E Mission Engineering Studies Timeline

Process for Executing Mission Engineering Studies

ME Analysis Planning – Alignment crucial: Problem → Scenario → Vignette(s) → Measures → Analysis Selection → Model(s) / Data

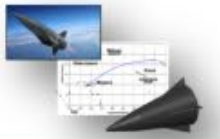
ME Analysis Execution Trial Architectures & Efficacy

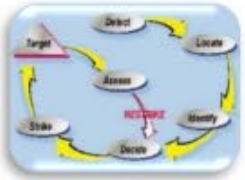
Reporting and GRA Documentation

1. **Problem Statement**
   - Questions
   - Suspected Gap(s)
   - Technologies
   - Concepts
   - Timeframe of interest
2. **Mission Characterization**
   - Scenarios
   - Vignettes
   - ROE/CONOPS
   - Assumptions
   - Threat Laydown and capability
3. **Mission Metrics**
   - MOS & MOEs – Success and Effectiveness
   - Quantifiable and Relevant
   - Link MOEs:
     - Top-down & bottom-up
     - Iterative decomposition
4. **Design of Analysis – Define MTs / METs**
   - Define Trial approaches to be evaluated
     - Models
     - Data
     - Analytics
     - End-products
   - Define per trial:
     - Define Architectures
       - 'As-Is' baseline (reference case blue forces)
       - 'To-Be' alternative (alt. blue force & performance)
     - Gather Data/Models
5. **Perform Analysis/ Run Models**
   - Mission Efficacy
   - Sensitivity Analyses (if req.)
   - Monte-Carlo
   - Parametrization
   - Cost Trades
   - Confidence-level
6. **Document Study Conclusions**
   - Selected Architecture
   - ME Analysis Report
   - Curated Data /Models for reuse
   - Decisional Briefings

Repeat until desired confidence is achieved

ROE = Rules of Engagement
MOS = Measures of Success
MOE = Measures of Effectiveness
MET = Mission Engineering Thread
MT = Mission Thread





Rapid Precision Strike (RPS)

Time Sensitive Target Quality of Service (TSTQoS)

Electromagnetic Spectrum Maneuver / Mission Data Integration (MDI)

Rapid Precision Strike, Next (RPS,n)

High Energy Lasers (HEL)

Position, Navigation, and Timing (PNT)

RDER Fires**

RDER Command and Control**

Contested Logistics**

Nuclear Command, Control, and Communication*

Air and Missile Defense*

Cyber*

Interdiction*

2017 — **NDAA FY2017 Sec 855 MIM**

2018 — **USD R&E Delivers MIM Strategy to Congress**

2019

2020 — **DoD Mission Engineering Guide Released**

Mission Engineering Digital Ecosystem (Technical Infrastructure)

2021 — **Rapid Defense Experimentation Reserve (RDER)**

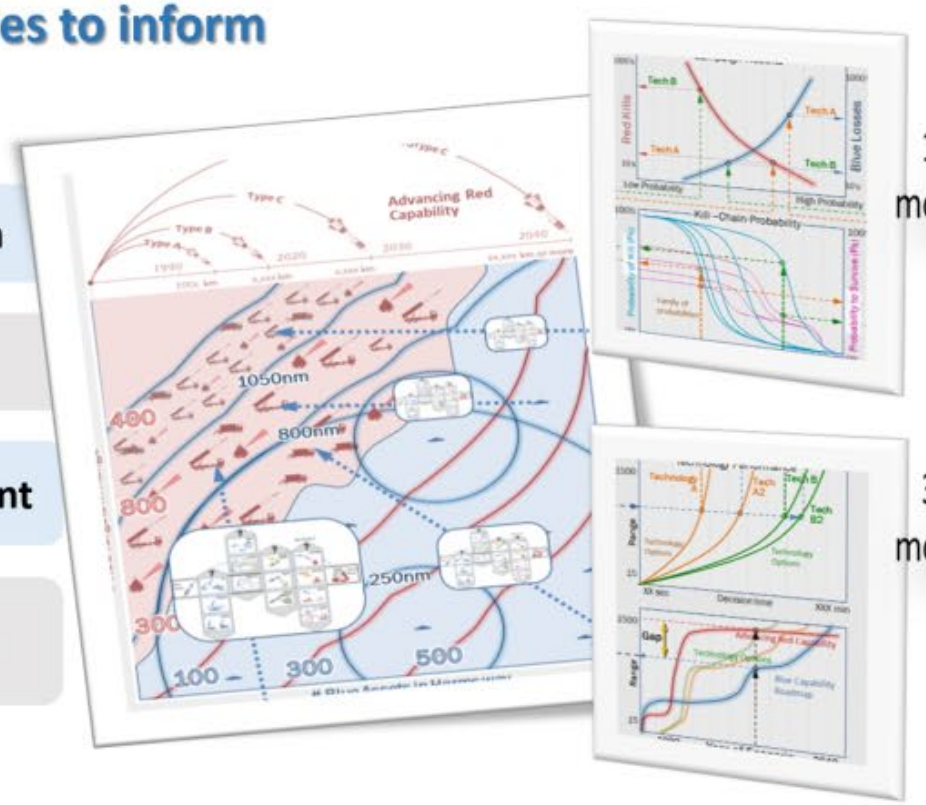
2022+

* Studies are in-development; kick-off planned December 2021
** Studies are pre-decisional and subject to change

R&E Mission Engineering Studies

Recently completed R&E Mission Engineering Studies to inform Department initiatives…

- Electromagnetic Spectrum Maneuver / Mission Data Integration
- High Energy Laser (Base Defense)
- Position, Navigation & Time (PNT) in Highly Contested Environment
- Rapid Precision Strike Next (Hypersonics – Campaign Analysis)



1-2 months

3-4 months

PLANNING

KICK-OFF

IPR #1

IPR #n

DRAFT

REPORT

ME topics align with the Joint Warfighting Concepts, Defense Planning Guidance (DPG) priorities, and R&E Modernization areas

ME Digital Environment, Tools and Models

Mission Engineering Database

Attributes:

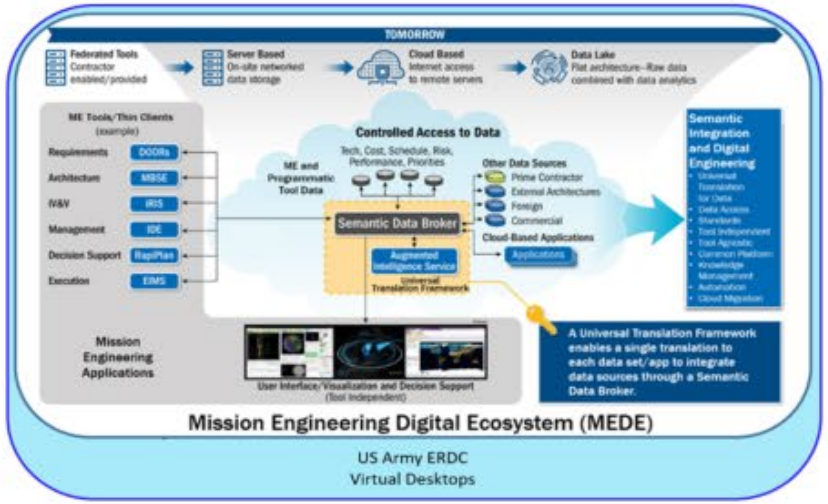
- Transparency of program performance data
- Collaborative mission efficacy analysis
- Curation of data — accuracy of analyses depends on pedigree of data

Raw data, scenario definitions, model files, documents, study scope, and analytical results

Data Management	Data Storage	Catalog
Consolidate raw data from the different studies	Standardize source document data for later use	Create and manage templates used on the studies
POC for studies to retrieve data that has already been used	Manage folders and storing process of data	Store input/output/ results data from studies
		Create and manage categorizations to cross-link elements

- Previous Analyses
- Technical Data
- Architectures
- Models

Mission Engineering Digital Environment (MEDE)



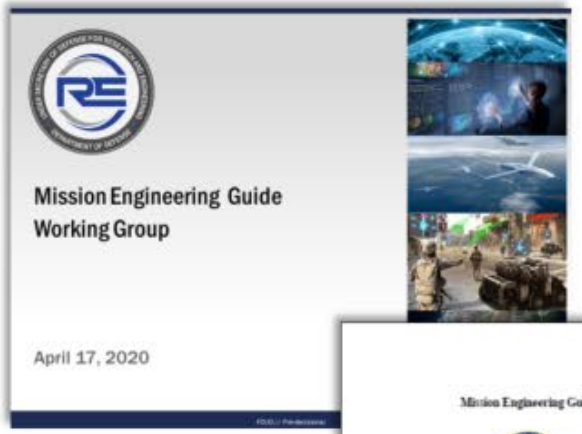
MEDE combines technologies, software, and a computer network infrastructure to support end-to-end mission engineering efforts.

- **Simulation Tools**
- **Analytic Tools**
- **Access by FFRDCs & Government Partners**
- **Collaborative**
- **Scalable**
- **Unclass & Secret & TS/SCI (TBD)**

ME requires shared knowledge and a digital environment for effective collaboration.

Mission Engineering Guide (MEG)

- OUSD (Research and Engineering) has published the Mission Engineering Guide in December 2020
- The MEG 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



Next Steps/Upcoming Initiatives:

- **Release ME Training; Update ME Guide; Establish ME CoP**

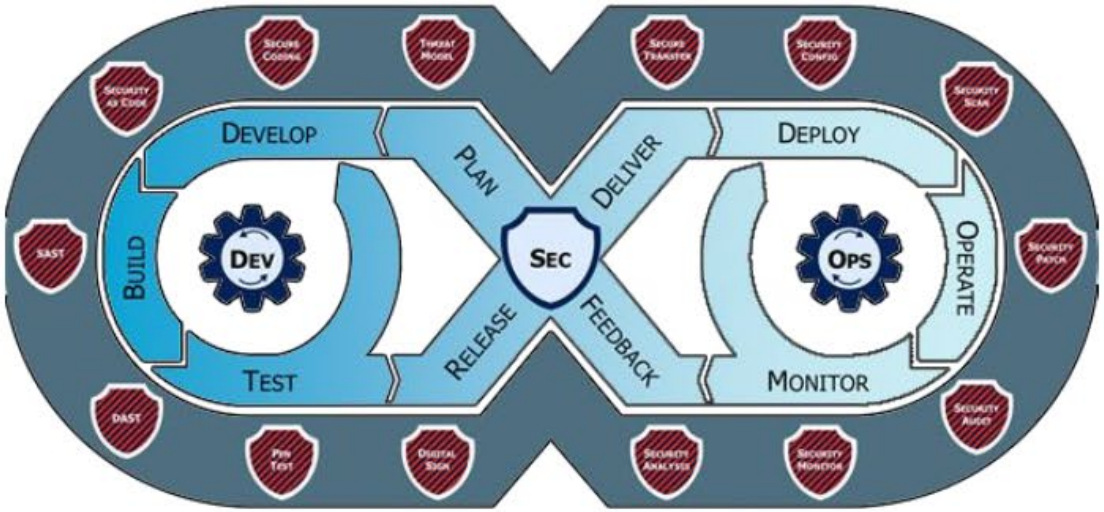
Obtain a copy of the DoD ME Guide
https://ac.cto.mil/mission-engineering/
https://www.dau.edu/tools/t/DoD-Mission-Engineering-Guide/

For Additional Information

Mr. Marc Goldenberg,
Chief Engineer Mission Engineering
OUSD(Research & Engineering)
(703) 692-6551 | Marc.J.Goldenberg.civ@mail.mil

Modern Software Engineering Journey

- **Agile Cultural Transformation**
  - One Team, One Fight
  - Organizational Change
  - Outcome/Execution Oriented
- **Embrace and Advance DevSecOps**
- **Leverage Cloud-Native Architectures/Edge Computing**
- **Develop Modern Workforce Competencies**
  - Digital Workforce
  - Advanced Modeling and Simulation
  - Data Science
- **Develop Curated Environments**
  - Repositories
  - High fidelity Modeling and Simulation Environments

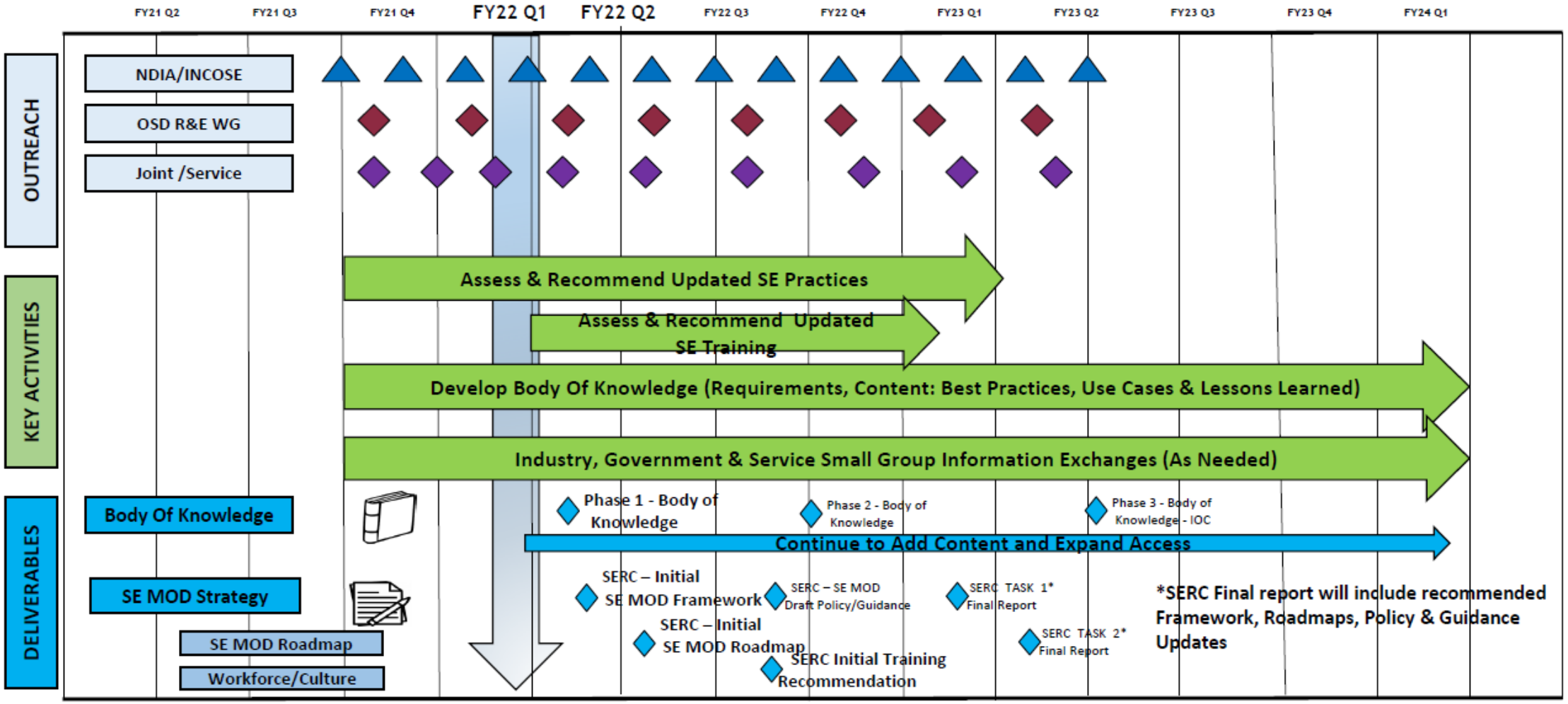


New Realities and Technology Advances Driving Change

	Old Way	Disadvantages	New Way	Advantages
Policy	Title 10 DoDI 5000.02	Regulatory Requirements Manufacturing Orientation	Adaptive Acq Framework DoDI 5000.87 SW Acq Pathway	Less Bureaucracy Capability Driven Commercial Best Practices Adopt Modern SWE Practices
Method	Document Centric Waterfall	Fixed Requirements Milestone Driven Months/Years Delivery Cycles	Continuous Delivery DevSecOps	Days/Weeks Delivery Cycles Rapid Feedback Collaborative Culture Responsive to Needs
Technology	Local Physical Servers	One offs (staff/sched/perf) Dedicated HW infrastructure Slow Tech Insertion Hard to Scale	Cloud Services Containers Microservices	Shared Infrastructure Simpler to Deploy Rapid Tech Insertion Easy to Scale
Security	Perimeter Security Static Trust	Systemic Fragility Poor support for mobile Privilege bound to location Assume secure perimeter	Zero Trust	Systemically Robust Natural Support for Mobile Privilege bound to identity Assume adversary present

Backups

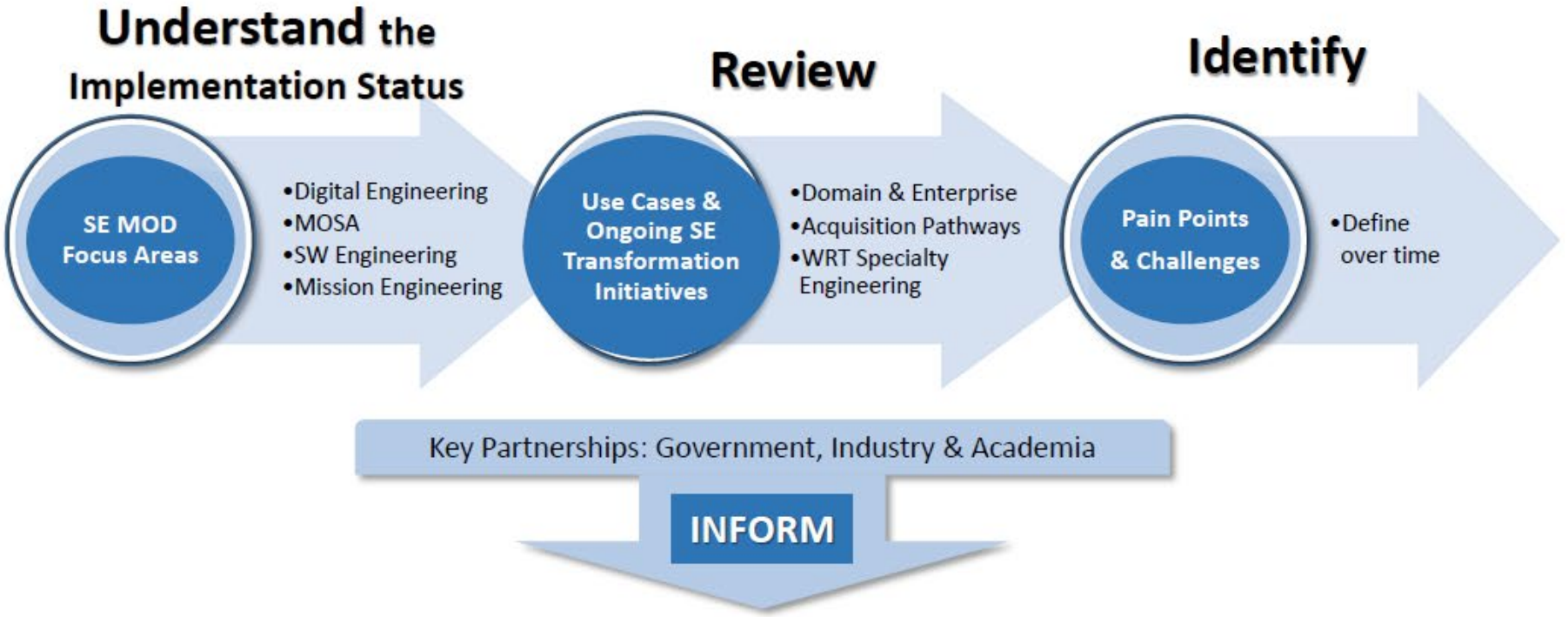
SE MODERNIZATION
Program Objectives and Milestones (POAM)



SE Modernization Deliverables

- **Draft SE Modernization Strategy** to include recommended:
  - SE Modernization Framework to align SE focus areas
    - Addressing pain points
  - Roadmaps indicating paths to SE modernization
  - Policy and guidance updates
    - Align and integrate into the Acquisition Pathways
  - Workforce strategy
    - Key roles and responsibilities from an integrated perspective
    - Gaps in skills/training
- **SEMOD Body of Knowledge (SEMODBoK)**
    - Best practices integrating SE Modernization Focus Areas
    - Align with the Adaptive Acquisition Framework
    - Use cases
    - Lessons learned
    - Synergy with CRWS/DE BoK

SE Modernization Approach



Action

- Best Practices/Lessons Learned/Use Cases
- SE Workforce Roles & Responsibilities
- SE Workforce Training
- Updated SE Guidance/Policy

Genesis of Mission Engineering

NDAA 2017 Sec. 855. 10 U.S.C.2358 Mission Integration Management

The Secretary of Defense shall establish mission integration management activities for each mission area specified in subsection (b).

(b) COVERED MISSION AREAS.—The mission areas specified in this subsection are mission areas that involve multiple Armed Forces and multiple programs and, at a minimum, include the following:

(1) Close air support.

(2) Air defense and offensive and defensive counter-air.

(3) Interdiction.

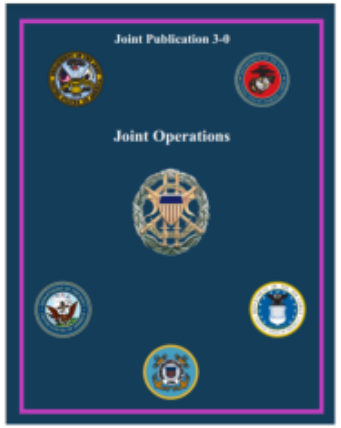
(4) Intelligence, surveillance, and reconnaissance.

(5) Any other overlapping mission area of significance, as jointly designated by the Deputy Secretary of Defense and the Vice Chairman of the Joint Chiefs of Staff for purposes of this subsection.

(c) QUALIFICATIONS.—Mission integration management activities shall be performed by qualified personnel from the acquisition and operational communities.

(d) RESPONSIBILITIES.—The mission integration management activities for a mission area under this section shall include—

Responsibility
1) development of technical infrastructure for engineering, analysis, and test, including data, modeling, analytic tools, and simulations;
2) the conduct of tests, demonstrations, exercises, and focused experiments for compelling challenges and opportunities;
3) overseeing the implementation of section 2446c of title 10, United States Code;
4) sponsoring and overseeing research on and development of (including tests and demonstrations) automated tools for composing systems of systems on demand;
5) developing mission-based inputs for the: requirements process, assessment of concepts, prototypes, design options, budgeting and resource allocation, and program and portfolio management; and
6) coordinating with commanders of the combatant commands on the development of concepts of operation and operational plans.

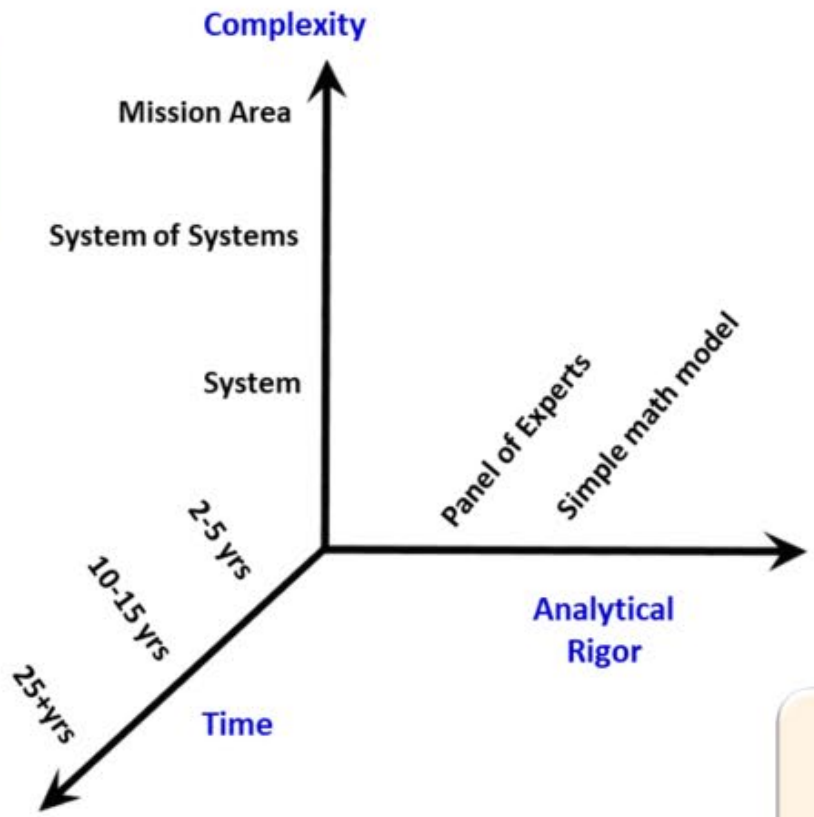


The DoD Joint Publication 3-0 (Joint Operations) defines mission as the task, together with the purpose, that clearly indicates the action to be taken and the reason thereby. More simply, a mission is a duty assigned to an individual or unit.

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

Mission Engineering Axis

Mission Engineering is a balancing act among the time frame, analytical rigor to be used, and the complexity of the problem to be addressed.



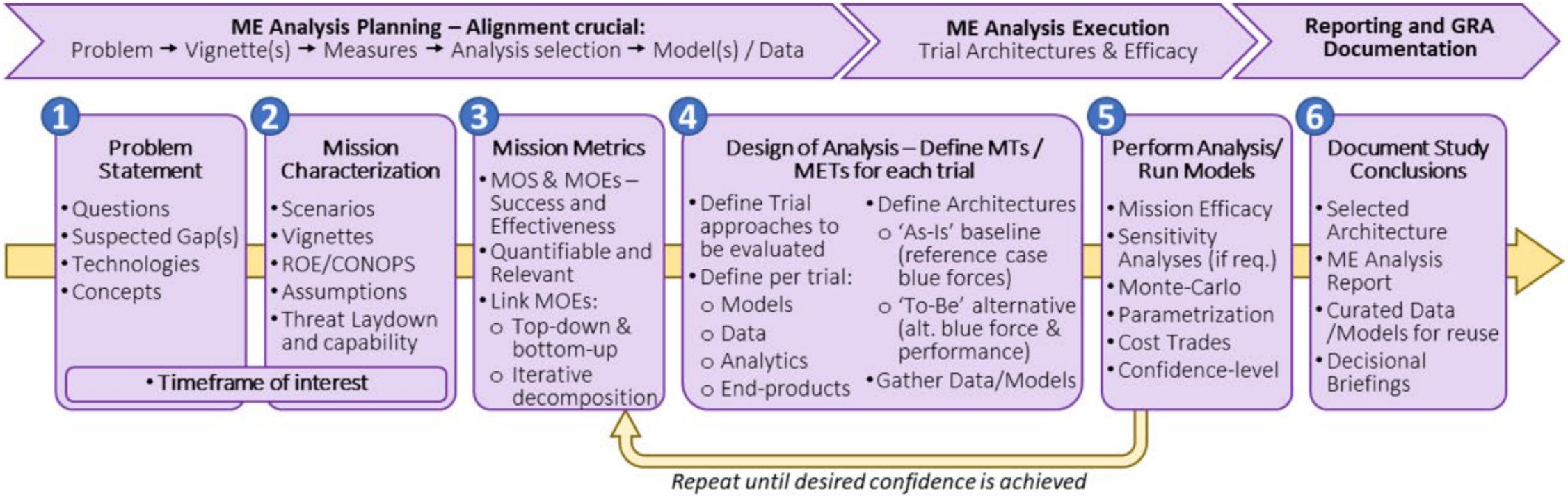
Reaching too far in one or more dimensions, say predicting outcomes 50 years in the future or increasing the complexity of the mission to be addressed, will impact the confidence-level that can be expected in the ME products.

Mission Engineering can be performed at many levels. ME is a balancing act between the time frame, analytical rigor to be used, and the complexity of the problem to be addressed.

It can also affect the rigor and validity of the analytics based on the availability and accessibility of data.

Mission Engineering Methodology

Process for Executing Mission Engineering Studies



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.