

NDIA Development Planning Working Group Update:

**“Improving the Integration of Government and Industry
S&T/IR&D to Support Development Planning”**

**NDIA 16th Annual Systems Engineering Conference
30 October 2013**

**John Lohse
NDIA DPWG Chair
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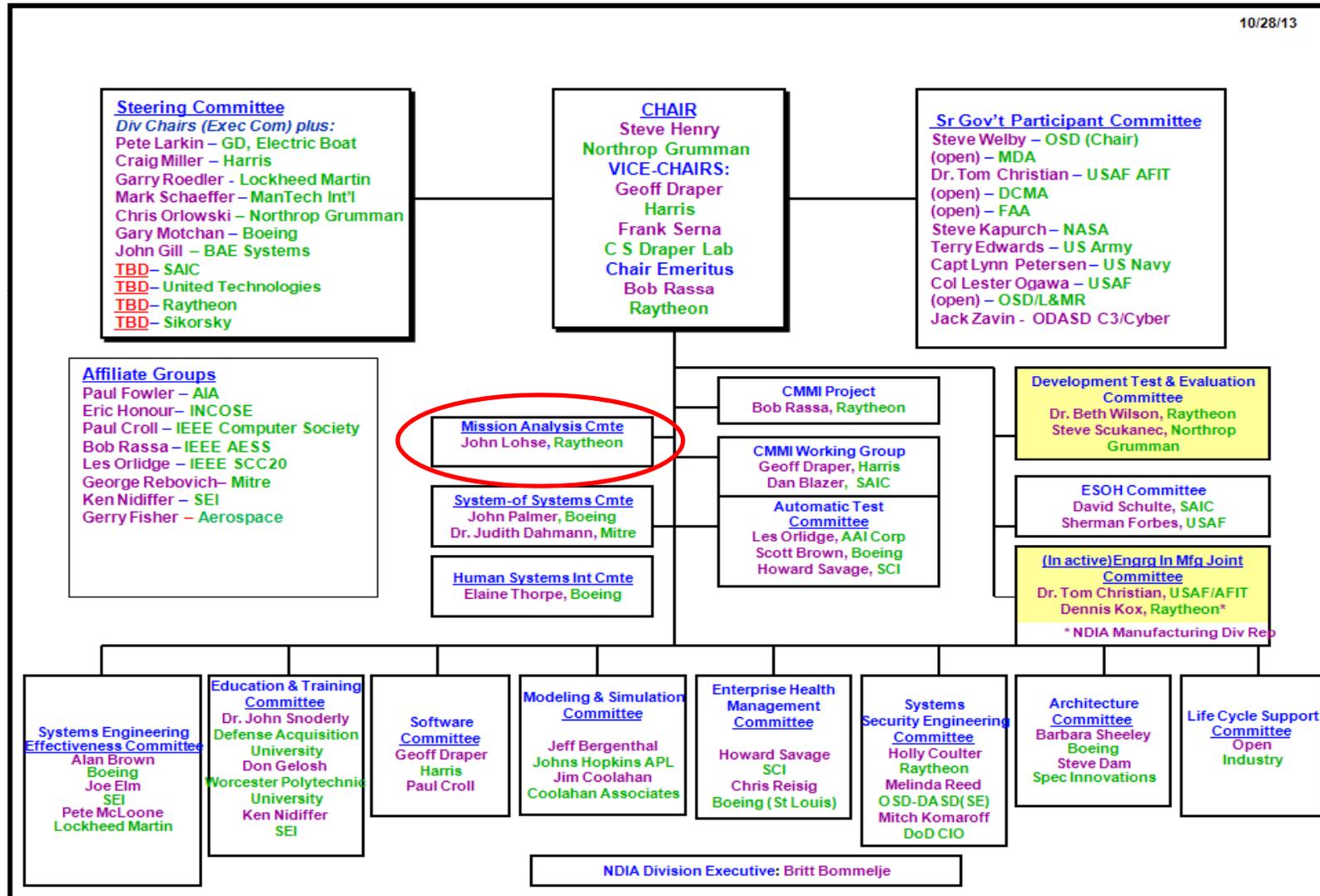
Agenda

- Overview
- Status of Workshop Findings
 - OCI
 - Systems Engineering Discipline for S&T/IR&D
 - Collaboration and Communication
 - 6.1/6.2 Investment Strategies
- Summary

Note: For the purpose of this brief, Operations Analysis is considered part of the Systems Engineering process. This question has been well debated, and this note does not beg to answer that debate.

Overview

NDIA SE Division Organization



NDIA DPWG Workshop

NDIA Systems Engineering Division
In conjunction with the Military Operations Research Society
Development Planning Working Group
Collaborative Engagement Workshop

on

Development Planning, S&T, Pre-milestone A SE, and IR&D Interactions

Lockheed Martin Global Vision Center
2121 Crystal Drive, Arlington (Crystal City), VA

June 21 – 22, 2012

- 43 Senior Level Attendees
 - Approximate 2:1 Government to Industry
 - The Services were well represented

DPWG Workshop Findings

1. The issue of Organizational Conflict of Interest (OCI) is seen as a barrier to collaboration
2. The issue of Intellectual Property (IP) is seen as a barrier to collaboration
3. Systems Engineering discipline is needed in the DP/S&T/IR&D Timeframe
4. Tactical and Strategic S&T/IR&D can be better leveraged to support Development Planning
5. Improved Methods of Collaboration and Communication Mechanisms are needed
6. 6.1/6.2 Investment Strategies need to align across Government and Industry

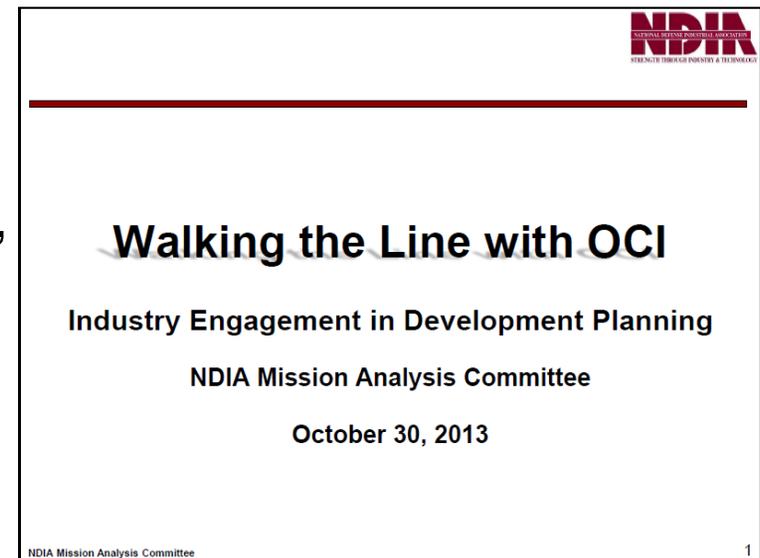
Status of Workshop Findings

DPWG Workshop Findings

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1. The issue of OCI is seen as a barrier to collaboration

- Needed to enable Industry participation in Pre-Milestone A activities
- Review DoD Source documentation
 - Identify key language and “genuine” OCI requirements
- Provide recommendations that are practical and feasible
 - Clear guidance on what IS and IS NOT allowed



NOTE: This finding suggests clarifying the OCI provisions, not loosening them.

DPWG Workshop Findings

1. The issue of Organizational Conflict of Interest (OCI) is seen as a barrier to collaboration
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3. **Systems Engineering discipline is needed in the DP/S&T/IR&D Timeframe**
4. **Tactical and Strategic S&T/IR&D can be better leveraged to support Development Planning**
5. Improved Methods of Collaboration and Communication Mechanisms are needed
6. 6.1/6.2 Investment Strategies need to align across Government and Industry

3. SE discipline is needed in the DP/S&T/IR&D Timeframe

4. Tactical and Strategic S&T/IR&D can be better leveraged to support Development Planning



- Need to inject effective SE into pre-MDD Mission/Operations Analysis
- Correlate Key Performance Parameters (KPPs) to the Measures of Effectiveness (MOEs)
- Perform conceptual analysis to identify Critical Technology Elements (CTEs), Measures of Performance (MoPs), Key Performance Characteristics (KPCs), etc
- Better leverage our tactical and strategic S&T/IR&D investment to support Development Planning

NDIA Mission Analysis Committee

The Role of Architecture to Influence the Development Planning Tradespace

19 June 2013

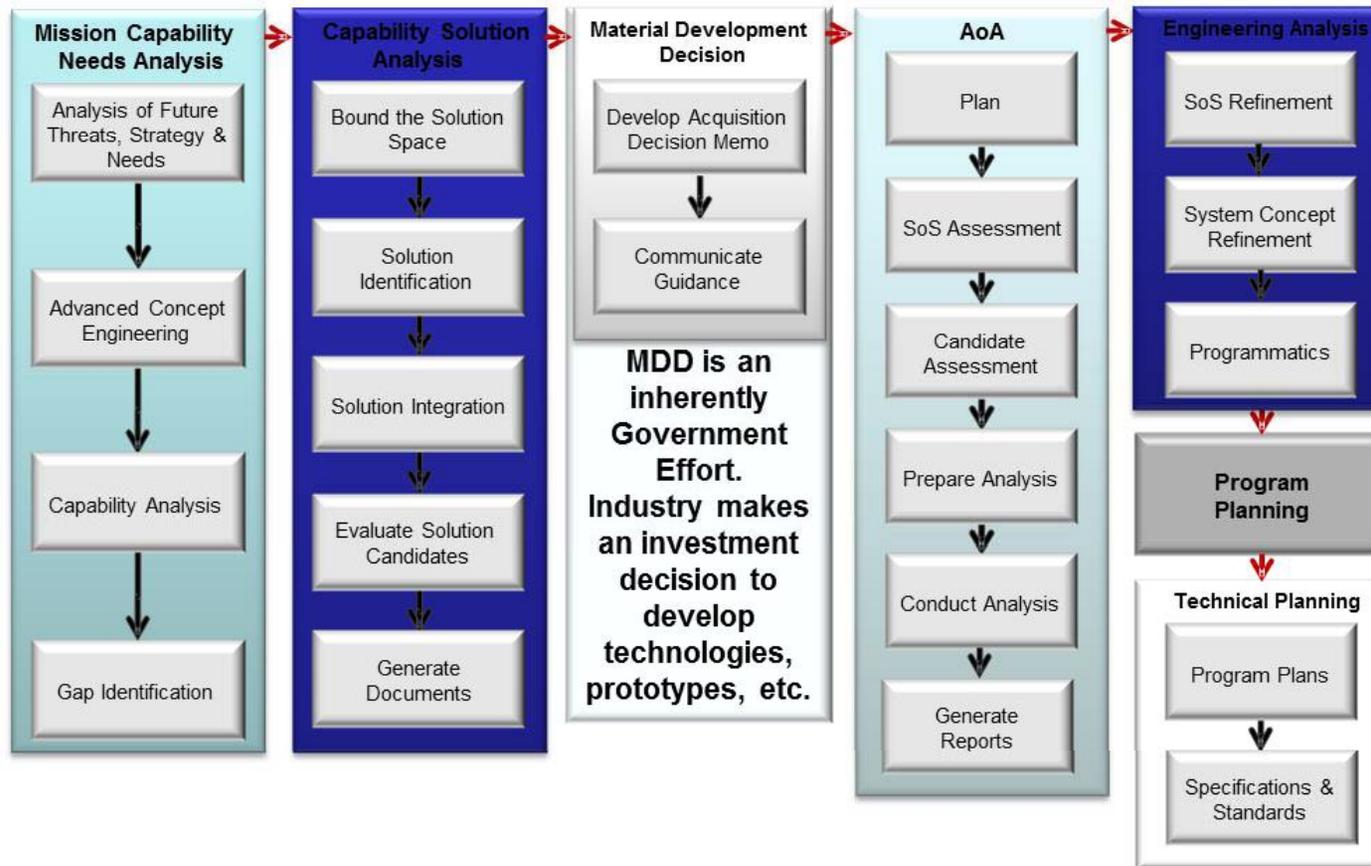
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The Role of Architecture

Understand The Problem Mission Architecting	Develop An Operational Concept SOS Architecting	Develop A System Concept System Architecting
<ul style="list-style-type: none"> • Understand Customer's Desired Capabilities • Analyze Requirements & Needs • Analyze Operations • Analyze Quality Attributes • Identify Reuse Assets • Identify Key Performance Goals And Measures • Initiate Technical Standards List • Understand Customer's Architecture 	<ul style="list-style-type: none"> • Define Mission Nodes & Their Relationships • Define Information Exchanges • Define Operational Activities • Develop Operational States • Develop Operational Event Sequence Diagrams • Initiate Simulation Activities 	<ul style="list-style-type: none"> • Define System Functions From Operational Activities • Define System Data Exchange • Define Systems, Sub-systems, & Functions • Develop State Event Sequence Diagrams • Perform Capacity Planning • Perform Performance Predictions

Mission Architecting Is The First Step In The Architecting Process

Industry's Pre-Milestone A SE Process *



The answer to “What problem are we trying to solve?” enables the tailoring of this process!

Mission Capability Needs Analysis

Phase	Sub-process	Enablers	Analytics
Mission Capability Needs Analysis	Analysis of Future Threats, Strategy, & Needs	Threat Intelligence Scenario Databases and Development (e.g. Integrated Security Constructs)	<p style="text-align: center;"><u>Identify the Problem</u></p> Threat Set Definition Political Impact (e.g. DIME - Diplomatic, Information, Military, Economic) Mission Capability Needs Measures of Effectiveness Performance Standards and Conditions Current State and Programmed State of Capability Mission Capability Gaps Red Team Assessments Stakeholder Analysis
	Advanced Concept Engineering	Mission Task Breakdown Service Task Lists Joint Capability Areas Mission Architecture Concept of Employment (existing) Wargaming Activities	
	Capability Analysis & Gap Identification	Government Documentation (e.g. QDR, NSS, NDS, NMS, Joint and Service UONs, Risk Assessments, etc) Military Exercises and Experimentation Warfighting Lessons Learned	

Mission Capability Needs Analysis

Phase	Activities		
	Analysis of Future Threats, Strategy, & Needs		
Mission Capability Needs Analysis	Identify threats		
	Identify range of missions/mission areas/use cases		
	Identify strategic/political interests		
	Identify mission areas of interest		
	Advanced Concept Engineering		
	Define representative scenarios (including operating environments and conditions)		
	Understand current Mission Architecture		
	Identify Mission Measures of Effectiveness (MOEs) (Maps to Mission Arch. Objectives and each step in the Functional Flow)		
	Solicit advanced concepts from S&T Base		
	Solicit advanced concepts from Industry		
	Capability Analysis & Gap Identification		
	Identify current capabilities (of mission area(s) of interest) (Derived from Mission Functional Flow)		
	Identify current Concepts of Employment (ConEMPs) (Mission Functional Flow and Nodes/Interactions define ConEMPs)		
	Evaluate current capabilities against the MOEs (Based on MOEs)		
	Identify capability gaps (Derived from Current Capabilities)		
Rank gaps relative to the importance to the mission and the severity of the gap (Evaluate gaps against the Mission Objectives)			
Architecture Role	Direct Influence	Secondary Influence	S&T/IR&D

Identify the Problem

Capability Solution Analysis

Phase	Sub-process	Enablers	Analytics
Capability Solution Analysis	Bound the Solution Space		<p><u>Identify/Reduce Potential Candidate Solutions</u></p> <p>DOTMLPF Assessment Concept Feasibility Assessment Solution Space Constraints Technology Needs Assessment Technology Gaps Assessment Technology Realism Assessment Solution Boundaries Key/Critical Measures (i.e. MoPs, COIs, KPPs, KSAs) Concept of Employment (per candidate) Affordability Analysis Service Budget Portfolio Analysis Cost, Schedule, Risk Assessment Tradespace Analysis Solution Capability Assessment (per candidate) Red Team Assessments Stakeholder Analysis</p>
	Solution Identification	Mission Capability Needs Mission Capability Gaps Measures of Effectiveness Current State of Technology Technology Roadmaps SoS Architecture Rules of Engagement Concept of Operations Planning and Budgeting	

Capability Solution Analysis

Phase	Activities
Capability Solution Analysis	Bound the Solution Space
	Perform or incorporate JCIDS DOTMLPF Study (Verify need for a materiel solution)
	Understand current SoS Architecture
	Identify conceptual solution space constraints (Derived from SoS Architecture Timelines, Nodes/Interactions, and Resource Flow)
	Provide a timeline projection for the availability of critical needs
	Define/bound the conceptual solution space (Derived from Solution Space Constraints)
	Identify Mission Measures of Performance (MOPs) and Critical Operating Issues (COIs) (Derived from SoS Functional Flow)
	Solution Identification
	Explore potential technologies from S&T and Industry Base (e.g. JCTDs, CRADAs, CRAD, IRAD, etc.)
	Identify "potential" conceptual solution candidates (including disruptive and late blooming technologies)
	Provide technology assessment of conceptual solution space (current vs future, practical vs plausible, TRL, MRL, etc.)
	Understand technology, cost, and schedule realism
	Downselect conceptual solution candidates (Derived from MOEs, MOPs, and COIs)
	Generate ConEmps for each candidate (Mission and SoS Functional Flows and Nodes/Interactions define ConEMPs)
	Integrate ConEmps into SoS Architecture for each candidate (i.e. system integration assessment)
	Evaluate conceptual solution candidates against "programmatics" (e.g. cost, schedule, risk, etc.)
	Evaluate conceptual solution candidates against the MOPs (Based on MOPs)
	Evaluate conceptual solution candidates against capability gaps using MOEs (Based on Capability Gaps and MOEs)
	Evaluate conceptual solution candidates for compliance to the "ilities"
	Rank the conceptual solution candidates (Evaluate candidates against Mission and SoS Objectives)
	Write a "draft" Initial Capabilities Document
	Influence the writing of the AoA Study Guidance

Architecture Role	Direct Influence	Secondary Influence	S&T/IR&D
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Identify/Reduce Potential Candidate Solutions

Analysis of Alternatives (Internal Industry)

Phase	Sub-process	Enablers	Analytics
AoA	AoA Planning	Initial Capabilities Document Measures of Effects Critical Operating Issues Measures of Performance Current State of Technology Technology Roadmaps	<p style="text-align: center;"><u>Refine and Select Solution</u></p> Candidate Trade Analyses Capability vs Cost Capability vs Risk Life Cycle Assessment Technology Realism Assessment Concept of Employment (per candidate) Affordability Analysis Cost, Schedule, Risk Assessment Solution Capability Assessment (per candidate) Red Team Assessments Stakeholder Analysis
	AoA Conduct	SoS Architecture Planning and Budgeting	

Analysis of Alternatives (Internal Industry)

Phase	Activities	
AoA	AoA Planning	
	Identify the conceptual solution candidates to be evaluated (from the AoA Study Guidance)	
	Identify technical, schedule, and budget constraints	
	Identify relevant trade studies (Derived from MOEs, MOPs, and COIs)	Architecture Role
	Identify the AoA evaluation criteria/critical success factors (Derived from MOEs, MOPs, and COIs)	Direct Influence
	Refine representative scenarios (including operating environments and conditions)	
	Write the AoA Plan	
	Refine the SoS Architecture around each candidate	
	Identify SoS interfaces and enabling systems/technologies	
	Understand legacy system knowledge for SoS interfaces or system upgrades	
	Define life cycle parameters, attributes, suitability, etc.	
	Provide technology assessment of candidates (current vs future, practical vs plausible, TRL, MRL, etc.)	
	Provide advanced technology prototype assessment	
	Provide T&E and "ilities" assessments of candidates (sustainability, reliability, maintainability, survivability, training, etc.)	
	Provide integration readiness assessment of candidates for SoS interfaces (Derived from SoS Nodes and Interfaces)	Secondary Influence
	Provide initial list of Critical Technology Elements (CTEs)	S&T/IR&D
	Provide initial cost estimate of candidates	
	Provide initial schedule estimate of candidates	
	Create initial risk assessment of candidates based on technology, cost, and schedule	
	AoA Conduct	
	Identify common models, data, and tools	
	Gather relevant models, data, and tools	
	Validate models, data, and tools	
	Determine procedure for model/data/tool configuration management and knowledge repository	
	Identify analysis techniques	
	Perform capability vs cost trades (i.e. affordability analysis)	
	Perform capability vs risk trades (i.e. performance, schedule, cost)	
	Perform AoA	
	Identify the Preferred System Concept	
	Write a CONOPs for the Preferred System Concept	
Write AoA report		

Refine and Select Solution

Engineering Analysis

Phase	Sub-process	Enablers	Analytics
Engineering Analysis		Measures of Performance System Architecture SoS Interface Definition Technology Readiness Levels Manufacturing Readiness Levels	<u>Refine Selected Solution</u> Critical Technology Element Definition Affordability Analysis Cost, Schedule, Risk Assessment Performance Requirements Decomposition Design Requirements Definition System Concept Red Team Assessments Stakeholder Analysis

Engineering Analysis

Phase	Activities
Engineering Analysis	Identify Preferred System Concept technical, schedule, and budget constraints
	Refine SoS Architecture
	Identify level of expectations for Preferred System Concept
	Identify Preferred System Concept SoS interfaces and enabling systems/technologies
	Understand legacy system knowledge for SoS interfaces or system upgrades
	Create evolutionary life cycle planning
	Refine Preferred System Concept life cycle parameters, attributes, suitability, etc.
	Refine Preferred System Concept MOPs (Derived from SoS Functional Flow)
	Refine technology assessment of the Preferred System Concept (TRL, MRL, etc.)
	Refine integration readiness assessment of the Preferred System Concept for SoS interfaces (Derived from SoS Nodes and Interfaces)
	Refine Preferred System Concept CTEs
	Provide cost estimate of the Preferred System Concept
	Provide schedule estimate of the Preferred System Concept
	Identify risk assessment of the Preferred System Concept based on technology, cost, and schedule

Architecture Role	Direct Influence	Secondary Influence	S&T/IR&D
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Refine Selected Solution

Techniques, Methodologies, and Tools

Phase	Techniques, Methodologies, and Tools
Mission Capability Needs Analysis	BOGSAT Back of the Envelope Spreadsheet analysis Math Models First Principal Analysis Monte Carlo Analysis Analytic Hierarch Process (AHP) Discrete Event Simulation Architecture (DoDAF, Zachman, etc.) Concept of Employment (ConEmp) M&S: EADSIM, ESAMS, STORM, SUPPRESSOR, etc.
Capability Solution Analysis	BOGSAT Spreadsheet analysis Math Models First Principal Analysis Monte Carlo Analysis Analytic Hierarch Process (AHP) Discrete Event Simulation Architecture (DoDAF, Zachman, etc.) Concept of Employment (ConEmp) Constrained Optimization Framework 3DoF to 6DoF Simulations M&S: EADSIM, ESAMS, STORM, SUPPRESSOR, etc.

Phase	Techniques, Methodologies, and Tools
AoA	Monte Carlo Analysis Analytic Hierarch Process (AHP) Discrete Event Simulation Architecture (DoDAF, Zachman, etc.) Concept of Employment (ConEmp) Constrained Optimization Framework 3DoF to 6DoF Simulations Leverage Existing Simulations Man-in-the-Loop Simualtions Software/Hardware-in-the-Loop Simulations Leverage Tech Demos M&S: EADSIM, ESAMS, STORM, SUPPRESSOR, etc.
Engineering Analysis	Monte Carlo Analysis Analytic Hierarch Process (AHP) Discrete Event Simulation Architecture (DoDAF, Zachman, etc.) Concept of Employment (ConEmp) Constrained Optimization Framework 3DoF to 6DoF Simulations Leverage Existing Simulations Man-in-the-Loop Simualtions Software/Hardware-in-the-Loop Simulations Leverage Tech Demos M&S: EADSIM, ESAMS, STORM, SUPPRESSOR, etc.

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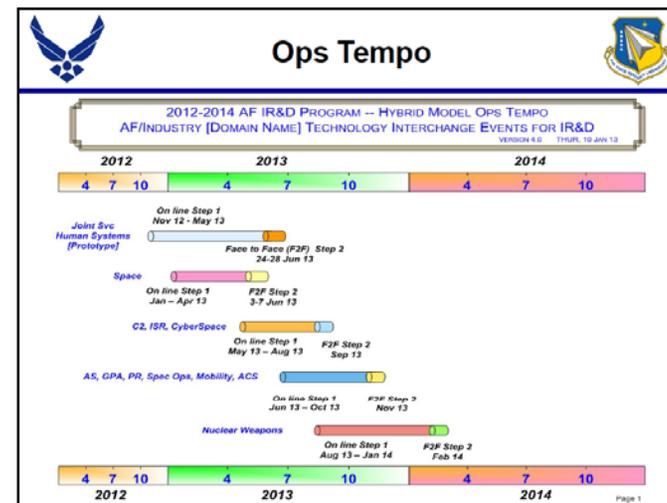
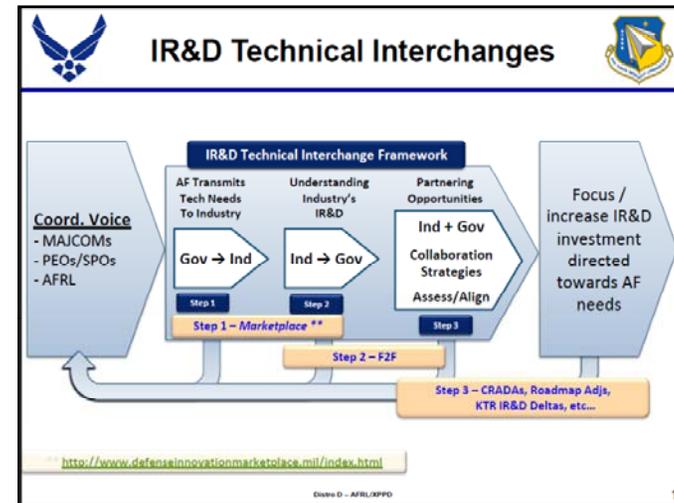
- Identify methods of collaboration
- Identify better methods to communicate collaboration opportunities
 - Identify communication opportunities and work with the Government to implement
 - Determine methods to “push” the communication to the right audience
 - Use Industry Associations to help get the word out



Source: Colonel Brooks McFarland
USAF OASD(R&E)

5. Improved Methods of Collaboration and Communication Mechanisms are needed

- AFRL IR&D Technical Interchanges
- IR&D Technical Interchange Framework
 - Marketplace
 - Face to Face
 - Focus on AF needs
- Ops Tempo provides
- AF/Industry Technical Interchange Events
 - Advanced Awareness
 - Domain focused



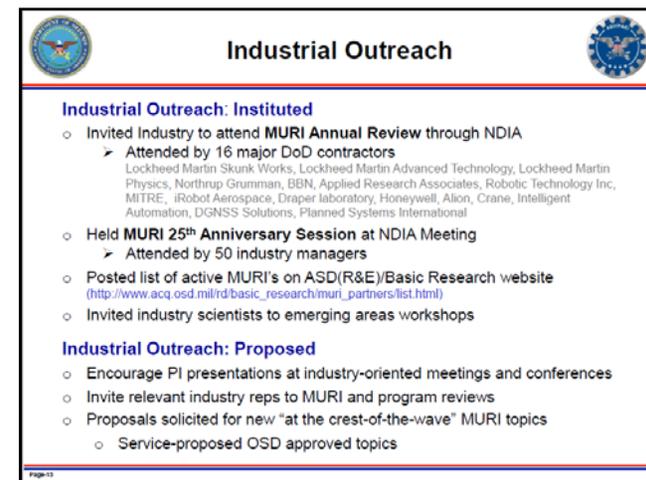
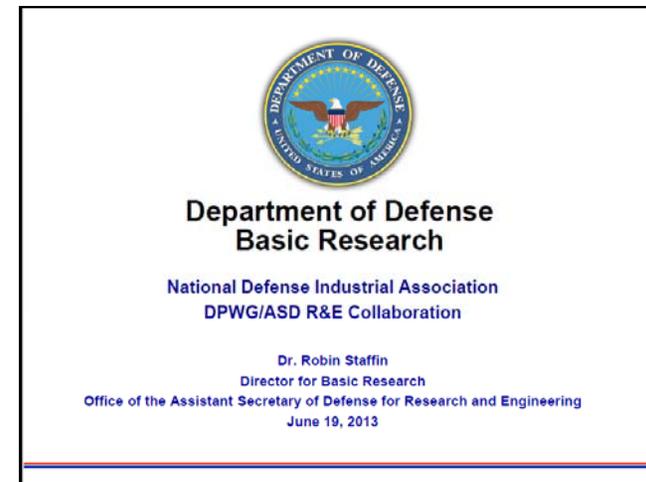
Source: Dr. Walter Price
 Technical Advisor, Development Planning, AFRL/EN

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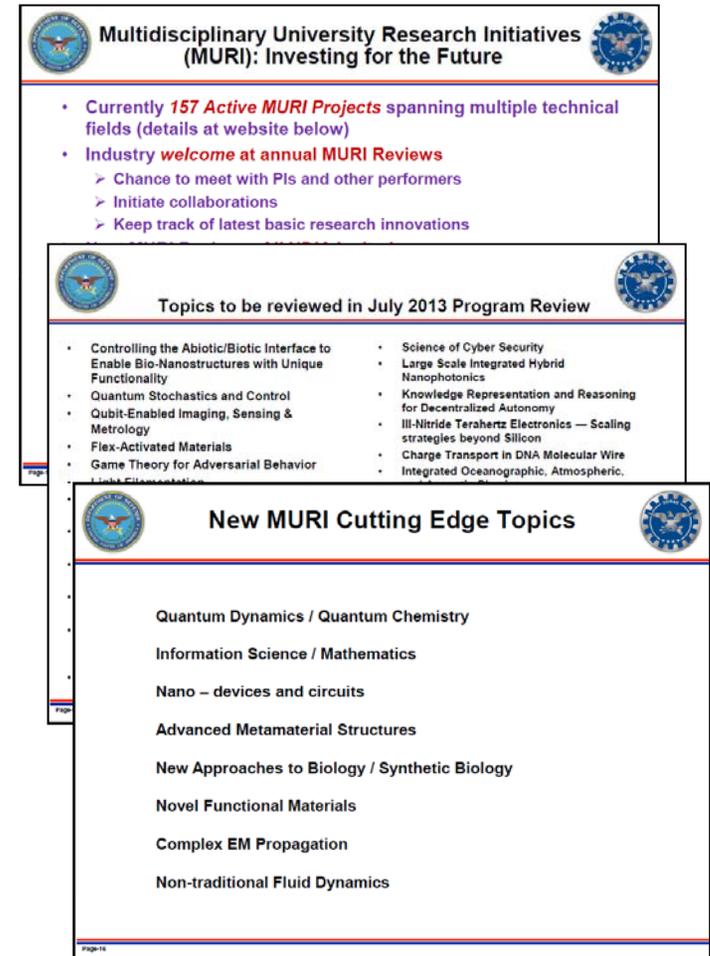
- Show the relationship of 6.1/6.2 investments to S&T needs
- Increase Industry involvement in the Multidisciplinary University Research Initiative (MURI) process
 - Enable Industry to be a submitter of 6.1 topics as an input to the Gov't S&T planning effort
- Increase Industry awareness and use of Defense Innovation Marketplace



Source: Dr. Robin Staffin
 Director for Basic Research, OASD R&E

6. 6.1/6.2 Investment Strategies need to align across Government and Industry

- MURI Review held July 24-25
- Limited Industry participation despite open invite
- Industry attendee comments:
 - Outstanding review
 - Highly technical
 - Networking directly with PI's
 - Excellent 6.1 opportunities



Multidisciplinary University Research Initiatives (MURI): Investing for the Future

- Currently **157 Active MURI Projects** spanning multiple technical fields (details at website below)
- Industry **welcome at annual MURI Reviews**
 - Chance to meet with PIs and other performers
 - Initiate collaborations
 - Keep track of latest basic research innovations

Topics to be reviewed in July 2013 Program Review

- Controlling the Abiotic/Biotic Interface to Enable Bio-Nanostructures with Unique Functionality
- Quantum Stochastics and Control
- Qubit-Enabled Imaging, Sensing & Metrology
- Flex-Activated Materials
- Game Theory for Adversarial Behavior
- Science of Cyber Security
- Large Scale Integrated Hybrid Nanophotonics
- Knowledge Representation and Reasoning for Decentralized Autonomy
- III-Nitride Terahertz Electronics — Scaling strategies beyond Silicon
- Charge Transport in DNA Molecular Wire
- Integrated Oceanographic, Atmospheric, and Space-based Earth Observation

New MURI Cutting Edge Topics

- Quantum Dynamics / Quantum Chemistry
- Information Science / Mathematics
- Nano – devices and circuits
- Advanced Metamaterial Structures
- New Approaches to Biology / Synthetic Biology
- Novel Functional Materials
- Complex EM Propagation
- Non-traditional Fluid Dynamics

Summary

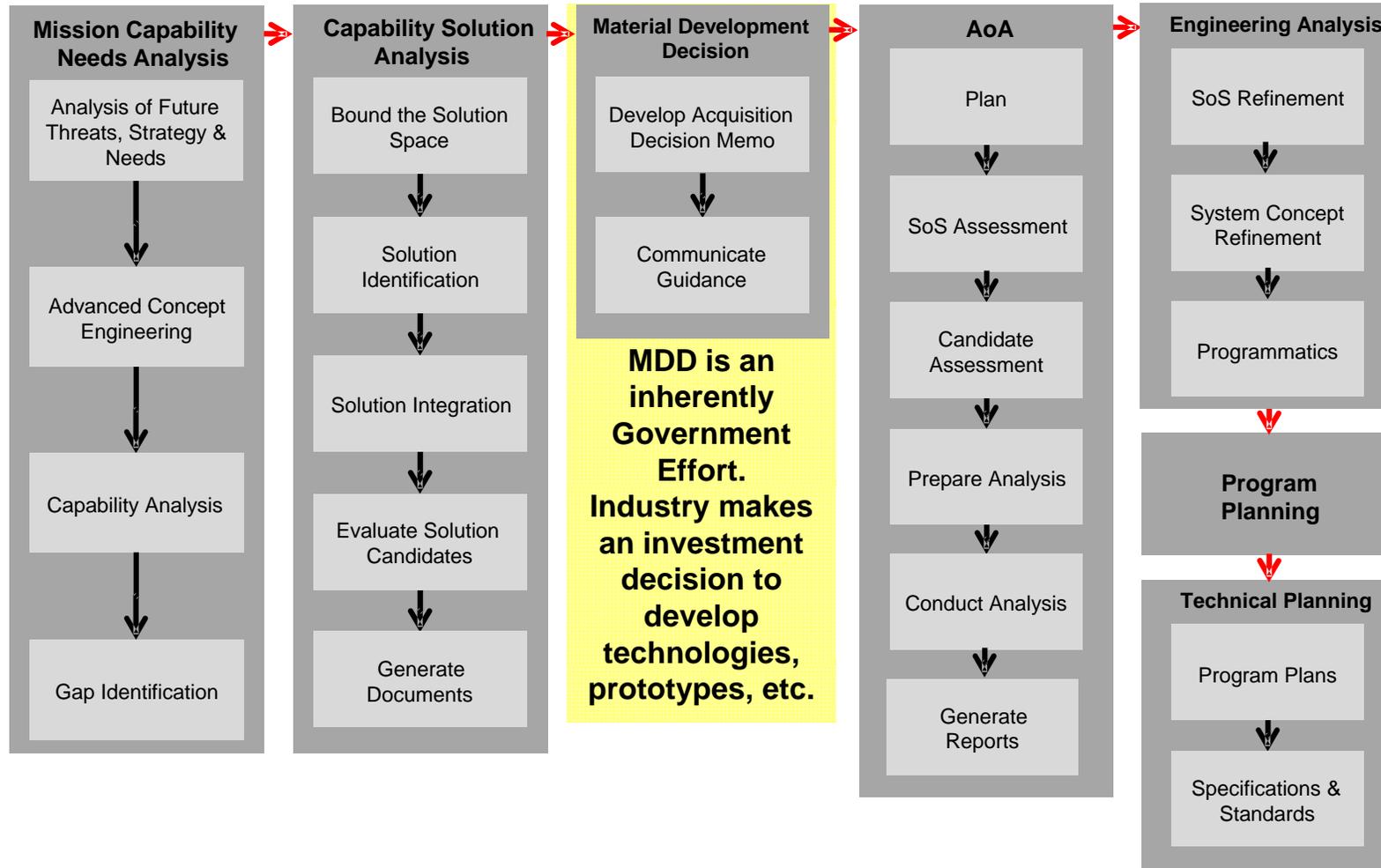
- **Strides have been made in the area of S&T/IR&D integration**
- **OCl is being addressed**
- **SE discipline for S&T/IR&D defined for Development Planning**
- **The Defense Innovation Marketplace provides Government and Industry awareness**
- **Service/Industry technical interchanges are taking place**
- **Industry is invited to participate in MURI Reviews**

Questions?

The NDIA DPWG thanks you for the opportunity to share our efforts!

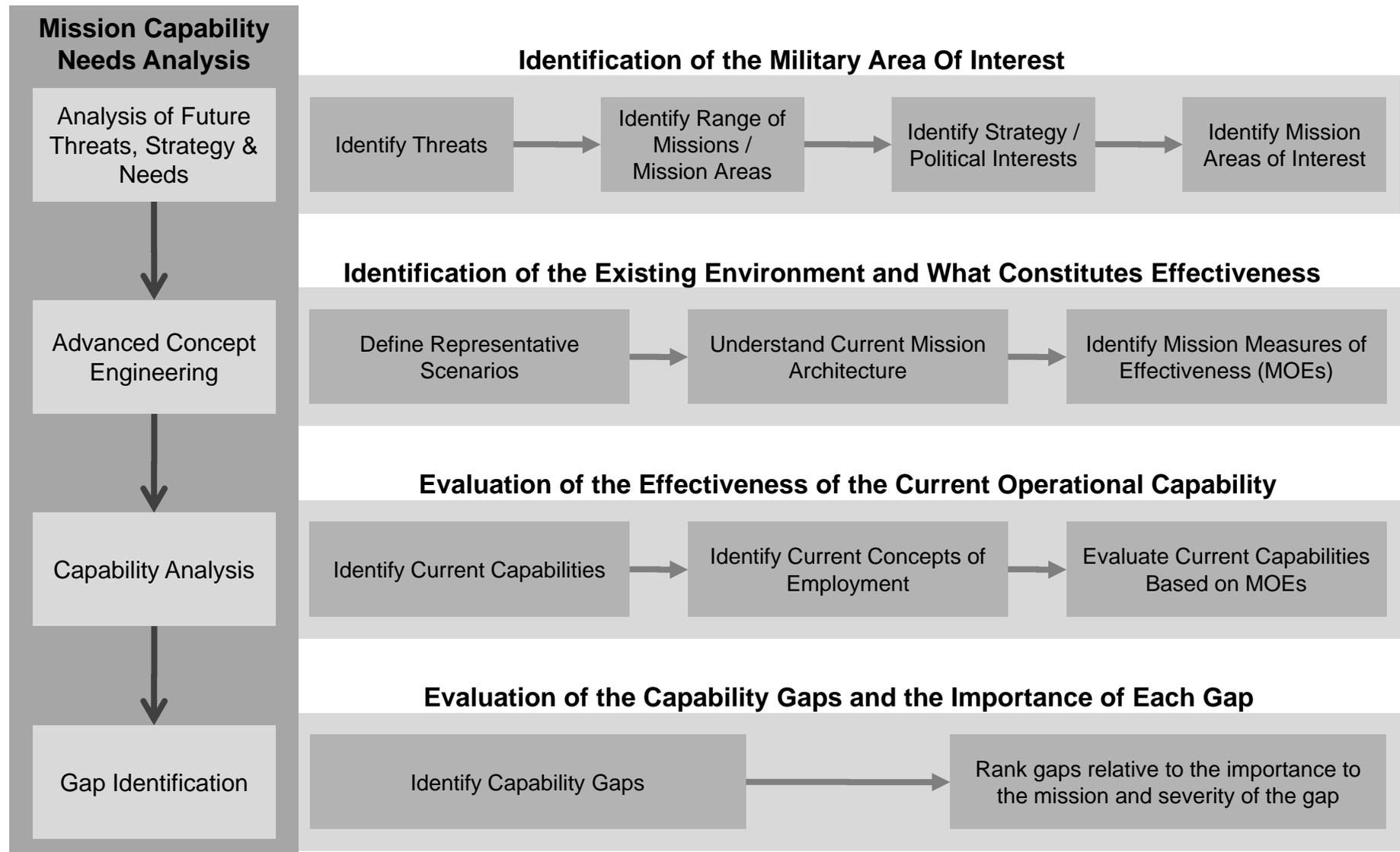
- Back-up

Industry's Pre-Milestone A SE Process

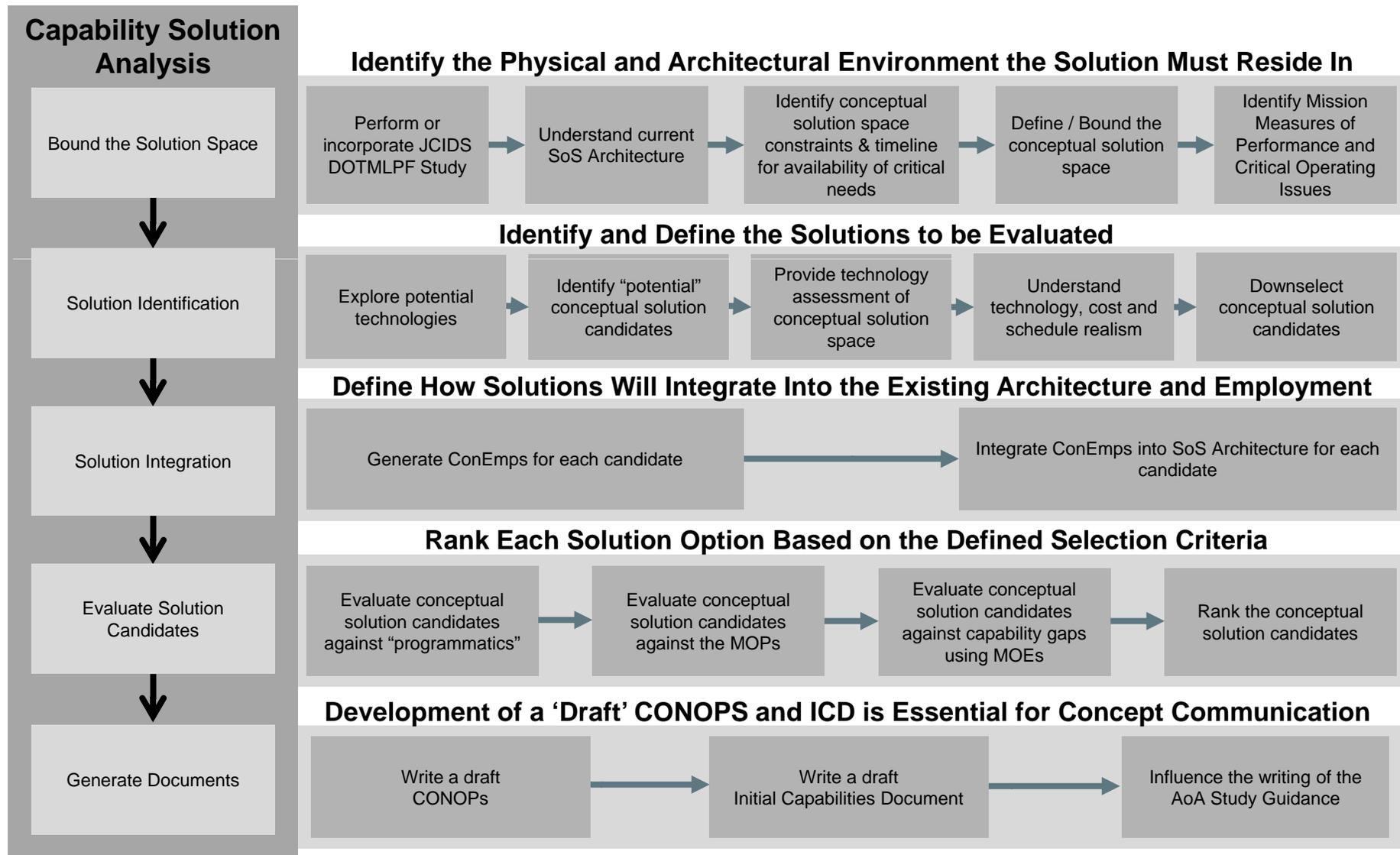


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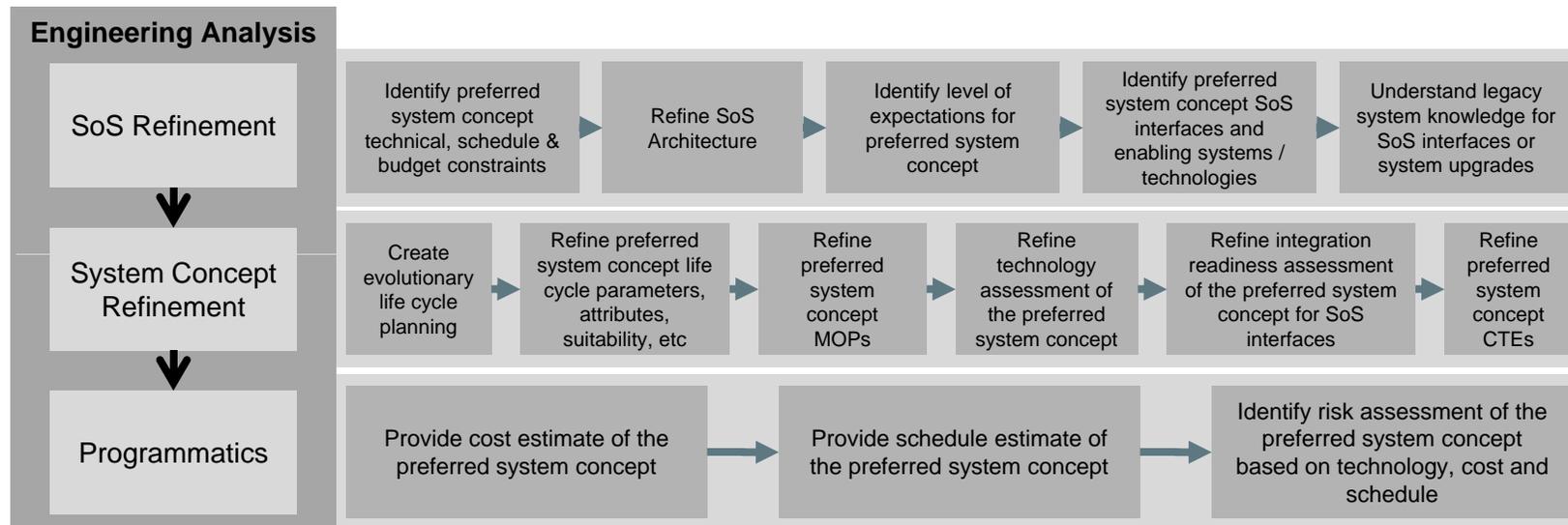
Mission Capability Needs Analysis



Capability Solution Analysis

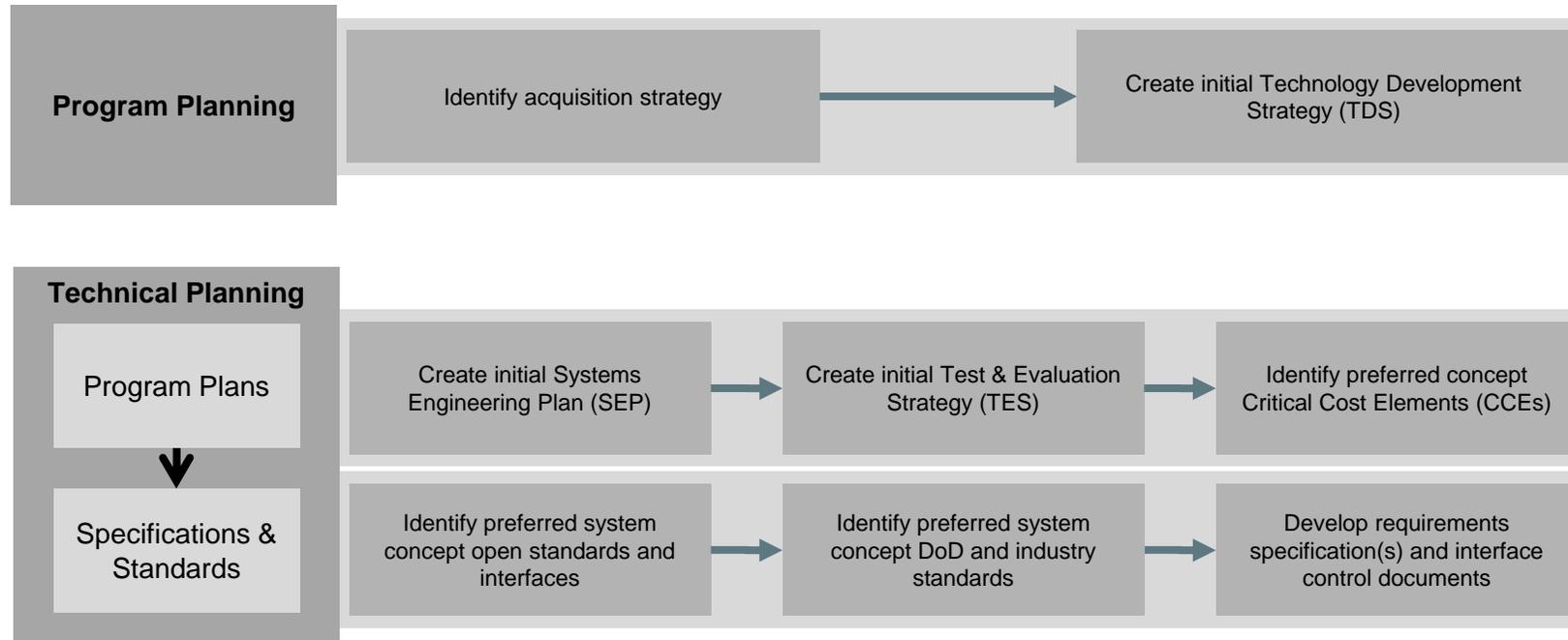


Engineering Analysis



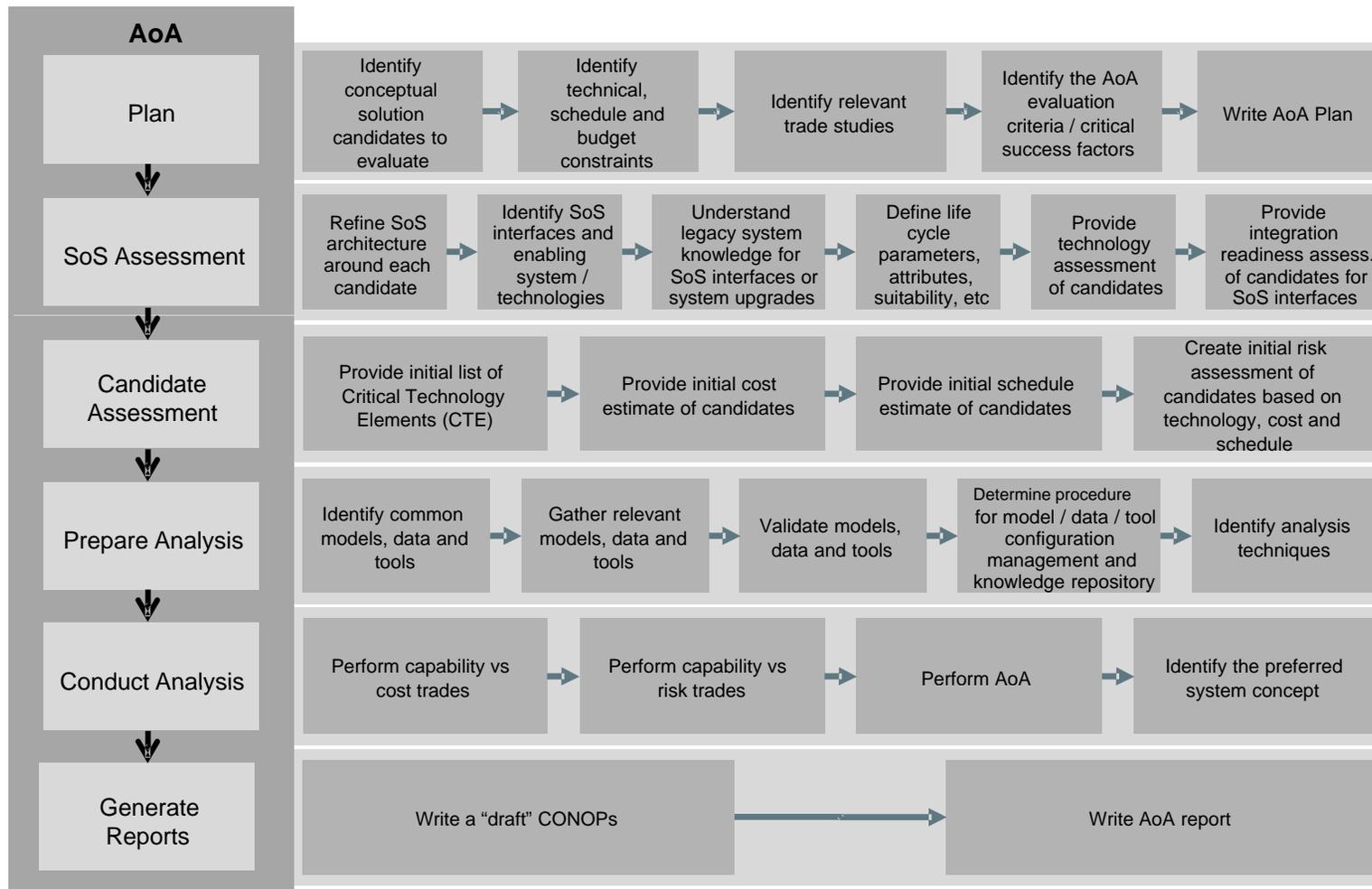
Engineering Analysis of the Preferred System Concept Shapes the Pre-Proposal Design

Program and Technical Planning



Planning Prepares the Way for Procurement Activities and Provides Information for Proposal Decision Making

Analysis of Alternatives (Internal Industry)



Internal AoA Provides Preparation for Preferred System Concept Engineering Analysis