



Where Do Early Systems Engineering and Contractor Interests Meet?

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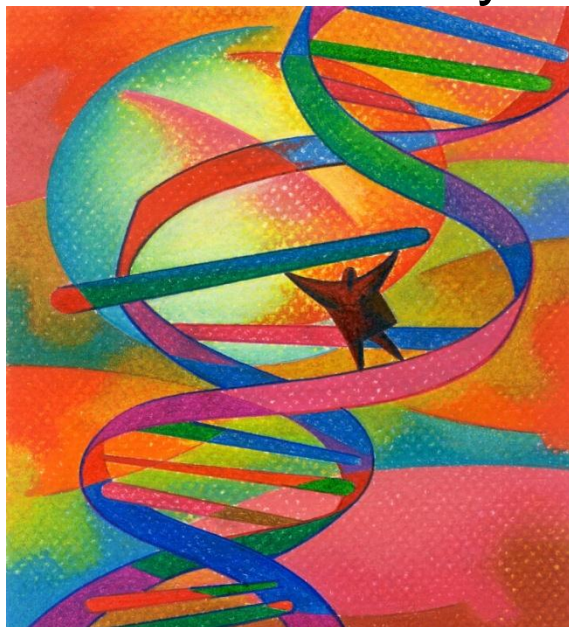
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Outline

- Background and Problem
- Early Systems Engineering
- DoD Acquisition Changes
- Meeting the Goals through Early Engagement
- Challenges of Early Engagement
- Emphasis on Mission Analysis
- Serendipity – Overcome Barriers with Mandates
- Conclusion

Background and Problem

- Increasing systems complexity
 - Technology
 - SoS
 - FoS
 - Mission volatility

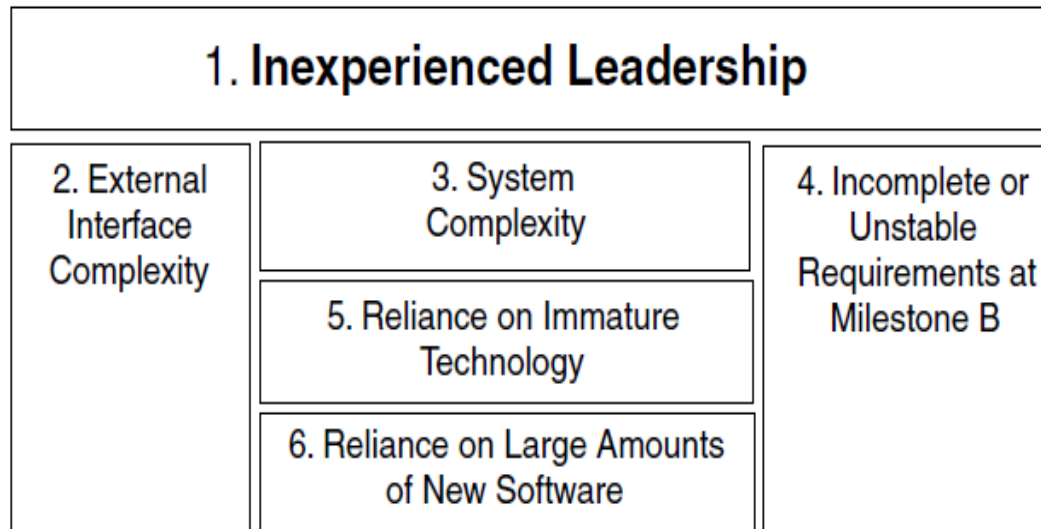


- Shrinking defense budgets



Background and Problem

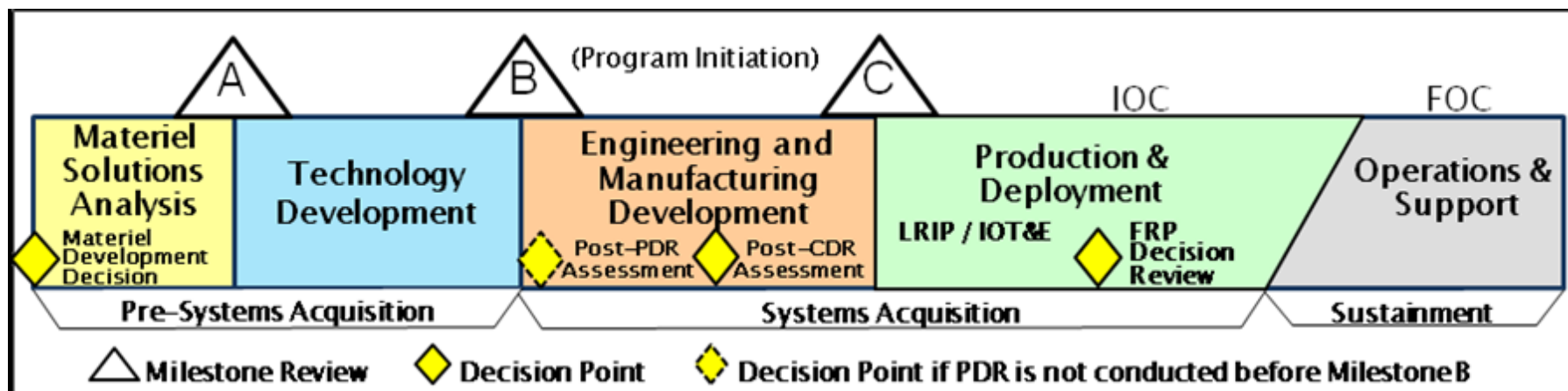
- Capability gaps
- Decline in development productivity twofold-or-greater growth in program cost and completion time over the past 30 years



Six Drivers of Cost, Development Time, and Performance Risk
Addressable by Systems Engineering Processes

Background and Problem

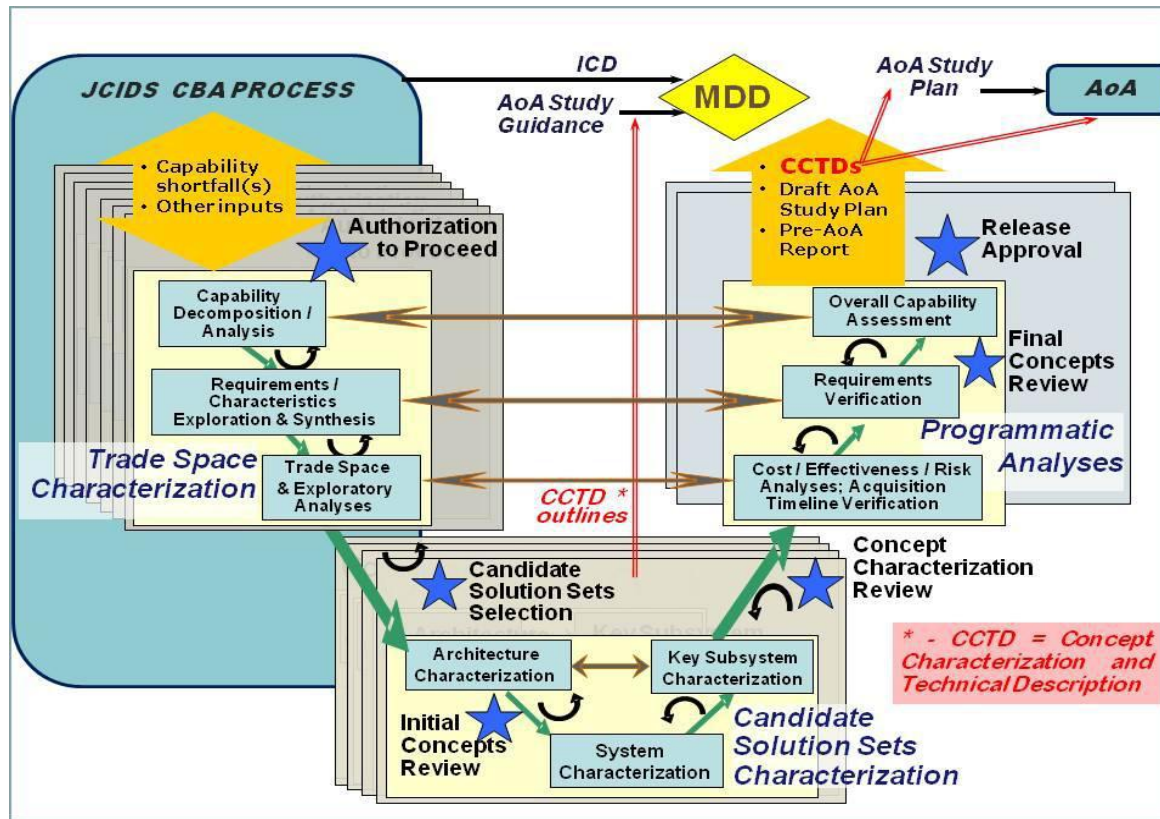
- DoD response with acquisition changes
 - Focusing on Systems Engineering (SE) in very early conceptual stages of acquisition during early program formulation
 - Corresponding organizational changes
 - Expanded partnership between government and industry



DoDI 5000.02 (Dec 2008) acquisition life cycle

New Emphasis is off the chart – left of MDD

Early Systems Engineering



- Early SE can be divided into four segments:
 - Capabilities-Based Assessment (CBA)
 - Concept Exploration and Refinement (CER)
 - Preferred System Concept (PSC) maturation
 - Technology Development (TD)

Early Systems Engineering – CBA and CER

CBA and CER are the New Emphasis

DoD Acquisition Changes

- Emphasize Early Systems Engineering (aka Development Planning)
 - Department of Defense acquisition legislation (e.g., “Weapon Systems Acquisition Reform Act”)
 - Instructions (e.g., “DoD Instruction 5000.02”)
 - Guidance (e.g., the United States Air Force “Early Systems Engineering Guidebook”)
 - Research (National Research Council “Pre-Milestone A and Early-Phase Systems Engineering: A Retrospective Review and Benefits for Future Air Force Acquisition”)

New mandates must overcome inertia

DoD Acquisition Changes

- Emphasize Affordability

- Carter memorandum
- Affordability as a KPP



- Early Systems Engineering brings multiple challenges to government and contractors
- Mandates provide an environment for meeting the challenges

Mandates can ease the pain

DoD Acquisition Changes

- Purpose has two goals
 - Deliver better results to the government customer
 - Benefit the warfighter
- Contractors support both goals independently of mandates

Goal congruity

Meeting the Goals through Early Engagement (Pre-Milestone A SE)

- Reduced likelihood of missing requirements that result in rework after Milestone B
- Reduced likelihood of capability gaps
- Early formation of cross-functional technical and business teams
- Increased likelihood of fully assessing the problem space before solution development
- Increased likelihood of developing multiple feasible solutions for Analysis of Alternatives (AoA)

Clear benefits

Meeting the Goals through Early Engagement

- Assess mission benefits, as well as gaps and costs, through modeling and simulation
- More accurate assessment of technical readiness and reduced risk
- More accurate assessments of cost and schedule
- Targeted IRAD
- Targeted CRADA

Clear Benefits

Challenges of Early Engagement

- Maintain competitive environment
- IP concerns
- Need to institutionalize and systematize (e.g., outside of sole source environment)

Clear challenges

Challenges of Early Engagement

- Front-end loaded
- Funding does not necessarily support it
- Customer schedule demands do not necessarily support it
- May need cultural changes in both customer and contractor ranks

Clear challenges

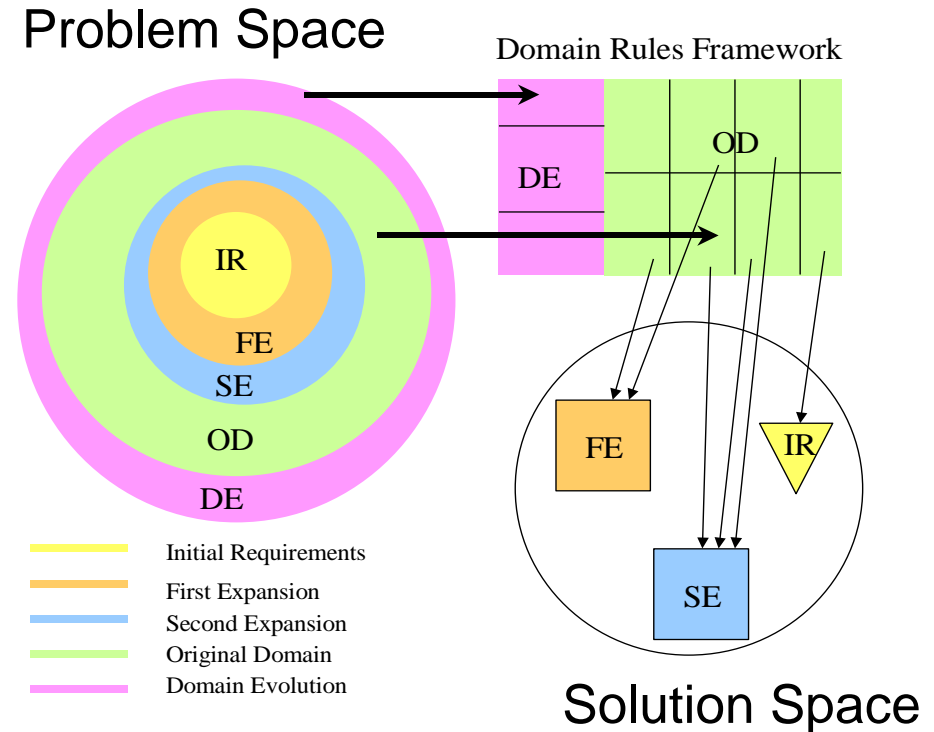
Challenges of Early Engagement

- Avoidance of organizational conflict of interest while working as closely as possible to understand government and warfighter needs
- Government needs to have procedures to avoid conflicts
- Government and contractor staff may be reluctant to work closely without contract in place

Clear challenges

Emphasis on Mission Analysis

- Comprehensive focus on problem space
- Avoid premature jump to solution space – preconceived solutions to wrong problem



Encourages mission focus

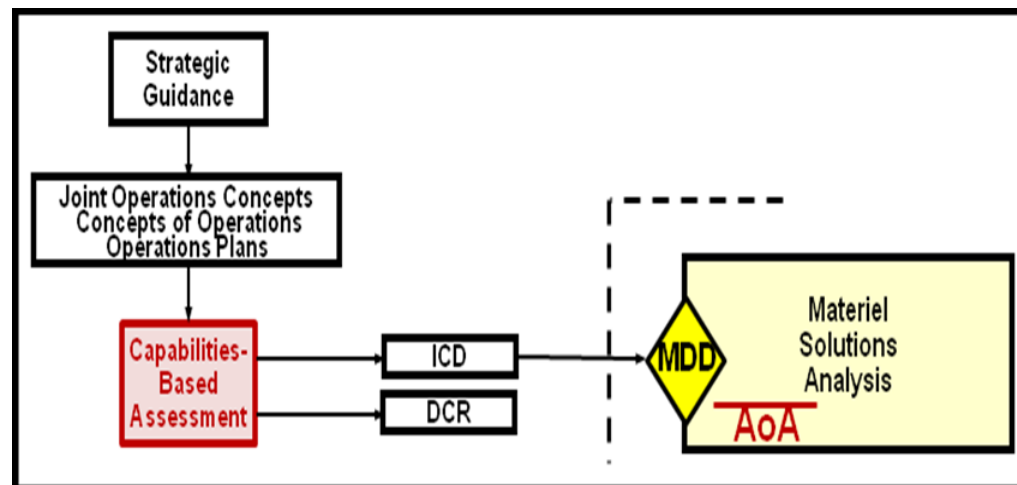
Emphasis on Mission Analysis

- End-to-end (SoS) modeling and simulation
- Interact with customer stakeholders
- Understand and agree on mission
- Iterate to avoid gaps

Encourages common understanding

Emphasis on Mission Analysis

- Product and technology independent views (Capability-Based Assessment somewhere between requirements and solution concepts) of mission
 - Development processes
 - Reuse
 - Architecture
 - Technology



JCIDS Capability-Based Assessment (CBA)

Initial focus not on technology or products

Serendipity – Overcome Barriers with Mandates

- Cultural
 - Now often already done by government
 - Government and contractors cautious about organizational conflict of interest
 - Government wants to develop concepts first to see how close contractors come to the government target
 - Contractor processes and expertise may not support early mission analysis
 - Contractor leadership and government surprised by front-end loading of cost and schedule

Win win

Serendipity – Overcome Barriers with Mandates

■ Business

- Lead to institutionalized funding mechanisms
- Lead to institutionalized collaborative mechanisms to avoid organizational conflict of interest
- Protect IP
- Allow and incentivize early collaboration
- Streamline out of date processes

Win win

Conclusion

In correcting the decline in development productivity, government mandates may assist contractors in streamlining their processes and cutting costs. Meeting the mandates for early engagement could improve the contractor's ROI as well as improve development productivity for the government, e.g.

- Reduced likelihood of missing requirements that result in rework after Milestone B
- Reduced likelihood of capability gaps
- More accurate assessment of technical readiness and reduced risk
- More accurate assessments of cost and schedule

Acronyms

- AoA: Analysis of Alternatives
- CBA: Capabilities-Based Assessment
- CER: Concept Exploration and Refinement
- DCR: DOT_LPF Change Request
- DOT_LPF: Doctrine, Organization, Training, Leadership and Education, Personnel, Facilities
- FoS: Family of Systems
- ICD: Initial Capabilities Document
- KPP: Key Performance Parameter
- MDA: Milestone Decision Authority
- MDD: Material Development Decision
- MS: Milestone
- NDIA: National Defense Industry Association
- PSC: Preferred System Concept
- SoS: Systems of Systems
- TD: Technology Development

Biography

- Dr. O'Brien received his Ph.D. in Information Technology and Engineering in 2006 from George Mason University and became a Raytheon Certified Architect in 2009. He has two granted patents and five pending patents. His doctoral dissertation, Breakdowns in Controls in Automated Systems, was published in book form in the United States and Europe in December of 2008. He is the co-author of "Agile Integration of Complex Systems," which appeared in the November 2010 issue of CrossTalk, the Journal of Defense Software Engineering. An article titled "External vs. Internal SOA Governance" is scheduled for publication later this year in CrossTalk.