

Top 5 Systems Engineering Issues within DOD and Defense Industry

Task Report

July 26-27, 2006

Task Description

Identify Top 5 Systems Engineering problems or issues prevalent within the defense industry

- Update status and re-validate SE issues from 2003
- Agree upon Top 5 SE issues for 2006

Document issues

- Description and current state
- Rationale and SE impacts
- Develop recommendations (short term and long term)

Generate task report

- Submit to OSD mid-August 2006

Task Group Participants

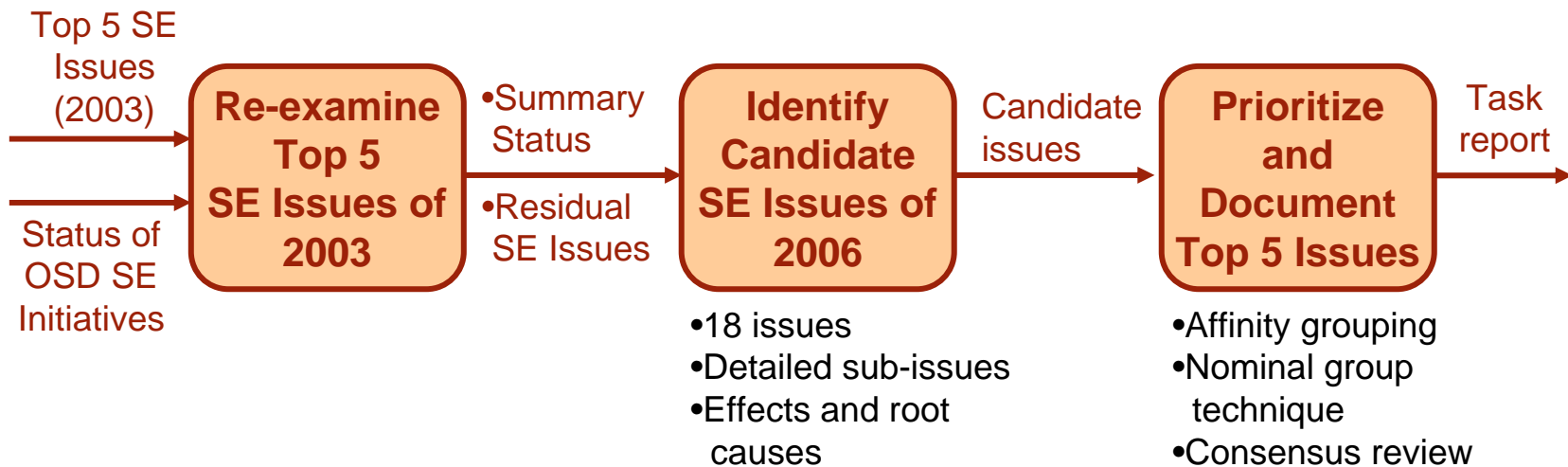
18 participants from industry and government

**Alion Science and Technology
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Harris
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Task Group Activities



Background – Top 5 SE Issues of 2003

Top 5 Systems Engineering Issues (2003)

- Lack of awareness of the importance and value, timing, accountability, and organizational structure of SE on programs
- Adequate, qualified resources are generally not available within Government and industry for allocation on major programs
- Insufficient SE tools and environments to effectively execute SE on programs
- Requirements definition, development and management is not applied consistently and effectively
- Poor initial program formulation

Details on NDIA Systems Engineering Division web site

http://www.ndia.org/Content/ContentGroups/Divisions1/Systems_Engineering/PDFs18/Modeling_Committee_PDFs/February2003_top_5_issues.pdf

Summary of OSD Initiatives for SE Issues

OSD Initiative

Policy updates

Summary

- **Systems Engineering Plan (SEP) on all programs**
 - **OSD SEP reviews for ACAT 1D and 1AM programs**
 - **Each PEO shall have a lead or chief systems engineer who monitors SE implementation within program portfolio**
 - **Event-driven technical reviews with entry criteria and independent subject matter expert participation**
- #### Improved SE Guidance
- **Defense Acquisition Guidebook**
 - **SEP Preparation Guide**
 - **IMP/IMS Guide**
 - **Risk Management Guide**
 - **Capability Maturity Model Integration-Acquisition Module (CMMI-AM)**
- #### Education and Training
- **Strengthened SE curricula via Defense Acquisition University (DAU)**
 - **Certifications**
 - **Continuous Learning Modules for R&M, Technical Reviews, System Safety, M&S in SE**
 - **Enhanced career paths**
- #### System level assessments
- **Non-advocate program support reviews**
 - **Technical Planning Review**
 - **Effective early engagement**
- #### Integrating Development T&E with policy and assessments
- #### Outreach
- **SE Forum**
 - **Leverage partnerships with industry and academia**
 - **Standup and participation in SE WIPTs**

Reference: Systems Engineering Update, NDIA Top 5 Issues Workshop. July 26, 2006. Briefing by Mr. Robert Skalamera, Deputy Director, Systems and Software Engineering (Enterprise Development), Office of the Deputy Under Secretary of Defense (A&T)

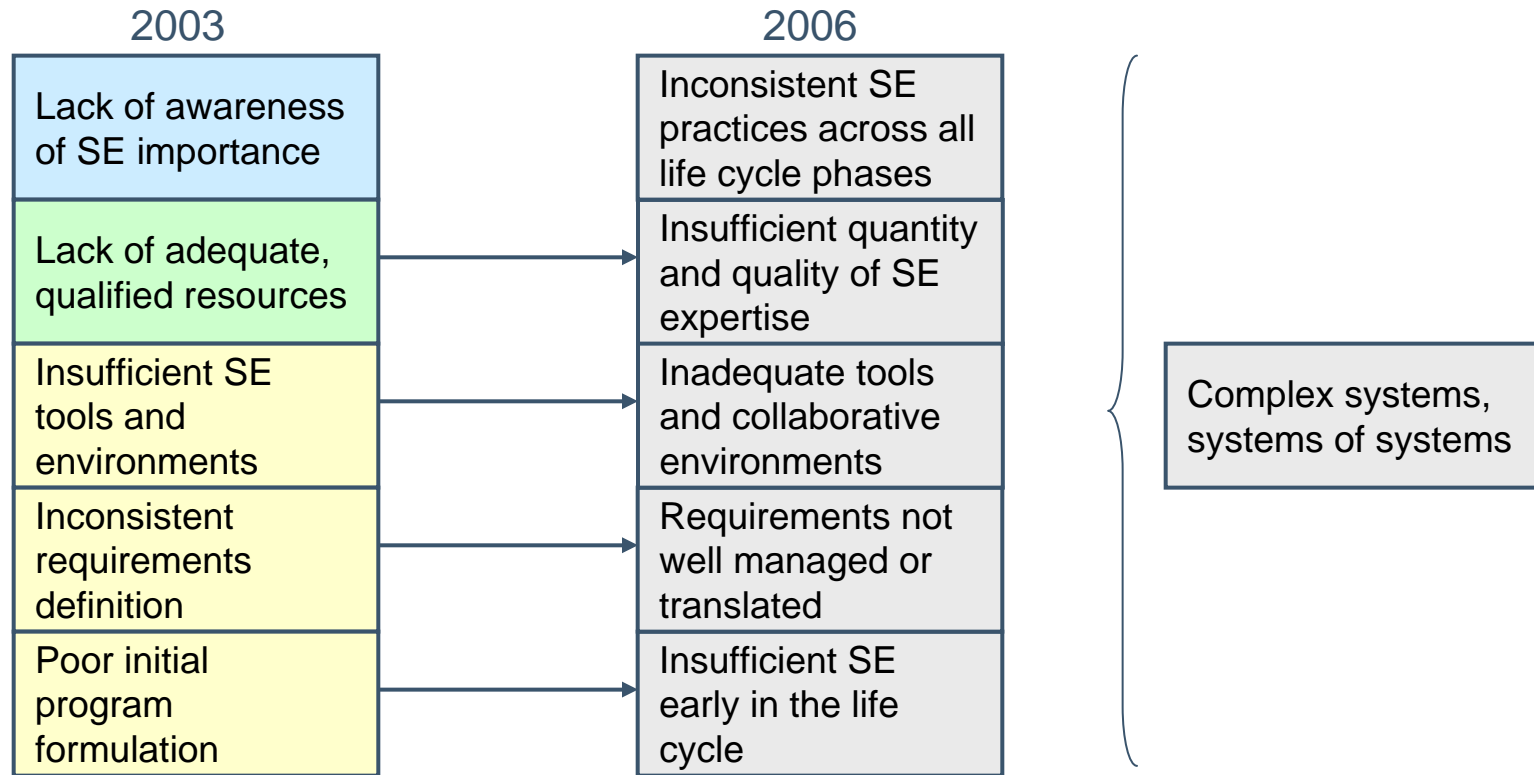
Assessment of Top 5 SE Issues from 2003

Issue (2003)	Summary Assessment (2006)
Lack of awareness of the importance, value, timing, accountability, and organizational structure of SE on programs	<ul style="list-style-type: none"> • Awareness achieved by top-down policy, guidance, training, organizational structures, etc. • Others aspects, such as buy-in, recognition of value, or behavioral changes are not yet consistently evident. • Measures of effectiveness are needed
Adequate, qualified SE resources are generally not available within Government and industry for allocation on major programs	<ul style="list-style-type: none"> • Qualifications addressed via training and certifications, but not necessarily the depth of the pipeline • Availability of adequately skilled SEs remains an issue for both government and industry (diminishing availability to support growing needs and increasing complexity)
Insufficient SE tools and environments exist to effectively execute SE on programs	<ul style="list-style-type: none"> • Model-based tools, methods, and repositories are improving, and are applied in training • Still need better integration of tools and methods across SE and other disciplines • Modeling and simulation plans need to be implemented
Requirements definition, development and management is not applied consistently and effectively	<ul style="list-style-type: none"> • Improved guidance has yet to be consistently implemented • Must address capabilities as well as specified requirements
Poor initial program formulation	<ul style="list-style-type: none"> • SEP policy, guidance, and event criteria should improve program plans and estimates, but effectiveness not yet clear • Greater coordination and integration of government/contractor plans needed early in acquisition life cycle • Greater integration of interfaces between acquisition, requirements, and programmatic needed

Top 5 SE Issues - 2006

- **Key systems engineering practices known to be effective are not consistently applied across all phases of the program life cycle.**
- **Insufficient systems engineering is applied early in the program life cycle, compromising the foundation for initial requirements and architecture development.**
- **Requirements are not always well-managed, including the effective translation from capabilities statements into executable requirements to achieve successful acquisition programs.**
- **The quantity and quality of systems engineering expertise is insufficient to meet the demands of the government and the defense industry.**
- **Collaborative environments, including SE tools, are inadequate to effectively execute SE at the joint capability, system of systems (SoS), and system levels.**

Summary - Evolution of Top SE Issues



Though progress is being made, the environment is changing and many underlying issues still remain.

Details of Top 5 SE Issues of 2006

Issue 1: Key systems engineering practices known to be effective are not consistently applied across all phases of the program life cycle.

Discussion Points:

- Inconsistent SE practices for program planning and execution
- Companies do not always execute at claimed CMMI® levels
- Confusion between architecting, SE, frameworks (DODAF)
- Lacking consistent SE measures (effectiveness, value, ROI)
- Technical baselines not always established, controlled, and maintained
- Risk management inconsistent; guidance lacks specificity, opportunities
- Dependencies on external interfaces outside program control (e.g., SoS)

Recommendations:

Ensure institutionalization of effective SE practices into program planning and execution

- Define and monitor required SE practices (e.g., DAG) for each phase
- Strengthen CMMI® for deployment of appraised processes on all programs
- Require appropriate SE measures across the life cycle (e.g., PSM, LAI)
- Require use of DOD Risk Management Guide, per joint working group
- Define and promulgate interface change control processes for SoS

®CMMI is registered in the U.S. Patent and Trademark Office by Carnegie Mellon University.

Issue 2: Insufficient SE is applied early in the life cycle, compromising the foundation for initial requirements and architecture development.

Discussion Points:

- Requirements, budgets, schedules established without adequate SE.
- Optimistic cost and schedule estimating.
- SE and PM functions are not well integrated, roles/responsibilities unclear.
- SE compromised in planning and design when SE value not understood.
- SoS inter-program complexity not accommodated in SE planning.

Recommendations:

Integrate engineering planning within the acquisition life cycle to ensure adequate time and effort for SE early in the program life cycle.

- Expand SEP policy to address risks of inadequate SE prior to Milestone A
- Establish guidance on SE/PM roles, responsibilities, communications
- PMs ensure distribution of SE effort among prime and subcontractors
- Increase PM awareness of value of effective SE
- Provide guidance for SE activities needed for SoS
- Integrate acquisition processes with requirements, programmatic to ensure procurement is consistent with schedule, resources, constraints
- Expand independent, non-advocate reviews of program formulation

Issue 3: Requirements are not always well-managed, including the effective translation from capabilities statements into executable requirements to achieve successful acquisition programs.

Discussion Points:

- Management structures and roles not well understood for SoS, capabilities
- Critical common element areas across capability areas must be identified, managed
- Capabilities broaden engineering trade space due to less specific requirements.
- Do not always have adequate access to trained SE resources for defining capabilities
- SoS environment strains capability process due to extended complexity, governance
- Inadequate understanding of true capabilities needed by warfighters
- Translating SoS capabilities into insertable technology across legacy systems requires series of feedback loops

Recommendations:

Emphasize the application of SE practices and resources to the capability definition process to address warfighter needs and translation into executable programs

- Lead the effort to require roles and structure that include SE in capabilities definition
- Standardize terms, processes, and methods for SoS and enterprise SE
- Enhance the application of SE to capabilities development to better define systems elements common across capabilities
- Emphasize technical planning for systems adaptability and technology insertion from program onset
- Emphasize the need for expanded contractor communications and interactions in early requirements definition process
- Encourage adoption of CMMI best practices for requirements (acquisition, development)

Issue 4: The quantity and quality of systems engineering expertise is insufficient to meet the demands of the government and the defense industry.

Discussion Points:

- Short supply of experienced, trained SE in government and industry.
- PM/SE turnover and fewer opportunities for OJT.
- Inconsistent SE certification methods across government and industry.
- Inconsistent roles and responsibilities across services results in inefficient use of government and industry resources

Recommendations:

Grow SE expertise through training, career incentives, and broadening “systems thinking” into other disciplines.

- Modify SEP template to clearly specify required SE qualifications for program staffing
- Work with academia to include introductory SE course in degree programs, establish recommended curricula for consistent skills
- Establish SE job code and career incentives for promotion into PM
- Require “systems thinking” training for other disciplines and PM to expand SE candidate pool
- Encourage an integrated and consistent SE certification definition between industry and govt.

Issue 5: Collaborative environments, including SE tools, are inadequate to effectively execute SE at the joint capability, system of systems (SoS), and system levels.

Discussion Points:

- Collaborative, information-sharing environments are needed to enable all stakeholders to work together effectively (M&S, workflow, design tools)
- Policies, guidance, standards inadequate for interoperability/sharing/reuse
- Expanded complexity of the SE trade space due to capabilities, SoS, PBA, etc. exceeds capabilities of current tools and environments (M&S, MBSE)

Recommendations:

Strengthen and clarify policy and guidance regarding use of collaborative environments, models, simulations, and other automated tools.

- De-conflict policies and standards to enable data sharing, tool interoperability
- Establish partnerships and roadmaps for evolving tool capabilities
- Define best practices and education to foster use/sharing of tools and data
- Sponsor definition of and encourage the use of a DoD business model facilitating shared information and tools
- Implement Acquisition Modeling and Simulation Master Plan