NDIA Top SE and SW Issues – 2010

Report on NDIA SE and SW Workshops
Held March 16-18, 2010

Presentation for NDIA SE Conference
October 2010

SW Issues - Geoff Draper, Harris
SE Issues - Hal Wilson, Northrop Grumman

Task Description

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

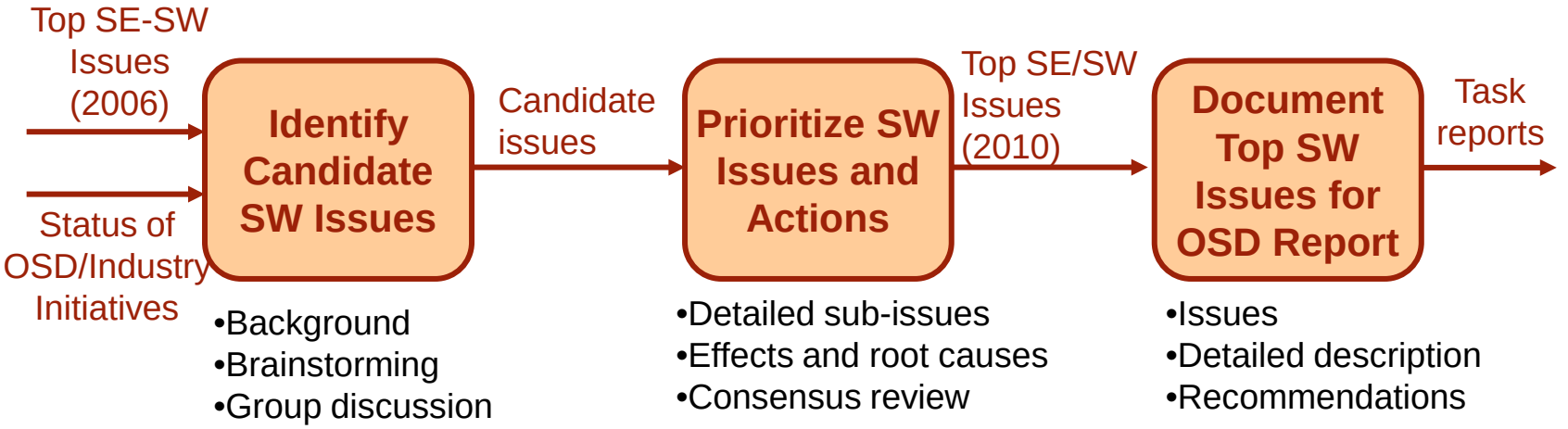
- Assess progress and update issues from 2006 workshops

Document issues

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

Generate task report

Task Group Activities



Reports are posted on NDIA SE Division web page > Studies & Publications
http://www.ndia.org/Divisions/Divisions/SystemsEngineering/Pages/Studies.aspx

Refer to these reports for full descriptions and consensus wording of issues/recommendations.

NDIA Top Software Issues – 2010

Results - NDIA Top SW Issues Workshop

March 16-17, 2010

2010 - Common Themes Noted

The need for rapid development has increased – rapid response to mission needs (faster, better, cheaper). Need to find ways to be more responsive, quicker.

The need for better SW architectures and modular components has been reinforced. Architectures are more difficult when accounting for legacy upgrades, SoS, and interoperability.

SW community must be engaged in advanced development planning.

Areas where action is needed:

- **Rapid acquisition** – response to urgent mission needs
- **Starting programs right** – effective program planning/startup
- **Executing programs right** – best practices, future practices
- **Sustainment** – consider total life cycle activities

2010 NDIA Top SW Issues

1. **Rapid acquisition:** **Development of software and systems must occur more rapidly than current acquisition models and development processes allow in order to meet the increasing demands of the warfighter.**

   Issues:

   - Current acquisition processes not well-suited to address rapid response needs
   - Prioritization of capabilities requires cooperative engagement between acquirer, developer and war fighter
   - Rapid development can be accelerated through reuse and use of open source and COTS but depends heavily on well-designed, flexible SW architectures
   - Multi-disciplinary approaches and processes are critical but not often in place
   - Inherent tradeoffs must balance engineering rigor with development and sustainment issues encountered post-deployment
   - Prototypes are helpful but are often declared operational as soon as introduced creating complications in support and stabilization

   Recommendations:

   1. NDIA facilitate a study or working group to characterize best practices and determine the measured effectiveness of rapid deployment techniques.
   2. NDIA establish a joint industry/government working group to investigate new acquisition approaches that accommodate rapid development.

2010 NDIA Top SW Issues

2. Start programs right: Inadequate/insufficient program planning and start-up has a negative impact on the program's SW success.

Issues:

- SW architecture and trades to achieve performance must occur earlier
- Clear and stable requirements are needed but are not often available
- Retrofits can cause significant cost and schedule impacts
- SW engineering plans are often omitted from RFPs and program plans
- Early planning often does not include software expertise, resulting in unrealistic plans and rework from late consideration of SW impacts
- Inconsistent SW estimation/measurement practices, disconnected from work planning and monitoring
- Ineffective program structures for accommodating SW changes
- Contractual constraints for flow-down, dialog with bidders, changing needs

Recommendations:

1. NDIA to provide best practices, in government and industry, that encourage the use of program assist start-up teams working directly with programs to develop comprehensive program plans, processes, and organizational structures.
2. NDIA to develop guidance and assets for improving planning and organization on software-intensive programs, with emphasis on improving the integration of software engineering with systems engineering and other program functions.

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3. Execute programs right: Current software development and management practices have not kept pace with emerging needs in areas such as complex systems, SoS, system assurance, software verification, and COTS/NDI integration.

Issues:

- SW management practices for traditional development are well understood, yet these practices are not always consistently followed
- Persistent issues are being addressed by new government policies and legislation
- Problems that face SW in the future:
  - Current SW engineering practices do not scale well when faced with expanding complexity of DoD systems and do not provide adequate insight into new development methodologies
  - Traditional SW integration and verification are costly and ineffective for more complex systems and integration strategies are not well integrated with system level approaches
  - System assurance practice is not adequate to anticipate and mitigate emerging vulnerabilities and threats
  - Plans and estimates for non-developmental items are often optimistic (COTS, GOTS)

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3. Execute programs right: (cont.)

Recommendations:

1. Government fund ongoing research into scaling software engineering practices and measures for complex systems and systems-of-systems.
2. NDIA and government collaborate on enhanced guidance for software integration and verification, and strengthened approaches for ensuring adequate software quality practices on defense programs.
3. NDIA and government define and communicate best practices for system assurance, and implement mechanisms to ensure their use on defense programs.
4. NDIA to develop guidance on strategies and practices for COTS/NDI usage and verification.

2010 NDIA Top SW Issues

4. Sustainment: There is insufficient attention given to the overall software life cycle activities including sustainment and changing threats.

Issues:

- Modern weapon systems are extensively dependent on SW-driven functionality, but sustainment resources are unable to keep up with changing mission scenarios.
- Sustainment costs are a major cost driver but not always considered adequately in system life cycle planning, engineering, and budgets.
- Mechanisms for sustainability not always built into the software architecture/design.
- Emphasis on competitive prototyping may negatively impact the consideration of sustainability and life cycle cost issues in system level trades.
- Mandated boundaries in funding, roles, and organizations can make it difficult to get focused attention on sustainment issues.
- Government life cycle cost estimates developed early in materiel concept trades constrain the quality of system baseline sustainment.

Recommendations:

1. Government to promote a product line focus within program offices to bring emphasis to sustainment issues (e.g., training, guidance).
2. Establish a government/industry task group to consider “color of money” issues and the flexibility that does exist to help mitigate the impact on sustainability.
3. Convene a joint government/industry workshop (including user community) to consider software sustainment issues across the program life cycle.

NDIA Top SE Issues – 2010

Results - NDIA Top SE Issues Workshop

March 17-18, 2010

2010 NDIA Top SE Issues

1. **Rapid Fielding: Increasingly urgent demands of the warfighter require effective capabilities be fielded more rapidly than the conventional acquisition processes and development methodologies allow.**

   Issues:

   - Quick response capability may be encumbered by tradition full –up acquisition processes
   - Strong SE capability along with appropriate SMEs is crucial to effective trades, assessment of the impacts of and the acceptance of reasonable risks
   - Rapid response to prioritized needs depends heavily on a tightly integrated and capable team which includes engagement from needed functional stakeholders.
   - Critical success factors for responding rapidly to urgent needs are not well documented or used in decision-making

   Recommendation:

   NDIA SED to convene a joint government/industry study, with cross-functional representation including T&E, to develop risk-driven guidance on tailoring SE processes and activities and DoD acquisition requirements from the Defense Acquisition System to achieve rapid acquisition and deployment.

2010 NDIA Top SE Issues

2. Human Capital: The quantity and quality of SE expertise is insufficient to meet the demands of the government and defense industry.

Issues:

- Experienced, trained SE personnel are in short supply, in industry and government
- Frequent PM/SE turnover and limited OJT/mentoring are impediments to success
- Inconsistent definition of SE roles and responsibilities results in inefficient use
- Interfaces between SE and other disciplines not adequately addressed by inexperienced work force

Recommendations:

1. Develop systems engineering expertise through role definition, selection, training, career incentives, and broadening "systems thinking" into other disciplines.
2. Establish systems engineering job codes or other indicators within government service to emphasize systems engineering in the recruiting of new hires.
3. Establish OSD policy/guidance for services to include SE expertise in RFP/proposal efforts and program start-up teams with reach-back capability.
4. NDIA SED E&T Committee investigate and recommend specific methods for developing SEs and accelerating training, including OJT rotation programs.
5. Provide contract incentives to increase development of SEs on programs.

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3. Effective SE: Systems engineering practices known to be effective are not consistently applied or properly resourced to enable early system definition

Issues:

- Lack of comprehensive SE impedes information available to decision-makers
- SE best practices not consistently followed; competitive pricing can lead to tradeoffs in SE process fundamentals
- SE value not consistently understood; dependencies on SE resources, experience
- Affordability and associated trades are not always performed
- Milestone reviews are often schedule-driven, not event-driven by defined criteria

Recommendations:

1. Establish a working group to develop consistent methods for presenting key SE information to decision makers, such as program managers (PMs) and Milestone Decision Authorities (MDAs).
2. Develop a recommended template for presenting key SE information, including activities, value/expected results, risk of not performing the activities, and future consequences.
3. Make the SE discipline a required process in the transition from S&T to early concept development.

2010 NDIA Top SE Issues

4. Informed decision-making: **Decision makers do not have the right information at the right time to support informed and proactive decision making that ensures effective and efficient program planning, management and execution.**

Issues:

- Many programs lack key leading indicators and measures for predictive insight
- Decisions are often not based on scientific characterizations of effective SE methods, practices, and solutions with a roadmap to address systemic issues
- We need to identify the program-specific information needs and cause and effect factors, measure them, and make sense of the patterns in order to inform in-process decisions.

Recommendations:

1. NDIA create a roadmap that programs can use to facilitate the definition and implementation of a technical measurement process to support engineering management decisions. Coordinate with INCOSE and PSM.
2. NDIA continue a research agenda to investigate causes and effects for program success and characterization of SE methods, practices, and solution approaches. Investigate context factors and how they dynamically interact.
3. NDIA continue to work with other parties to explore & potentially create a data collection and analysis capability in order to develop technical management benchmarks.

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5. SE technical integrity and rework: Lack of technical authority can impact the integrity of developed systems and result in cost/schedule/system performance impacts as the technical solution is iterated and reworked in later stages of the development.

Issues:

- Engineering is often not empowered to do the proper System Engineering the first time.
- System engineering fundamentals and program tradeoffs are not properly implemented in programs.
- In many cases, the technical baseline definition of a system and management of that baseline is not established before field testing.
- Technical reviews are not rigorous, comprehensive disciplined, and do not employ a sound methodology.
- Often there is no senior technical authority (or a specified chain of technical authority) to respond to the issues addressed above when they do get identified.
- Where technical authority is present, technical decision-making capability can be enhanced with the use of independent experts to broaden the technical and domain expertise in the program office.
- In most cases after examining current methods and approaches to implementing technical authority on program, it does not appear that there are sufficient technical authority mechanisms in place on AF, ARMY, NAVY and NASA program current methods. Where these mechanisms may exist, they are not empowered to drive the technical aspects of the program.

2010 NDIA Top SE Issues

5. SE technical integrity and rework (cont.)

Recommendations:

1. Add a requirement to the SEP guidance that the SEP must explicitly identify the technical authority (TA) for the program:
   - the TA role, authority, responsibility, and the performance reporting chain
   - TA conduct and chairing of technical reviews
   - the mechanism for elevating technical issues beyond the program office for resolution.

   Examine whether OSD can establish a policy directing all services to enact a technical authority process to resolve issues at a higher level than the PM.
2. NDIA review and update guidance, as needed, for entry/exit criteria and application for consistent rigor in technical reviews. Consistency will need to be flowed through development contracts.
3. Create a career path for senior technical people with broad experience that leads to seniority and authority equivalent to the PM and PEO. NDIA SE Division discuss with NDIA PM Systems Committee and OSD to determine if there are actions that can be taken through NDIA to support this.

Task Group Participant Organizations

NDIA Top SW Issues:

The Boeing Company
Booz Allen Hamilton
CSC
Harris Corporation
Lockheed Martin
NASA
Northrop Grumman
OUSD (AT&L), DDR&E
Raytheon Company
Rockwell Collins
Software Engineering Institute
Stevens Institute
U.S. Army
U.S. Air Force Office of Scientific Research
U.S. Air Force

NDIA Top SE Issues:

Alion Science & Technology
American Rheinmetall Munitions
The Boeing Company
Booz Allen Hamilton
Harris Corporation
Lockheed Martin
Northrop Grumman
OUSD (AT&L), DDR&E
Raytheon Company
Rockwell Collins
Software Engineering Institute
SynGenics Corporation
U.S. Army – HQ DA – CIA
U.S. Army – RDECOM-ARDEC
U.S. Air Force Office of Scientific Research
U.S. Navy – SPAWAR Systems Center
Vitech Corporation

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http://www.ndia.org/Divisions/Divisions/SystemsEngineering/Pages/Studies.aspx