Revitalization of Systems Engineering: Past, Present and Future

Karen B. Bausman
NDIA 25 October 2005
Air Force Center for Systems Engineering
937-255-3355 ext 3331
DSN 785-3355 ext 3331
Karen.bausman@afit.edu

Overview

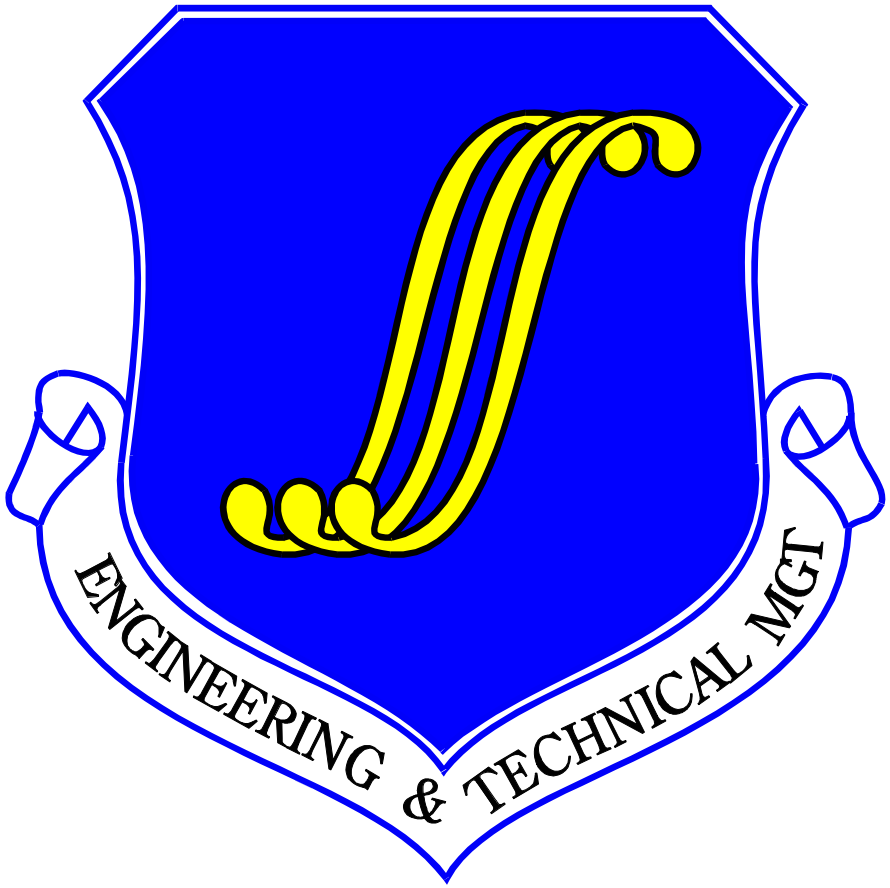
- OSS&E
- Background
- AFMC Revitalization Plan
- SAF SE Activities
- DoD SE Activities
- Current Initiatives and Products
- Conclusions

Why do we care?

"Increasingly, I'm convinced that the systemic problem is in the field of systems engineering."

– Air Force Times, 24 Jun 02

AFMC SE Revitalization Plan



S E Revitalization Plan

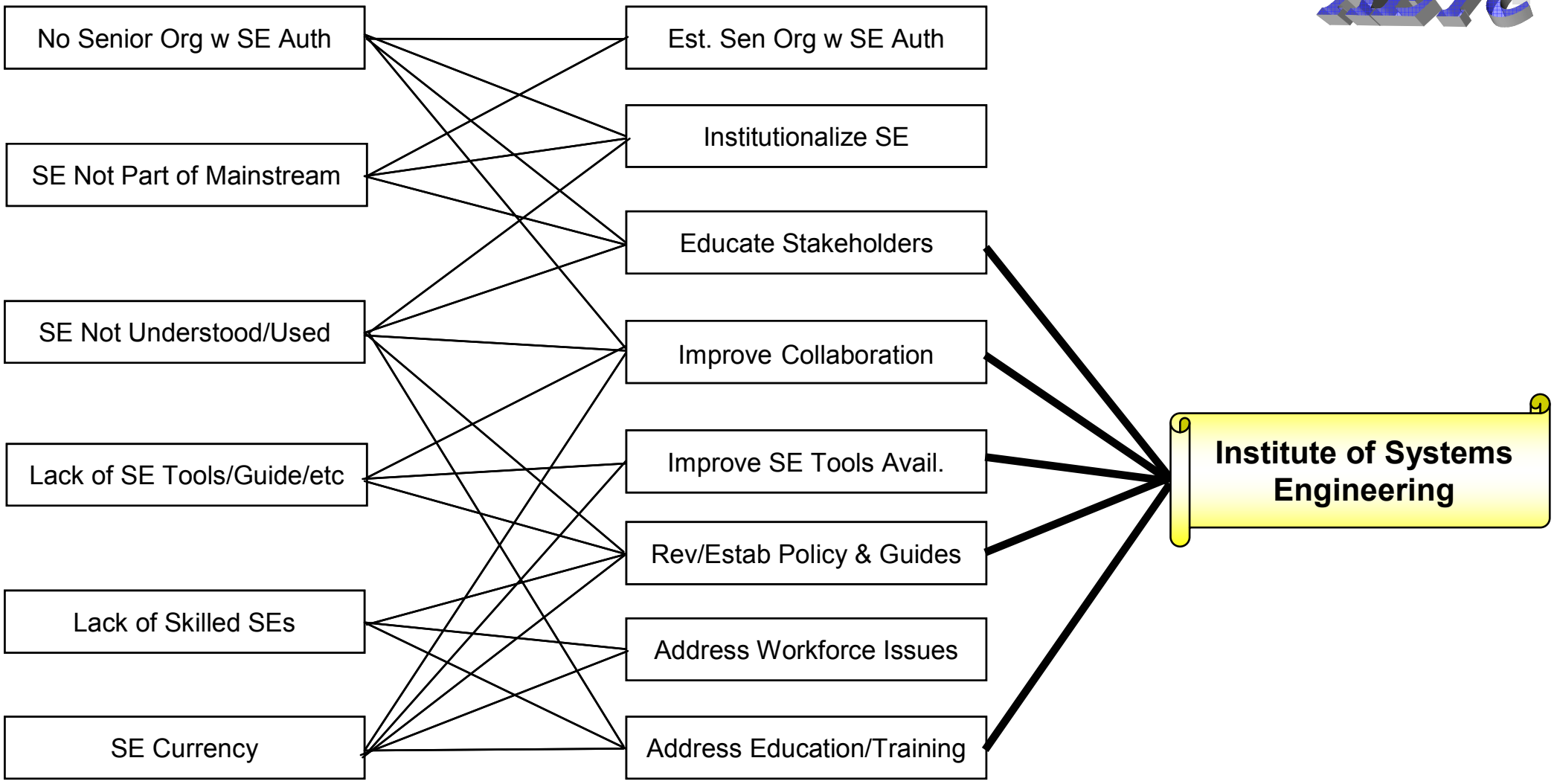
1. Senior Level Champion and Support
2. Evaluating at all existing policies/instructions for currency/connectivity between “Lust to Dust”
3. Developing a USAF guide/pocketbook for Systems Engineering Management
4. Increase interaction with industry to ensure improved implementation on Acquisition and Sustainment Programs
5. Reviewing education/training requirements
6. Developing civilian career path and military field for Systems Engineering Management Professionals*
7. Establishing Institute for Systems Engineering – Later changed to Air Force Center for Systems Engineering (CSE)

* Remember Systems Engineering Management is not just for Engineers

AF SE Focus Forum

- Questions to be addressed:
  - What are the Gaps in existing Systems Engineers knowledge and performance?
  - How should the ISE fill those Gaps?
  - What organizational structure should ISE have (i.e. reporting chain)?
  - How do we know when the ISE is successful?
  - How do we plan for expansion from just AFMC/AFIT ISE to DoD National ISE?
- Invited Participants
  - AFMC/EN, ASC/EN, SMC/AX, WR/ALC
  - MITRE, Aerospace, RAND, Navy, Army
  - AFIT, USC, George Mason
  - Boeing, Raytheon, Northrop Grumman, NDIA, INCOSE

SE Focus Forum Results



Issues

Recommendations

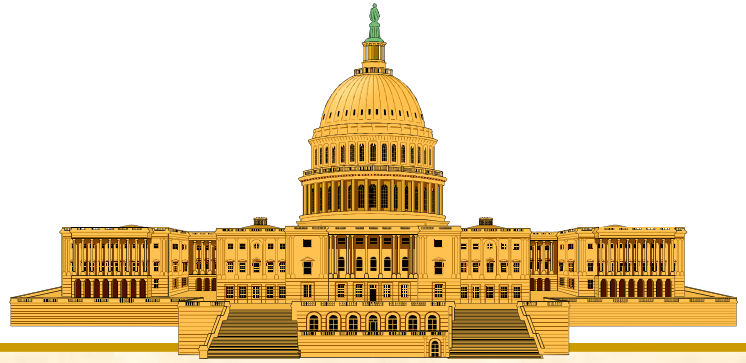
Air Force CSE

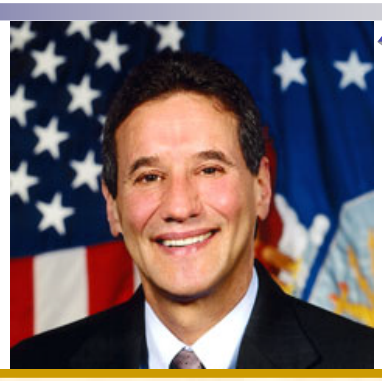
- Purpose:
  - Collaborate the education and training of engineers and managers in basic systems engineering/management processes and principles, best practices, tools, industry standards, lessons learned giving them the right questions to ask
  - Provide consultative services through the establishment of a senior level group of industry, government, and academia experts
  - Advocate and maintain systems engineering/ management process and tools in order to sustain a robust disciplined process into the future

Systems engineering is not learned entirely in the classroom, it is also learned with hands-on experience working on real systems

SAF SE Activities

Congressional Testimony





"We need to instill an adequate systems engineering foundation within the acquisition process. Systems engineering is one of the bedrocks of sound management for acquisition programs as it ensures that contractor-proposed solutions are consistent with sound engineering principles. Decisions based on a solid systems engineering approach will ensure our program managers will be better prepared to assess their programs' health and will help to keep programs on budget and schedule. As such, I am implementing a process by which *all future Milestone Decision Authorities will not sign out any future Acquisition Strategy Plans that lack the necessary attention to systems engineering.* Additionally, I am demanding *systems engineering performance be linked to the contract award fee or incentive fee structures*. This link will help ensure the industry will also follow a sound systems engineering approach."

-- 2 Apr 03

Policy History

Policy Memo 03A-001, 6 Jan 03, "Incentivizing Contractors for Better Systems Engineering"

- Directed action on current programs within 90 days
- Provided direction for future acquisitions
- Provided examples of incentive/award fee plan provisions and SE tools

Policy Memo 03A-003, 15 Jan 03

- Clarified importance of AFMC, AFSPC, ACE and engineering organizations as conduit for expertise

Policy Memo 03A-005, 09 Apr 03

- Consolidated 03A-001 and 03A-003
- Directed action on current programs by 30 Apr 03
- Directed Re-invigorating Basics of Sound SE Disciplines

Policy site: http://www.safaq.hq.af.mil/acq_pol/afpolicies.shtml

Critical Steps for Front Ends

- Risk Assessment to Identify, Classify and Measure all Performance, Cost and Schedule Issues
- Technical Strategies that Evolve from Risk Assessment and are Integrated with Business and Sustainment Strategies
- Develop Program IMP and Share with Bidders
- Evaluation Criteria that Clearly Define Levels of Acceptability for:
  - All Product Performance, Cost and Schedule Issues and Risks
  - All Proposal Performance (Process and Practice) Issues and Risks
  - Contractor Past Performance in Critical Areas and Risk
  - Potential Show Stoppers
- Statement of Objective that Focuses on solid SE Approach
- RFP that overlays an organized structure based on Risk and Strategies
- A Systems Thinking Team that works together to cross the t's, dot the i's, ensures legality and covers bases

SAF SE Focus Areas
People Processes Policy Programs

Good SE Processes

- Structured Requirements Development for Performance and Verification with Feedbacks
- Risk Management Program Integrated with Other Processes
- Baseline Management Flexible enough to Support Program
  - Allocation to Subs and Vendor levels
  - Traceability for Subs and Vendors
  - Control for all Levels
  - Integrated Baseline/Change Reviews that look at performance, cost and schedule
- Process Checklists
- Event Based Schedules with Measurable Completion Criteria

If Its Not Documented It ISN"T Repeatable or Improvable!

How to Measure SE Processes

- Focus on IMP Completion Criteria for Measuring Progress & Maturation
  - Tie to Progress Payments
- Interact with Quality Department (Contractor and Government) to Track Process and Practice Implementation
- Initiate Technical Performance Measures for Critical Technical Parameters
- Co-Chair Contractors CCB
- Participate in Contractors Risk Assessments and Updates
- Participate in Contractors Reviews with Subcontractors and Major Vendors
- Use Measurable Criteria that reflect Systems Engineering
  - Use leading indicators, hold periodic award fee reviews, periodic plan changes, and board meetings as opportunity for appropriate refocus

Remember – We Measure To Improve!!!!!

DoD SE Activities

Top Five S E Issues*

- Lack of awareness of the importance, 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
- Poor initial program formulation
- Requirements definition, development, and management is not applied consistently and effectively

* Based on an NDIA Study in January 2003

DoD S E Shortfalls*

- Root cause of failures on acquisition programs include:
  - Inadequate understanding of requirements
  - Lack of systems engineering discipline, authority, and resources
  - Lack of technical planning and oversight
  - Stovepipe developments with late integration
  - Lack of subject matter expertise at the integration level
  - Availability of systems integration facilities
  - Incomplete, obsolete, or inflexible architectures
  - Low visibility of software risk
  - Technology maturity overestimated

• DoD-directed Studies/Reviews

Major contributors to poor program performance

DoD Revitalization of S E

- Issued systems engineering (SE) policy
- Issued guidance on SE and test and evaluation (T&E)
- Established SE Forum—senior-level focus within DoD
- Instituted system-level assessments in support of OSD major acquisition program oversight role
- Working with Defense Acquisition University to revise SE, T&E, and enabling career fields curricula
- Integrating Developmental T&E with SE policy and assessment functions—focused on effective, early engagement of both
- Leveraging close working relationships with industry and academia

DoD Response Policy

- All programs shall develop a SE Plan (SEP)

- 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

- OSD shall review program's SEP for major acquisition programs (ACAT ID and IAM)

Driving systems engineering back into programs

DoD Response
Guidance and Tools

- Defense Acquisition Guidebook:
  - –SE in DoD Acquisition–SE Processes
  - –SE Implementation in the System Life Cycle
  - –SE Tools and Techniques, and SE Resources
  - –Test & Evaluation

- Systems Engineering Plan:
  - –Interim guidance
  - –Preparation Guide
  - –Twenty-five focus areas to address in technical planning
    - •One each, tailored for Pre-SDD, SDD, and Sustainment

DoD Response
Guidance and Tools

- SE in the Integrated Defense AT&L Life Cycle Management Framework Chart (v5.1)
- Guides (in development):
  - Reliability, Availability, and Maintainability
  - Risk Management
  - Integrated Master Plan/Integrated Master Schedule
  - Contracting for SE
- Tools:
  - Defense Acquisition Program Support
  - Initial Operational T&E (IOT&E) Readiness
  - Capability Maturity Model Integrated Acquisition Module (CMMI-AM)

http://www.acq.osd.mil/ds/se

Current SE Initiatives/Products

- Senior Level Champion and Support
  - SAF/AQR Technical Leaders Roundtable
  - DoD SE Senior Level Forum

- Evaluating at all existing policies/instructions
  - SE AFI 63-XXX In Coordination

- Developing a USAF guide/pocketbook for Systems Engineering Management
  - Defense Acquisition Guide, DoD SEP Guide
  - CSE SE Handbook, CSE SEP Guide

- Increase interaction with industry to ensure improved implementation on Acquisition and Sustainment Programs

  - NDIA, INCOSE, GEIA, AIAA, AIA, IEEE, et al

Current SE Initiatives/Products

- Reviewing education/training requirements
  - Revamped SE Masters Program at AFIT
  - Created SE Certificate Program at AFIT
  - Established SE PhD Program at AFIT
  - Established Distance Learning Methods at AFIT
  - Established Academic Agreements through Outreach

- Developing civilian career path and military field for Systems Engineering Management Professionals*
  - AFMC Established Engineering Focal Points and Home offices at each Center
  - AFMC Defining SE Core Competancies

- Establishing Institute for Systems Engineering – Later changed to Air Force Center for Systems Engineering (CSE)

Current SE Initiatives/Products

- Influence and institutionalize systems engineering process
  - Policy, process, practices, tools
    - Collaboration with government, industry & academia
  - Advocacy / consultation
  - Rotational program

App/Dev

- Educate the workforce
  - Academic programs
    - Graduate programs – MS, PhD & certificate
    - Intermediate Developmental Education Program
    - Seminars, workshops, short courses
    - Outreach--provide accessibility at key locations
  - Case studies

Education

Critical Behaviors

- Systems Thinking
  - All Functionals Learn Technical Basics of System
  - All Functionals Participate in Risk Assessments
  - All Functionals Bring Their Strategies to Table to Develop Overall Program Acquisition Strategy
- Integrating the Total System
  - Institute a Flexible Baseline Management System for Government Documentation Prior to Contract Award
    - Risk Assessment and Measures, Functional Strategies, SAMP, ASP, RFP, SSP
  - All Functionals Identify and Share Information That Impacts Change to Program Baselines
- Discipline, Discipline, Discipline…
  - Ensure Flexible Baseline Management System Proposed for Systems/Subsystems/Major Vendor Levels and IS IMPLEMENTED

Attitude Is Everything!!!!

Conclusions

- Making Progress with Current Innovations and Products
- ALL ORGANIZATIONS Need to Work Closer Together
- Need Serious Involvement with Sustaining Organizations
- Need to Establish Measurement Guides for Effectiveness
- Would Like to Engage Industry
  - Presence at CSE
  - Help in Defining “Better Way to do Business”