Systems Engineering: MITRE & SERC

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"The SERC-MITRE Doctoral Fellows Program collaboration presents the unique opportunity to transition systems engineering research into practical systems engineering application for government programs of critical national importance."

MITRE

Our History

MITRE is a private, independent, not-for-profit organization, chartered to work in the public interest

Founded in 1958 to provide engineering and technical services to the U.S. Air Force

Supports a broad and diverse set of sponsors within the U.S. government, as well as internationally

Currently manages Federally Funded Research and Development Centers for the:

- Department of Defense
- Federal Aviation Administration
- Internal Revenue Service/ Department of Veterans Affairs
- Department of Homeland Security
- Administrative Office of the U.S. Courts
- Department of Health and Human Services

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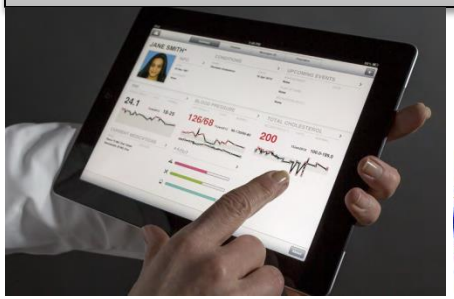
SE: A Core Need Across Our Sponsors

Secure Health Data Sharing

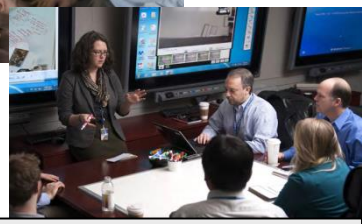


GPS Modernization

Runway Incursion Reduction

Enterprise IT Modernization

Systems Engineering



Taxpayer Web Tools

Biometric Identity Management

VA Operations Center

Challenges in Systems Engineering for a Complex Future

TRENDS

Global/Virtual Workforce and Collaboration
- Performance metrics and cost/benefit rationale… Makes efficient use of resources
- Technology development and assessment (focus on Virtual Collaboration, Mobile Workforce, and Social Media)
- Virtual/Mobile Business Process Definition (How do we do business in a virtual/mobile environment)
- Early incorporation of business needs and end users in definition

System of Systems (SoS) Engineering
- Ecosystem complexity (Increasing system complexity, scale, and dynamism)
- Cross agency integration
- Interoperability with government and non-governmental entities
- Systems Assurance

Open Source Software Migrations (bi-directional)
- Collaborative solution
- Redistribution of code
- Mash-ups
- Integration across applications and into legacy environments

More Frequent Use of Rapid/Agile/Iterative Methodologies
- Tailored approach to business needs and operational constraints
- Faster delivery and integration of usable products
- Rapid technology advancement

Decision Analytics and Solution Modeling
- Model based system engineering
- Business rules
- Data Discovery
- Risk analysis and management

Renewed Focus on Quality Management
- Fewer, more effective quality metrics/measures
- Metrics-driven governance and decision support
- Lifecycle tailoring to focus resources on quality drivers

DRIVERS

Political: Transparency, Effective Governance and Accountability, Address Security Risks.

Operational: Ecosystem Complexity and Diverse Integration, Increased Involvement from Diverse Stakeholders, Input and Sharing with General Public. Improve Efficiency and Effectiveness. Lack of Process Definition to Define Change and New Behaviors

Economic: Financial Instability, Global Perspective Needed, Global Financial Market Impacts, Focus on Budget Reductions and Cost Reduction (Do more with less), Siloed Budget Allocations

Technology: Ubiquitous Computing changing/expanding the way we relate and work, Rapid and Agile Response, Architectures moving toward XaaS (Cloud, Virtualization, Capacity on Demand), larger amounts of data (Big Data) accessible and available for analysis and decision making.

Need to change the way we work, who we work with, where we work, and how we collaborate

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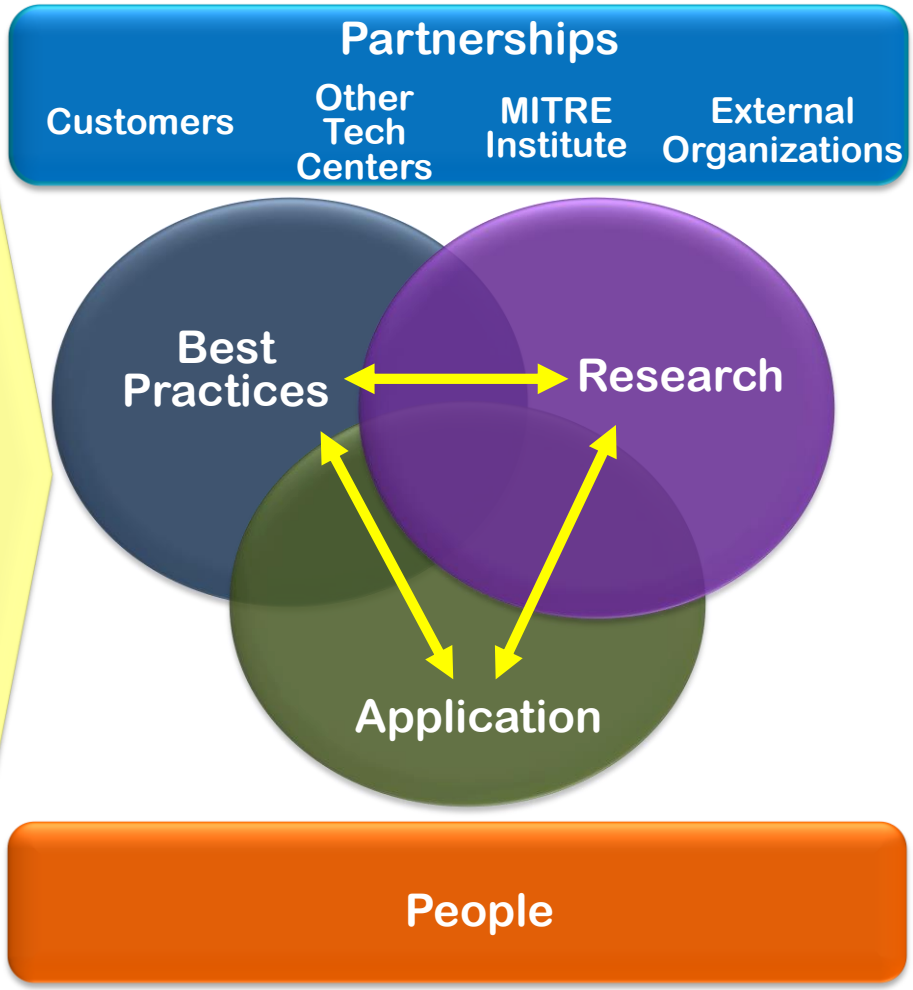
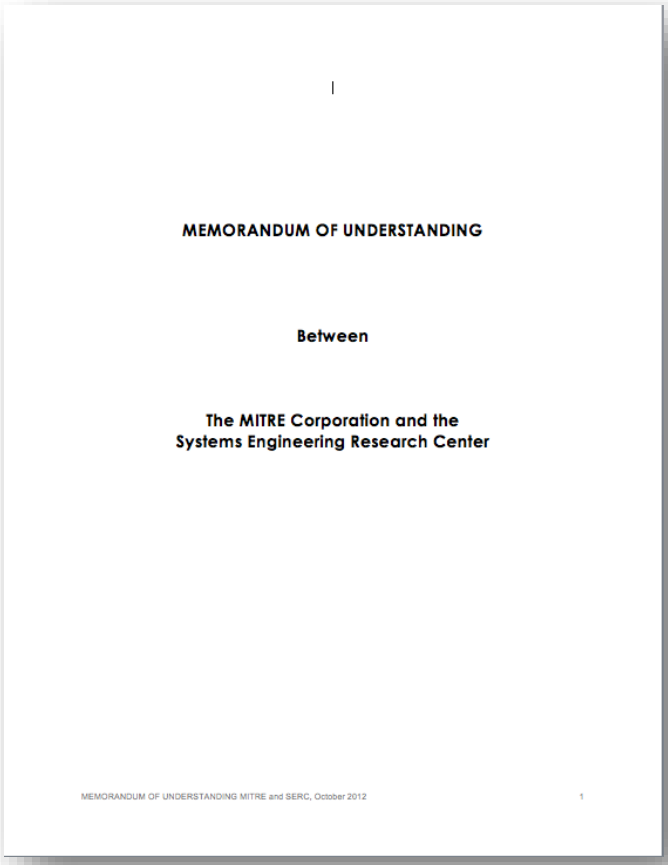
Systems Engineering Technical Center

Core Competencies

- **Requirements**
- **Design & Engineering**
- **Quality**
- **System Assurance**
- **Systems of Systems**
- **Model Based SE**
- **Agile SE**



SERC - MITRE Collaboration



MEMORANDUM OF UNDERSTANDING

Between

The MITRE Corporation and the
Systems Engineering Research Center

MEMORANDUM OF UNDERSTANDING MITRE and SERC, October 2012 1

Share information and work on tasks that support our sponsors' missions:

- Independently conduct collaborative research
- Apply and/or test the other's research
- Conduct joint collaborative research
- Participate in the SERC Doctoral Fellows Program

Collaboratively enhance the practice of systems engineering through rigorous and relevant research for a transformational impact on the Department of Defense (DoD) and other parts of the US government.

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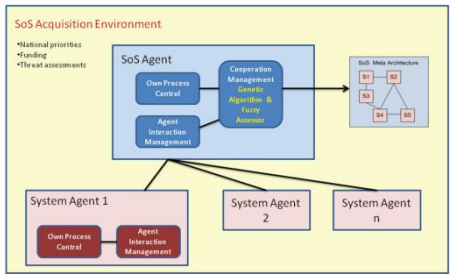
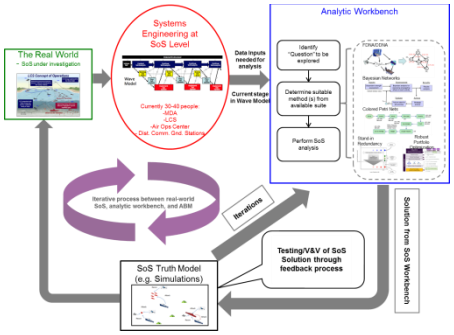
MITRE - SERC Engagements





- **Missouri S&T SoS Research**
  - "Computational Intelligence Approach to System of Systems Architecting and Analysis"
  - MITRE provided SME support on SoS SE Implementers' View
- **Purdue SoS Research**
  - "SoS Analytic Workbench"
  - MITRE engaged Purdue team on utility of toolsets in applying security systems engineering to SoS
- **University of Virginia**
  - Cyber Security
  - MITRE provided operational perspective on security CONOPS employing new capabilities provided by the research
- **Stevens**
  - "Helix"
  - Providing MITRE input to the data collection on systems engineers

Hosted MITRE-SERC exchanges on research priorities and initiatives

MITRE

SERC Doctoral Program at MITRE

- **Recent work provided:**
  - Valuable insights for Complex Systems Engineering and Architecture
  - Informed ongoing Army Command Post architecture development (Acquisition)
  - Exemplar of future SERC Doctoral Fellows program interactions
- **SERC MITRE Doctoral Fellow**
  - MITRE Advanced Graduate Degree Program provides 20% time off to pursue individual research, a SERC Doctoral Fellow requirement
  - MITRE provides doctoral advisor, who helps shape topic selection (and access to data) for areas of critical national importance
  - SERC provides doctoral advisor, who helps shape research execution including engaging advisors from across SERC universities and sponsors.

MITRE

Exemplar Products – Command and Control Case Study - Operation Iraqi Freedom

- Identified major implications for architecting and adapting Command and Control (C2) systems
- Researched C2 Architectures, Doctrinal Publications, Field Manuals, After Action Reports and Journal Publications over a 10 year case period:
  - Millennium Challenge era,
  - Initial Combat Operations,
  - Stability, and
  - Support Operations.

1999-2002	Major Implications	Data Elements
Operational Expectation	• Training operations focusing on major and offensive and defensive operations, Army Operations Manual revised in 2001 with increased emphasis on Joint operations with Traditional Military Partners.	• Army Operations Field Manual (FM) FM 100-5, 1993, FM 3-0, 2001; • Counterguerilla Operations,
Business Organization	•	
Technical Organization	•	
Exercise Feedback	Sha •	

2003-2004	Major Implications	Data Elements
Operational Expectation	Combat operations initially successful with: • New levels of information availability • 'Widespread situational awareness and understanding' • Greater synchronization of the joint force. Transitioning from Combined Arms Maneuver to Wide Area Security: •	• 3rd Infantry Division After Action Report 2003-2004, • V Corps After Action Report 2003-2004; • Army Universal Task List FM 7-15, 2003;
Business Organization	•	
Technical Organization	•	
Mission Feedback	Sys ope •	

2005 - 2009	Major Implications	Data Elements
Operational Expectation	• Security of operational environment - Urban Operations FM is refined and describes characteristics and effects of urban environment and population centers • Neutralization of insurgent tactics – Counterinsurgency (COIN) FM is refined providing general approach to COIN, emphasizing logical lines of operation and local context •	• Urban Operations FM 3-06, 2006 • Counter Insurgency Operations, 2006; • Army Operations Field
Business Organization	•	
Technical Organization	•	
Mission Feedback	•	

2005 - 2009	Major Implications	Data Elements
Operational Expectation	• Stability of operational environment - Stability Operations Field Manual is refined - explaining a roadmap from conflict to peace; defines military role in support of civilian agencies charged with leading complex endeavors for stability operations; • Counter Insurgency Operations FM is rewritten emphasizing strengthening local support of national government and Iraqi self-sufficiency. • Stability and Support Operations Tasks description increases in Army Universal Task List Field Manual - emphasizing on support of economic, infrastructure and governance development • Combined operations with Iraqi forces consist of numerous decentralized patrols focusing on security and building Iraqi force capability. • Operational focus shifts to multiple decentralized but unified stability and support operations with increased emphasis operations with non-governmental and National military partners.	• Army Stability Operations Field Manual FM 3-07, 2008; • Counter Insurgency Operations, 2006; • Army Universal Task List FM 7-15, 2009; • Army Operations Field Manual (FM) FM 3-0, 2008; • After Action Reports 2003-2009; • Operational Needs Statements 2003-2009;
Business Organization	• Span of Control – Five to 15 element span of control including non US subordinate elements • Operational Connectivity – Forward Operating Bases (FOB) established to provide physical security and augment logistics and life-support capabilities for the integration of US, non-governmental and other National military partner organizations	• Select After Action Reports, 2003-2009; • Select Operational Needs Statements, 2003-2009;
Technical Organization	• Forward Operating Base (FOB) infrastructure improved with commercial power generation as well as and increased bandwidth and low latency transmission systems for internal and external FOB networks. FOBs become interconnected across the Iraq establishing a backbone network for collaboration. • FOB becomes primary conduit for supporting Digital command posts. (CP) fielded to Division, Brigade, Battalion and Company echelons. •Command Post consists primarily of commercial computers with productivity and collaboration software, Army Battle Command Systems (ABCS) and IP telephones. •Specialized computer software developed for significant activity reporting and analysis at Battalion and above echelons (Combined Information Network Data Exchange). • Units modify command post and command and control architecture to include other unanticipated mission partners and specialty systems. • Vehicle platform stock modified to provide collaboration, mobile command and control capability and employ satellite based digital connectivity for mobile leaders and staff.	Architecture artifacts from: • Army Battle Command System 6.4, SWB2, CS 11-12, 2003-2009; • Army FM 7-06 Tactics, Techniques, and Procedures (TTPs) for the Joint Network Node - Network (JNN-N) SEP 2006. • Select After Action Reports 2003-2009; • Select Operational Needs Statements 2003-2009; • CIDNE reference. References: • (Cogan and Raymond 2006; Moelter 2008; Feickert 2009), (Feickert 2009), (Johnson 2005; Cogan and Raymond 2006). (Johnson 2005; Moelter 2008). (Moelter 2008; Commanders 2009)
Mission Feedback	• Shift of system focus to developing and sharing understanding cultural and human nuances over long periods of time and unit rotations. • Counter Insurgency operations focus on small patrols and integrated intelligence products to eliminate threats in order to provide secure environment for stability operations. Commanders adapt C2SoS to facilitate working directly with Iraqi and non-governmental partners out of the FOB with the local populace. • Operational environment requires large number of subordinate units to integrate with Iraqi and other mission partners to develop trust and organic capability. Cultural awareness information remains a critical component to successful operations.	• Operation Iraqi Freedom/Operation New Dawn, 2003-2009; • Operation Enduring Freedom, 2001-2009; • Select After Action Reports 2004-2009; • Select Operational Needs Statements 2004-2009;

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