Driving Engineering Productivity: Engineered Resilient Systems (ERS)

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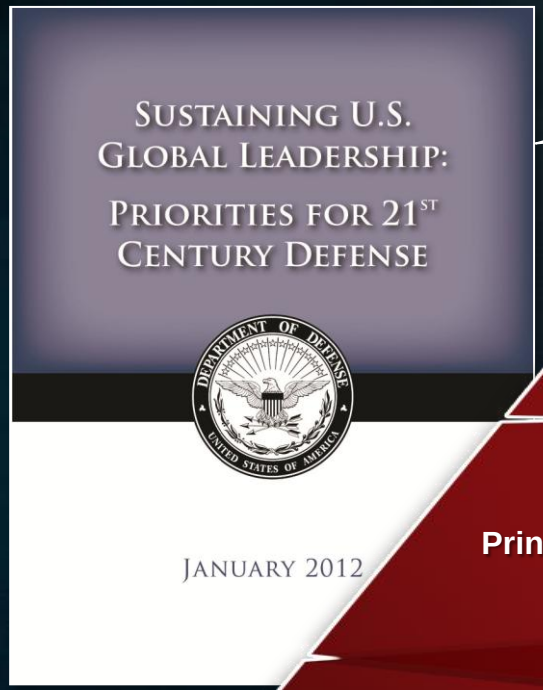
DoD Engineering Enterprise

- ***World's Largest Engineering Organization***
- ***Over 100,000 Uniformed and Civilian Engineers***
- ***Over 39,000 Acquisition Corps Certified Systems Engineers (SPRDE)***

ERS: Foundational for Defense Systems across All Mission Areas



"This country is at a strategic turning point after a decade of war."
- Secretary of Defense Panetta

Require affordable, adaptable & effective systems and Concepts of Operation

Critical Mission Set

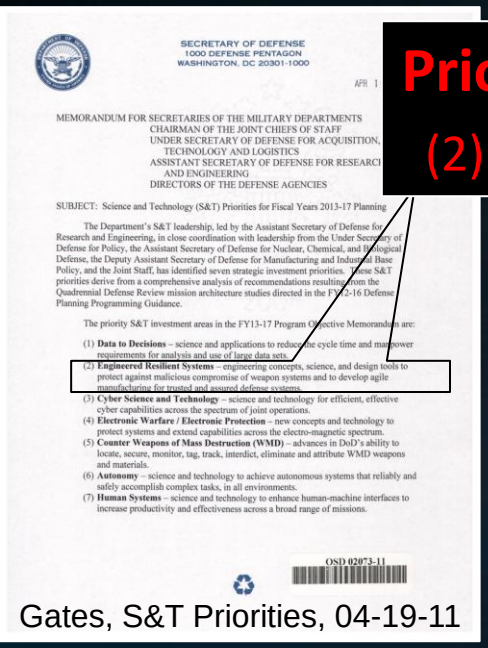
Strategic Principles to Ensure Mission Success

- **Offer versatility**
- **Enable course changes**
- **Reduce costs**
- **Develop new capabilities leveraging network warfare**

Engineered Resilient Systems

Agile and cost-effective design, development, testing, manufacturing, and fielding of trusted, assured, easily-modified systems

Rethinking the Role of Systems Engineering



SECRETARY OF DEFENSE
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WASHINGTON, DC 20301-1000

APR 1

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDER SECRETARY OF DEFENSE FOR ACQUISITION, TECHNOLOGY AND LOGISTICS
ASSISTANT SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING
DIRECTORS OF THE DEFENSE AGENCIES

SUBJECT: Science and Technology (S&T) Priorities for Fiscal Years 2013-17 Planning

The Department's S&T leadership, led by the Assistant Secretary of Defense for Research and Engineering, in close coordination with leadership from the Under Secretary of Defense for Policy, the Assistant Secretary of Defense for Nuclear, Chemical, and Biological Defense, the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy, and the Joint Staff, has identified seven strategic investment priorities. These S&T priorities derive from a comprehensive analysis of recommendations resulting from the Quadrennial Defense Review mission architecture studies directed in the FY12-16 Defense Planning Programming Guidance.

The priority S&T investment areas in the FY13-17 Program Objective Memorandum are:

(1) **Data to Decisions** – science and applications to reduce the cycle time and manpower requirements for analysis and use of large data sets.
(2) **Engineered Resilient Systems** – engineering concepts, science, and design tools to protect against malicious compromise of weapon systems and to develop agile manufacturing for trusted and assured defense systems.
(3) **Cyber Science and Technology** – science and technology for efficient, effective cyber capabilities across the spectrum of joint operations.
(4) **Electronic Warfare / Electronic Protection** – new concepts and technology to protect systems and extend capabilities across the electro-magnetic spectrum.
(5) **Counter Weapons of Mass Destruction (WMD)** – advances in DoD's ability to locate, secure, monitor, tag, track, interdict, eliminate and attribute WMD weapons and materials.
(6) **Autonomy** – science and technology to achieve autonomous systems that reliably and safely accomplish complex tasks, in all environments.
(7) **Human Systems** – science and technology to enhance human-machine interfaces to increase productivity and effectiveness across a broad range of missions.

OSD 02073-11

Gates, S&T Priorities, 04-19-11

Priority S&T Investment Areas:

(2) Engineered Resilient Systems (ERS)

- **Engineered Resilient Systems has the potential to significantly improve *engineering productivity* and, consequently, *system affordability***

There is currently insufficient support for engineering tools and services essential to making critical decisions affecting system cost, schedule, capabilities, and adaptability

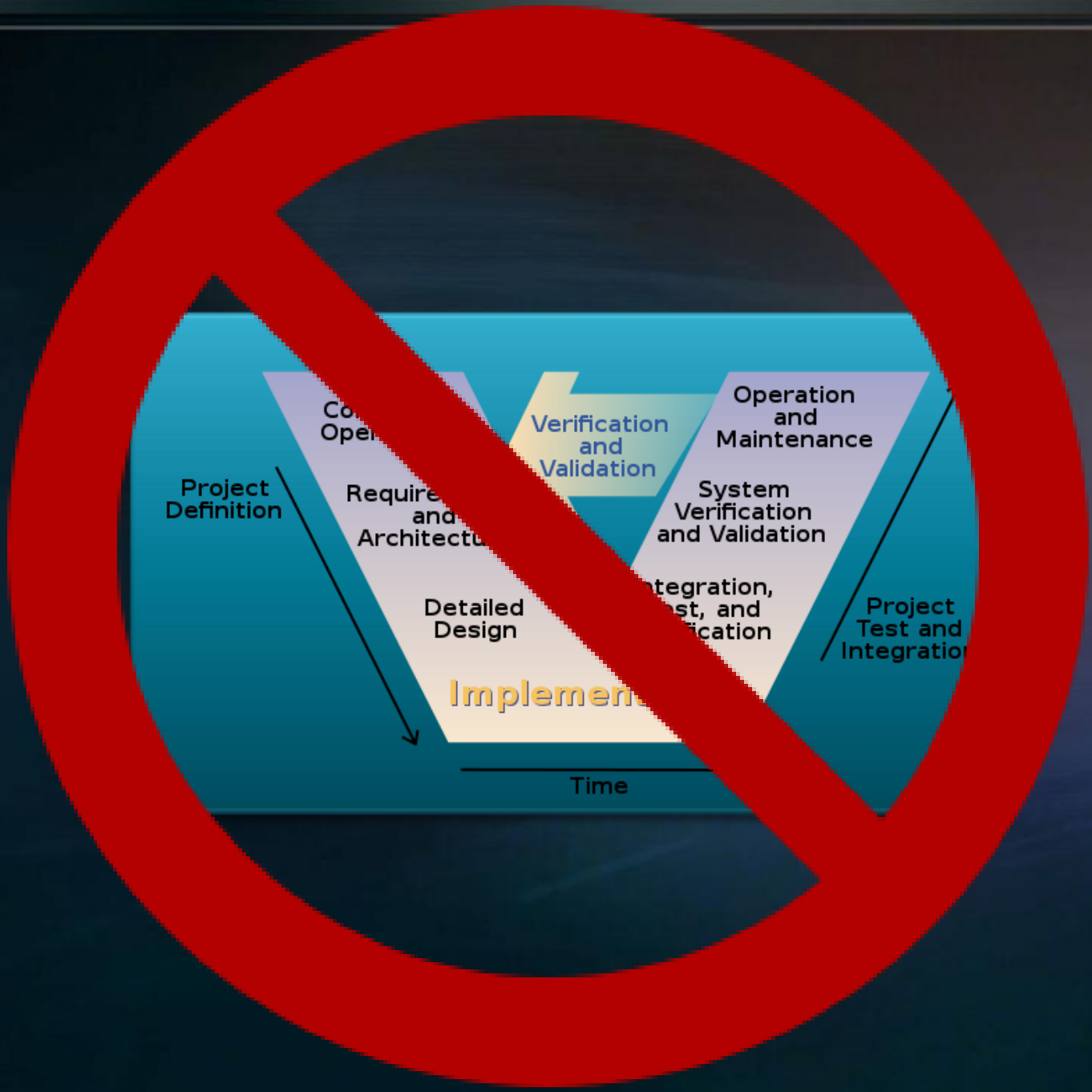
System Engineering in the 21st Century

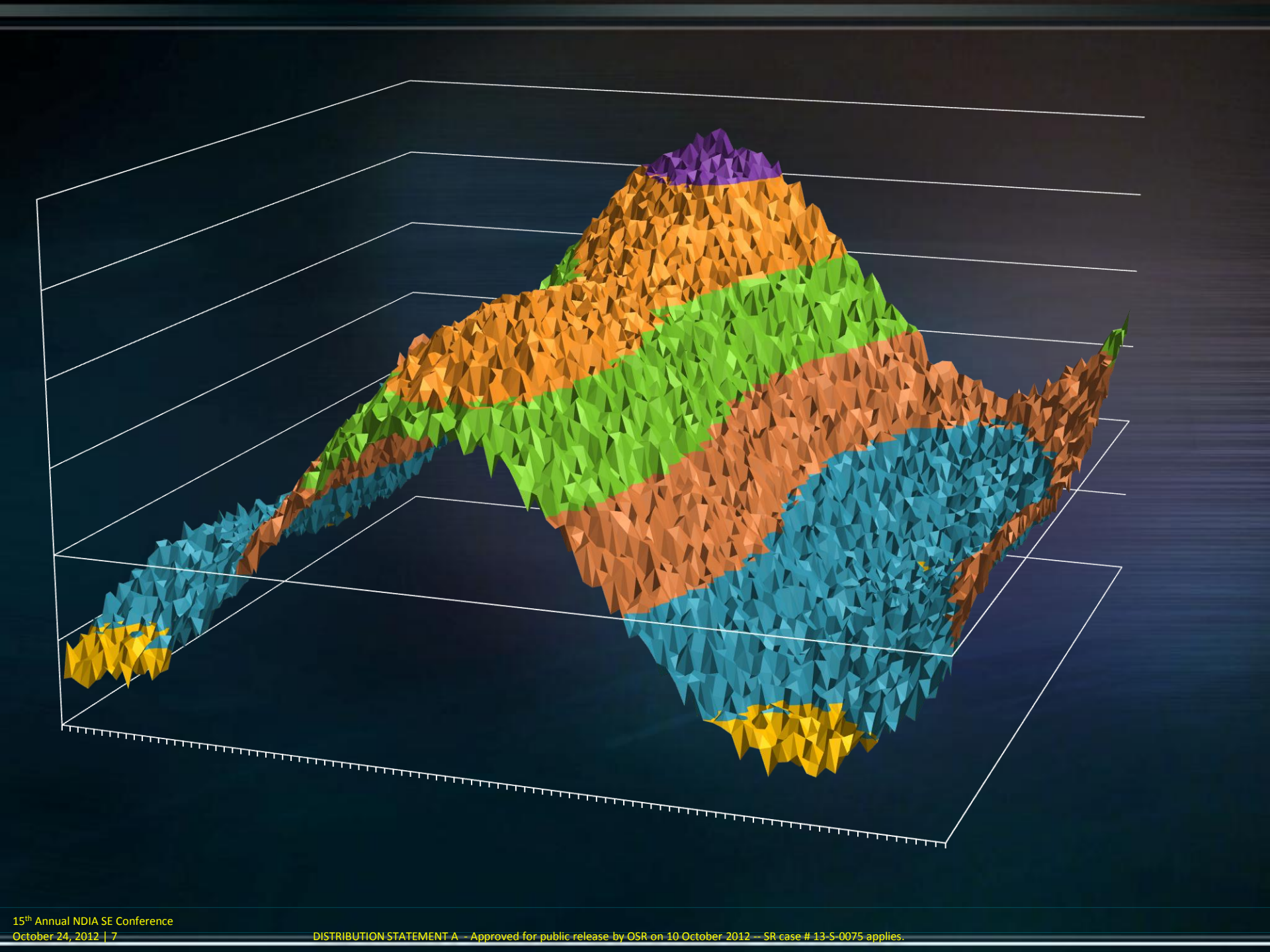
Increasingly Multidisciplinary

Design Focused

Trade Spaces vs. Explicit Valued Requirements

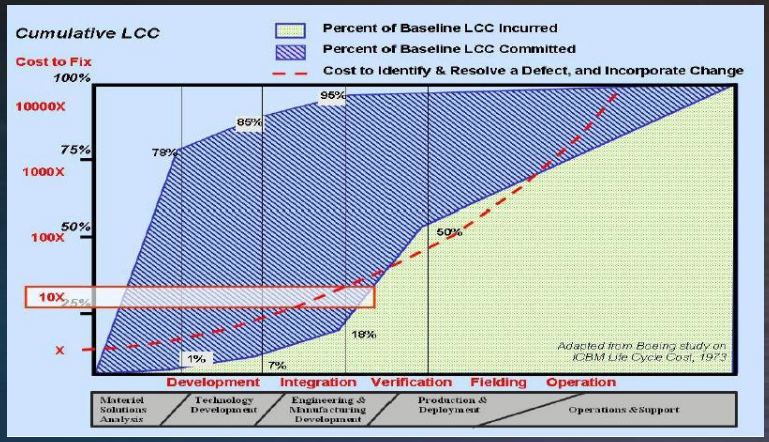
Rapidly shifting threats render current engineering and development approaches unsustainable in both cost and time



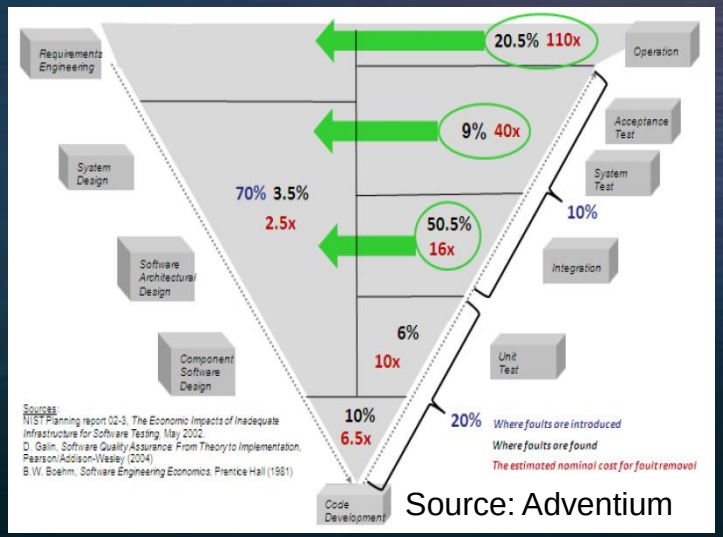


Need Engineering Productivity Upfront

- ERS S&T Gap Analysis: *critical need to insert engineering rigor into early design processes*
- Hardware's hard, software's harder – today's systems use both
- Systems-level engineering challenges
  - Interdisciplinary interactions across components / subsystems
  - Interactions resulting from physics but not via design
  - Emergent behavior
  - Dynamics



Source: SAF/AQ & AFIT



Source: Adventium

Need to Invest in Decision Tools to Ensure Early On that We're Building the Right Thing: Affordable, Adaptable, Effective

ERS at this Conference

Wed, 8:00 – 9:45 **Engineering in the Current Strategic Context**	**Stephen P. Welby** Driving Engineering Productivity (14768)	**Edward M. Kraft, PhD** How to Use Engineering Resilient Systems Technologies to Improve Defense Acquisition Processes (14697)	**Garth Jensen** Human Systems S&T: Benchmark benefits to system designers considering complex trade spaces (14935)
Wed, 10:15 – 12:00 **Modeling and Cross Domain Coupling of Systems, Environments, and Operational Contexts**	**Al Sanders, PhD** Hidden Cost of Potential ROI of Developing Advanced Manufacturing M&S Capabilities (14902)	**Scott Morton, PhD** Engineering Resilient Systems Through the Use of Kestrel (14799)	**Robert Wallace, PhD** **Lynn Ewart, PhD** Physics-based Modeling in Virtual Environments to Improve Combat Operations (14842)
Wed, 1:30 – 2:00 **Trade Space Exploration / Analysis of Alternatives**	**Elias Rigas and Eric Spero, PhD, ARL** Systems Tradespace Analysis: Assessment of Current Capabilities and Future Directions (14855)	**Adrian MacKenna, NAV** Implementation of Design Space Exploration and Optimization for Early Stage Ship Design (14776)	**Mike Bosworth** Early stage systems engineering with uncertain requirements (14752)
Wed 3:30 – 5:00 **Panel (Robert Hummel, PhD): Making ERS Possible: Current Commercial Tools and Techniques (14767)**			
Thursday, 8:00 – 9:45 **ERS Approaches to Managing Risk and Uncertainty**	**Andrew Long** Design of Resilient U.S. Space Architectures (14833)	**Loren Miller** Case Study in the Development and Implementation of Platform-based and Model-based Engineering (14652)	**Troy A Peterson** Platform Evolution - Extending System Lifecycles Under Uncertainty (14921)
Thurs, 10:15 – 12:00 **ERS: Opportunities for the Future**	**Marc Halpern, PhD** Gartner Analysis of engineering markets (14848)	**Robert Neches, PhD** Engineered Resilient Systems: Insights and Achievements within the ERS SecDef S&T Priority (14773)	**Jeffery Holland, PhD** Engineered Resilient Systems: The Integration of Design, Engineering and Tradespace Analysis (14937)

Engineering of Resilient Systems is Pervasive

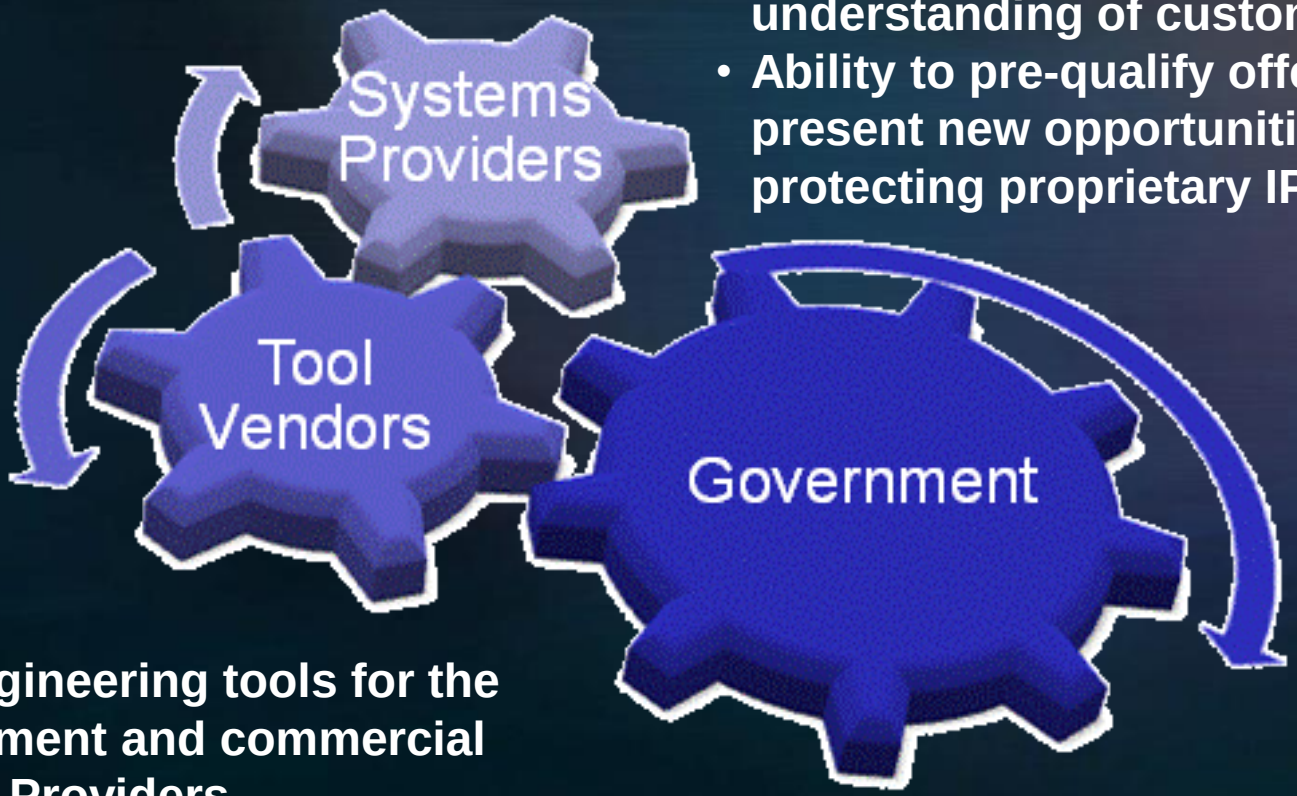
A Sampler of Other Presentations Relevant to ERS

- The Acquisition Community Modeling and Simulation Strategy (AMSS) to Support Department of Defense Acquisition: Model-Based Systems Acquisition
- Evaluating and Improving Operational Test Effectiveness Using Statistical Test Optimization
- A Value-Based Orthogonal Framework for Improving Life Cycle Affordability
- Integrating Requirements to Analyze Capability Gaps and Redundancies Across the Army's System of Systems (SoS)
- Model Based Engineering for Embedded Test Software Requirements Development
- Education in Complex Systems for Systems Engineers
- Weapon System Design Trade Offs
- Leveraging Systems Engineering's Broader Definition to Establish Program Integration
- Integrating System Models Around Decisions
- Building a Business Case for Systems Engineering - the results of the 2012 SE Effectiveness Study
- Insights on the Implementation of Development Planning

Where This is Going

A Better Way of Working Together

- **Risk mitigation through better understanding of customer**
- **Ability to pre-qualify offerings, present new opportunities, while protecting proprietary IP**



- **New engineering tools for the Government and commercial System Providers**

- **Better specifier of needs**
- **Better evaluator of offerings**

Thank You