Engineered Resilient Systems

NDIA Systems Engineering Conference
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Engineered Resilient Systems SecDef S&T Priority

"We need to continually move forward with designing an acquisition system that responds more efficiently, effectively, and quickly to the needs of troops and commanders in the field."

Secretary of Defense Chuck Hagel
3 April 2013

ERS

Engineered Resilient Systems

2010-2011
Theoretical Foundations

2012-2013
Demonstrated Proof of Concept

2014
Architecture, Tools & Infrastructure Development

2015
ERS V.1 Release

What is a "Resilient" System?

A Resilient System…

- *is reliable and effective in a wide range of contexts,*
- *is easily adapted to many others through reconfiguration or replacement, and*
- *has predictable degradation of function.*

C-130 Hercules

AC-130A
Drone Control

EC-130E
Airborne battlefield command and control & electronic warfare

HC-130H
Maritime and Ice Patrol

C 130 Rapid Deployment
Food & water drop to Iraq Yazidi fleeing ISIS

JC-130
Mid-air Retrieval

21st Century Acquisition Challenges

Affordability

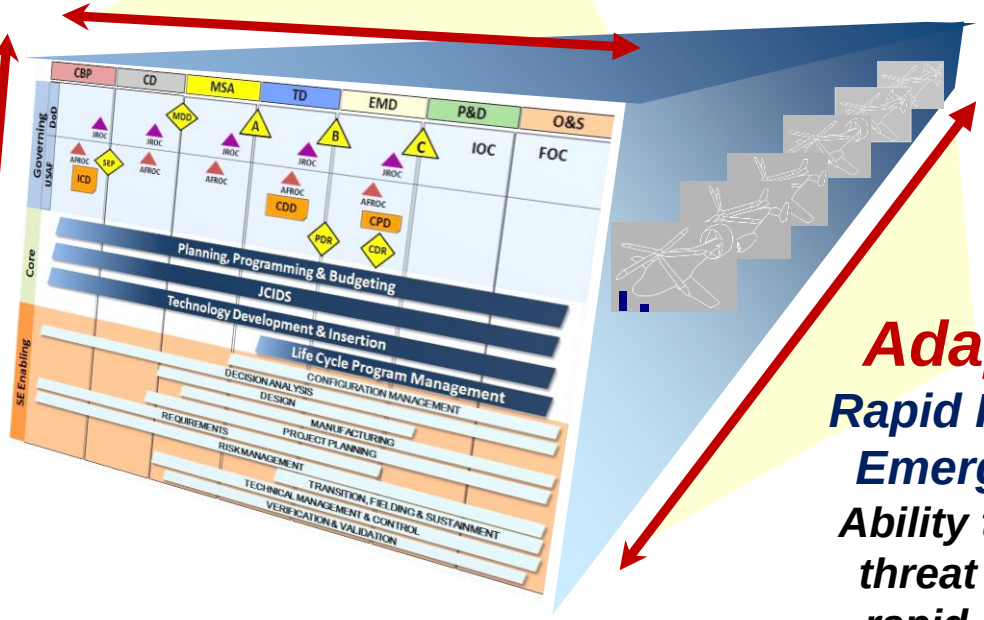
Highest Value to the Department

Time and Cost commensurate with the Department's Mission and Goals

Risk Mitigation

Confidence in Engineering & Design Decisions

Managing knowledge and decision-making across communities and functions



Adaptability

Rapid Response to Emerging Threat

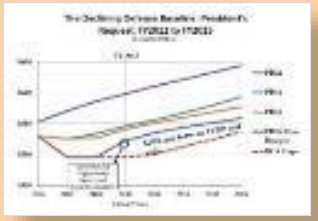
Ability to respond to threat as needed – rapid prototyping, upgrades, reconfiguration…

ERS Goal: Quantify and Buy Down Acquisition Risk

Ongoing Problems

- *Increasing Costs*
- *Rate of change and uncertainty*

COMPLEXITY



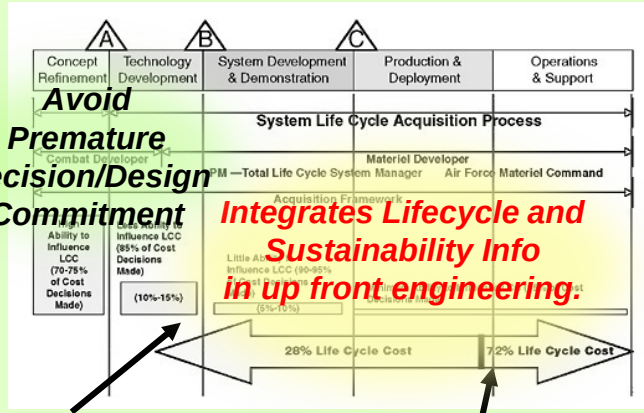
BUDGET CONSTRAINTS

- *Rapid, emergent threat*
- *Requirements creep*
- *Adaptability deficiency*
- *Life extension demand*
- *Technology disruptors*
- *Workforce decline/expertise*

ERS – Innovative Approach

Empower rigorous risk analysis

- *Requirements Generation*
- *Analysis of Alternatives*
- *Lifecycle Intelligence*
- *Virtual Prototyping*



Avoid Premature Decision/Design Commitment

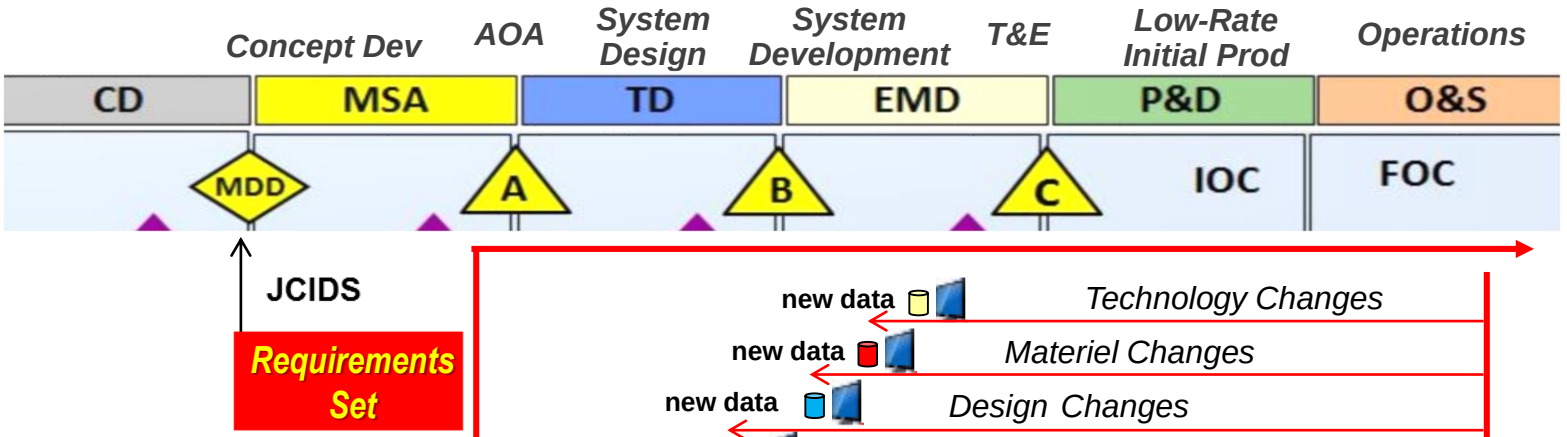
Integrates Lifecycle and Sustainability Info in up front engineering.

Mitigate Issue:
28% Life Cycle Cost vs. 72% Life Cycle Cost
National Academies Press (NAP) 2008

ERS: Inserts new S&T into the Acquisition Environment

Acquisition Quagmire:
Reliance on Process-driven Engineering

Operational		***EVOLVING THREAT***		***MISSION CHANGE***		
Engineering & Cost	**FIXED 75% Lifecycle Costs Material Solution**	**TECHNOLOGY DISRUPTION**	**UNSTABLE PERFORMANCE**	**COST & SCHEDULE OVERRUN**	**LIMITED EFFECTIVENESS**	

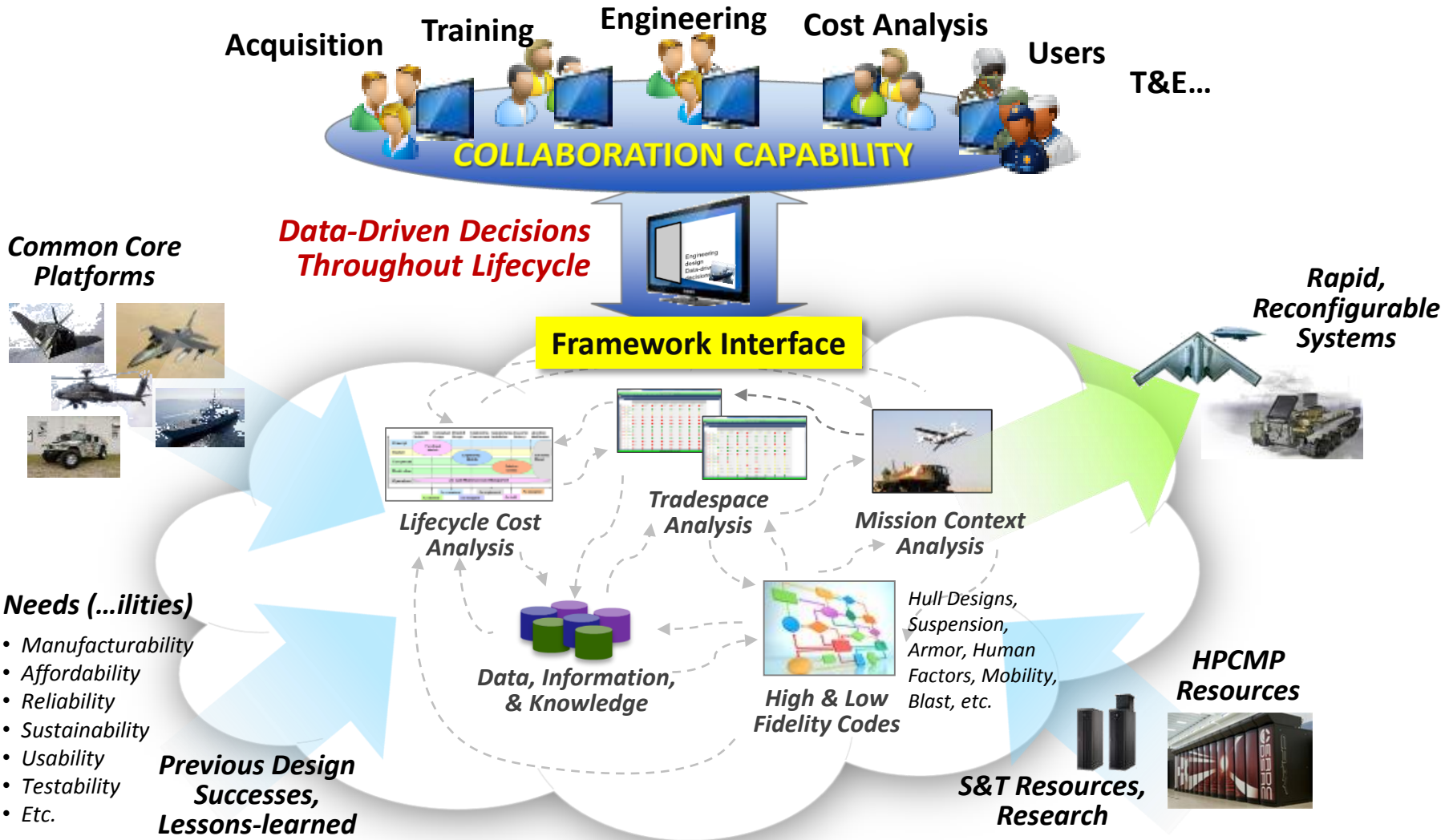


Increased cost in

- ***Responsiveness***
- ***Time & delivery***
- ***Budget***
- ***…etc.***

- ***Linear acquisition process***
- ***Lacks adaptability to changes***
- ***Stove-piped workforce and data sources***
- ***Information shared via static documents***
- ***Limited Reuse***

ERS Transformation:
Enables Data-driven Engineering & Decisions



ERS Framework Concept

Needs/Requirements

Army
Tools, Information & Infrastructure

Air Force
Tools, Information & Infrastructure

Navy
Tools, Information, & Infrastructure

Framework Standards

Pre-Milestone A Systems Engineering

ERS Framework

Open Architecture
Common Environment
Shared Capabilities
Enables Collaboration

Acquisition

Framework Interface

- Acquisition Program
- Acquisition Program
- Acquisition Program

Acquisition teams leverage ERS capabilities throughout the systems lifecycle

Requirements ***Budget***
Mission
Evaluation ***Decisions***

KNOWLEDGE HUB
RAPID PROTOTYPING
SECURITY
IP PROTECTION

Innovation ***Tools***
Materials
Concepts ***Manufacturing***

Facilitates interactions among government, industry, academic communities and functions

ERS Building Blocks
Current Investment Areas

Mission-Relevant Tradespace Analysis

- Cross-domain tradespace analytics
- Cost/lifecycle analysis
- Integration of producibility, sustainability, other "-ilities"

Collaborative Analysis and Decision-Making

- Management of knowledge
- Retention of / access to data
- Cross-community decision support
- Cross-community analysis

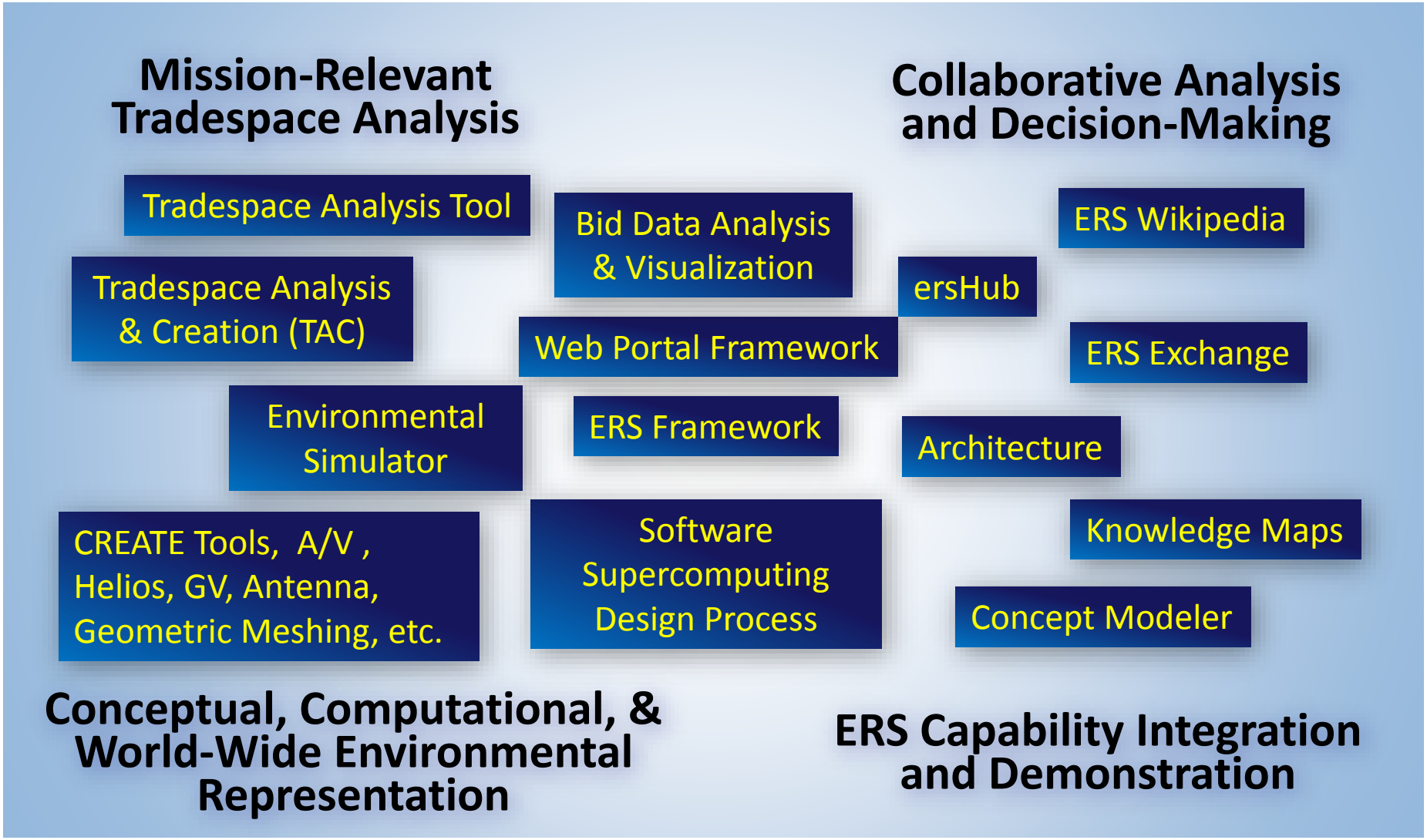
Conceptual, Computational, & World-Wide Environmental Representation

- Physics-based models
- Systems representation
- Simulated environmental representation
- Mission context immersion

ERS Capability Integration and Demonstration

- Open, extensible architectural framework
- Integrated representations
- Tools (tradespace, lifecycle costs, other analytics)

Current ERS Products



ERS Overall Roadmap
10 Years

Versions

V1
- Initial tradespace tools for Ships
- Launch prototype KM environment
- Initial integrating architecture
- Link physics-based models and environmental data

V2
- 2nd gen tradespace tools for Ships, GV, AV
- KM Environment
- Industry linked to architecture env
- Risk representation and mitigation
- Env simulation
- Initial cost modeling
- Initial mission tools

V3
- User-configured analytics
- Env simulation anywhere on Earth
- Manufacturability & Producibility Tools
- Lifecycle cost tools
- Novel weapons systems modeling
- Mission context tools

V4
- Modeling of entire acquisition cycle
- Validated cost representation
- Virtual prototyping of all materiel alternatives
- Portfolio analyses of trades at increasing echelons
- Cognitive computing

Demos & Transitions

- Ships – LX(R)
- Ships – SSCTF
- Helo – CH-47 blades
- Ground vehicle
- Air vehicle cost model
- Ships – modular vessel
- Helo – UH-60
- Support new platforms

☆ Major Versions

♦ Significant Milestones

NDIA Systems Engineering ERS Track

OSD Outlook and Vision	**DOD Prototyping Objectives** **Open Systems Architecture in DoD Acquisition**
Architecture & Infrastructure	**ERS Architecture** **Collaboration Infrastructure for Agile Model-Based Design** **Engineering Data Visualization Efforts for ERS** **Designing Resiliency into Critical Infrastructure Systems**
ERS Technologies and Tools	**Tradespace Enabled Decision Making** **Optimizing Systems Architecture and Whole of Life Costs** **Making Cost Effective Decisions in Early Program Phases**
Physics-based Representation	**Environmental Simulation in support of ERS** **Computational Research & Engineering Acquisition Tools & Environments (CREATE) Program**
Demonstration	**ERS for Ship Design and Acquisition**
Industry Perspectives	**Transforming the way we do business** **Gartner: Innovation Platforms: The Next Phase in IT for Model-Based Engineering**

ERS and Industry

Industry experience, capabilities and tools are critical to the success of ERS.

Focused IR&D

www.defenseinnovationmarketplace.mil

Focus IR&D on innovative approaches to critical problems as outlined by DoD

Industry Visits

ERS conducts visits with leaders in the Defense Industrial community to share concepts and further understand current and innovative capabilities and development projects.

SBIRs

Phase I and II SBIR projects are the focus of Army Research Laboratory Vehicle Applied Research Division at Aberdeen. See Dr. Eric Spero for information.

ERS Community of Interest

Engineered Resilient Systems Community of Interest
Cross-Service Initiative

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