NDIA

Celebrating 20 Years of Systems Engineering Excellence

20th Annual Systems Engineering Conference

Conference Program

October 23-26, 2017 | Waterford at Springfield | Springfield, VA
NDIA.org/systemsengineering

Welcome to the NDIA Systems Engineering Conference

On behalf of the National Defense Industrial Association's Systems Engineering Division, I would like to extend a very warm welcome to the 20^{th} Annual Systems Engineering Conference. Yes, the 20^{th} Annual – who knew when we started this conference 2 decades ago that we would continue to have important systems engineering issues to address? Well, perhaps most of you - because after all, technology keeps moving, our military capability continues to increase, the complexity of our systems continues to grow, and the threats we have to address continue to grow at an alarming rate.

For example, 20 years ago the term "Cybersecurity" wasn't addressed in DoD circles. Interoperability wasn't considered. Systems-of-systems weren't mentioned. And today, these are some of our hottest issues that the entire defense-industrial complex seeks to successfully address, not to mention affordability, sustainability and a host of other issues that continue to need attention.

This conference is the primary one in the US that brings together the engineering arms of the Office of the Secretary of Defense, the Services, many of the Federal Agencies, and the defense industrial complex to address and seek solutions to the issues we all face. Executives, managers and engineers from all of the major US defense contractors, as well as the principal engineering executives, managers and engineers from the Department of Defense and the Services and Federal Agencies are here, and dialog among us is critical to achieving a mutual understanding of the issues we collectively face and desperately need to solve. This conference provides an outstanding opportunity to have that dialog and exchange ideas, so please take maximum advantage of this opportunity.

And if there is anything that the conference committee, whose names are listed in the program, or I, or the outstanding NDIA staff can do to assist you, please let us know.

Bob Rassa
Manager, Engineering Programs
Raytheon Space & Airborne Systems

Dear Attendees, Speakers and Sponsors,

I would like to add my warm welcome to those attending the annual Systems Engineering Division conference. This year's conference marks the 20th anniversary of this prestigious event. I congratulate the NDIA Systems Engineering Division for their sustained, superior performance in producing a highly consequential event and applaud the many ways the division supports the Defense Department and defense community.

This conference is the premier event addressing the application of systems engineering principles to defense acquisition. As such, it is the main forum to exchange information and ideas among the Defense Department, the services, defense agencies, industry and academia.

I wish the best of experiences here at the conference, and look forward to many more years of division engagement with the community to promote and refine the systems engineering practice.

Sincerely

Herbert J. Carlisle
General, USAF (Ret)
President and CEO

20TH ANNUAL SYSTEMS ENGINEERING CONFERENCE

OCTOBER 23-26, 2017 | SPRINGFIELD, VA

INTRODUCTION

Considered the major annual systems engineering event focusing on the performance of DoD programs and systems, the National Defense Industrial Association's Annual Systems Engineering Conference offers content tailored to all levels of systems engineering (SE) professionals:

- Keynote Presentation
- Systems Engineering Executive Panels
    - DoD Executive Panel: Service Systems Engineering Leads discuss SE issues
    - DoD Executive Panel: Interagency Systems Engineering Activity
    - Industry Executive Panel: Industry Leaders discuss Systems Engineering issues
    - DoD Executive Panel: Service and Agency Program Managers discuss systems engineering issues
- Technical Breakout Sessions (2+ days)

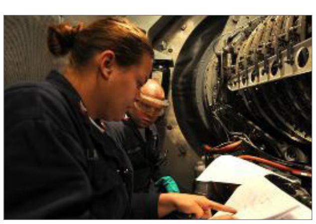
Demonstrating broad systems engineering community support, the conference is once again this year enjoying technical co-sponsorship by IEEE AES, IEEE Systems Council and the International Council on Systems Engineering.

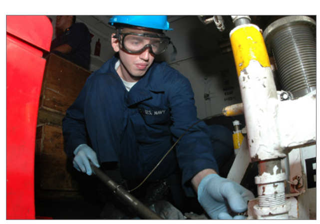
Further attesting to its value and relevance to Systems Engineering professionals within the defense industry, the conference continues to receive the support of the Office of the Deputy Assistant Secretary of Defense for Systems Engineering.

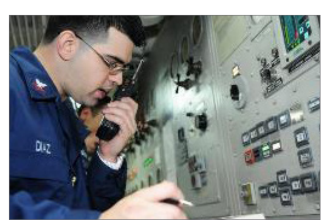
Major themes running through the three plus day agenda will include net-centric operations, data/information interoperability, system-of-systems engineering, cyber security and all aspects of system sustainment.

CONFERENCE OBJECTIVE

This conference seeks to create an interactive forum for Program Managers, Systems Engineers, Chief Scientists, Engineers, and Managers from the Requirements, Design, Verification, Support, Logistics and Test communities from both government and industry. The conference and the professional exchanges it will prompt will create opportunities to shape future policy and procedures.







BACKGROUND

The Department of Defense continues to seek ways to improve the acquisition of military equipment and capability to assist the warfighter in protecting the U.S. and its Allies around the world in a complex environment of ever-changing threats and conditions.

The Weapon Systems Acquisition Reform Act (WSARA) of 2009 defines Systems Engineering as a key enabler to effect improvements in defense acquisition and program execution that will produce more effective and affordable military systems. Previous DoD Better Buying Power initiatives, with their focus on achieving dominant capabilities through technical excellence and innovation, continued to emphasize the importance of engineering to the Department. The new administration seeks to increase military spending which will put additional onus on the defense industrial complex to achieve acquisition excellence, and systems engineering performance on the part of government and industry as partners is a key ingredient to success.

Systems Engineering is the "umbrella" engineering function that drives successful program execution and ensures an appropriate balance between requirements, performance, cost, schedule, and overall effectiveness and affordability. Systems Engineering principles embody strong technical and risk/opportunity management aspects for the acquiring Program Office as well as the prime and subcontractors. Strong emphasis on systems engineering throughout a program, especially in early development planning, is a key enabler of successfully fielding complex defense systems.

NDIA's Annual Systems Engineering Conference explores the various roles of systems engineering from all aspects and perspectives—pragmatic, practical and academic—and brings key practitioners together to work on effective solutions to achieve a successful and affordable warfighting force.

CONFERENCE CHAIR

Mr. Robert Rassa
Director, Engineering Programs
Raytheon Company

DIVISION CHAIR

Mr. Frank Serna
Principal Director, Strategic Initiatives
Draper Laboratory

DIVISION VICE-CHAIR

Mr. Joseph Elm
Director of Engineering
L-3 Communications

NDIA PLANNING TEAM

Ms. Tammy Kicker, CMP
Director, Meetings & Events

Ms. Tina Fletcher
Meeting Planner, Meetings & Events

SCHEDULE AT A GLANCE

MONDAY, OCTOBER 23

8:00 am - 12:00 pm	Display Move In
12:00 pm - 5:30 pm	Registration
1:00 pm - 3:00 pm	Tutorials
3:00 pm - 3:30 pm	Networking Break
3:30 pm - 5:30 pm	Tutorials continue

TUESDAY, OCTOBER 24

7:00 am - 5:00 pm	Registration
7:00 am - 8:15 am	Networking Breakfast
8:15 am - 8:30 am	Opening Remarks: Bob Rassa, Raytheon; Frank Serna, Draper Labs
8:30 am - 9:30 am	Plenary Session Keynote: Vice Admiral Paul Grosklags, USN, Commander, Naval Air Systems Command
9:30 am - 10:00 am	Networking Break
10:00 am - 11:15 am	Executive Panel: DoD Systems Engineering
11:15 am - 12:30 pm	Executive Panel: Interagency Systems Engineering
12:30 pm -1:30 pm	Networking Luncheon
1:30 pm - 2:45 pm	Plenary Session Continues: Industry Executive Panel
2:45 pm - 3:00 pm	Presentation of Lt Gen Thomas R. Ferguson Systems Engineering Excellence Awards
3:00 pm - 3:30 pm	Networking Break
3:30 pm - 5:00 pm	Executive Panel: Program Managers
5:00 pm - 6:30 pm	Networking Reception

WEDNESDAY OCTOBER 25

7:00 am - 5:15 pm	Registration
7:00 am - 8:00 am	Networking Breakfast
8:00 am - 9:40 am	Concurrent Breakout Focus Sessions A
9:40 am - 10:15 am	Networking Break
10:15 am - 11:55 am	Concurrent Breakout Focus Sessions B
11:55 am - 1:00 pm	Networking Luncheon
1:00pm - 2:40 pm	Concurrent Breakout Focus Sessions C
2:40 pm- 3:15 pm	Networking Break
3:15 pm - 5:20 pm	Concurrent Breakout Focus Sessions D

THURSDAY OCTOBER 26

7:00 am - 5:15 pm	Registration
7:00 am - 8:00 am	Networking Breakfast
8:00 am - 9:40 am	Concurrent Breakout Focus Sessions A
9:40 am - 10:15 am	Networking Break
10:15 am - 11:55 am	Concurrent Breakout Focus Sessions B
11:55 am - 1:00 pm	Networking Luncheon
1:00 pm - 2:40 pm	Concurrent Breakout Focus Sessions C
2:40 pm- 3:15 pm	Networking Break
3:15 pm - 5:20 pm	Concurrent Breakout Focus Sessions D

TRACK OBJECTIVES

AGILE IN SYSTEMS ENGINEERING

Track Chairs: John Norton*, Raytheon Company*
Linda Maness*, Northrop Grumman Corporation*
Eileen Wrubel*, Software Engineering Institute*

Agile usage is becoming more prevalent within the government space. Lessons learned and ideas for implementation can be shared with those who are experienced in using Agile concepts. This track brings together practitioners with experience applying agile methods in a variety of disciplines and domains, with the goal of collaboration to expand their effective use in systems engineering and on defense programs

ARCHITECTURE

Track Chairs: Bob Scheuer*, The Boeing*
Ed Moshinsky, *Lockheed Martin Corporation*

Architecture is a key element in systems engineering. This track addresses architecture frameworks, strategies, and applications to improve system design, test, operations, and support.

COMPUTATIONAL RESEARCH & ENGINEERING ACQUISITION TOOLS AND ENVIRONMENTS (CREATE)

Track Chair: Douglass Post*, DoD High Performance Computing Modernization Program (HPCMP)*

The DoD HPCMP CREATE Program is a Tri-Service Program launched in 2006 by OSD and the HPCMP to develop and deploy eleven physics-based high performance computing software applications specifically to enable the DoD acquisition engineering community to design and analyze military ships, aircraft, ground vehicles, and radio frequency antennas. These tools enable engineers to generate an arbitrarily large number of design options (virtual prototypes expressed as digital product models) for design-space exploration, rapidly assess the feasibility and performance characteristics of each design option, and accurately predict the performance of each weapon platform with high-fidelity tools. With these tools, DoD engineers can identify design defects and performance shortfalls and fix them before metal has been cut, thus reducing costly rework and improving system performance. This reduces the cost, schedule, and risk of acquisition programs. The tools and computer time are available to DoD engineers (government and industry). The tools are being used by more than 180 DoD engineering organizations (government 40%, industry 50%, and other 10%--including academia) with over 1,400 users.

DEVELOPMENTAL TEST & EVALUATION (DT&E)

Track Chairs: Joe Manas*, Raytheon Company*

Developmental Test and Evaluation is a key aspect of successful systems engineering. This track addresses the entire continuum of test and evaluation from early planning to operational testing.

DIGITAL ENGINEERING/MODEL-BASED SYSTEMS ENGINEERING

Track Chair: Philomena Zimmerman, *DASD/SE*

Digital Engineering is an emerging set of practices for Systems Engineering and other engineering disciplines which has, at its core, the use of models (data, algorithms and/or processes) as a technical means of communication. When used properly, models can provide a cohesion across engineering activities, and cohesion with acquisition activities. When coupled with computational capabilities, resultant data from simulations can be used in decision-making at all echelons, and an increased level of insight and risk reduction in the end item can be achieved.

ENGINEERED RESILIENT SYSTEMS (ERS)

Track Chairs: Lois Hollan, *Potomac Institute*

Engineered Resilient Systems (ERS) is a Department of Defense priority initiative that seeks to transform engineering environments so that warfighting systems are more resilient and affordable across the acquisition lifecycle. The track will present new results across the ERS initiative including anchor technologies and computational representation.

EDUCATION & TRAINING

Track Chair: Don Gelosh*, Worcester Polytechnic Institute*

The Education and Training track for 2017 is an excellent collection of thirteen presentations from government, industry, and academia. The presentations describe a wide range of systems engineering workforce development activities from competency frameworks, cybersecurity skills, MBE and MBSE best practices, System of Systems guide and capstone marketplace to development of technical leaders.

ENTERPRISE HEALTH MANAGEMENT/PROGNOSTICS/ DIAGNOSTICS/RELIABILTY

Track Chairs: Chris Resig*, The Boeing Company*

The health of the system as a whole – the enterprise – is a critical function of systems engineering. This session will touch on some issues relating to the system health, including prognostics, diagnostics and reliability.

ENVIRONMENT, SAFETY, AND OCCUPATIONAL HEALTH (ESOH)

Track Chairs: Sherman Forbes*, USAF*
Dave Schulte*, SAIC*
Lucy Rodriguez*, Booz Allen Hamilton*

The ESOH track provides a cross section of topics that reflect the many different Systems Engineering design considerations included under the DoDI 5000.02 acronym ESOH, as defined in MIL-STD-882E, the DoD Standard Practice for System Safety. This year, Mr. James Thompson, Director, Major Program Support (MPS), within the Office of the Deputy Assistant Secretary of Defense for Systems Engineering will be the ESOH track's keynote speaker. Mr. Thompson will share his perspectives on Risk, Issue, and Opportunity (RIO) Management and Independent Technical Risk Assessments (ITRAs). Mr. David Asiello, the Acquisition, Sustainability & Technology Programs lead in the Office of the Assistant Secretary of Defense for Energy, Installations, and Environment will follow Mr. Thompson's presentation with a presentation focusing on how ESOH Risk Management is an integral part of the RIO Management Process and offering suggestions for improving the rigor, accountability, and visibility of ESOH risk management. There will be an extended question and answer period following Mr. Thompson's and Mr. Asiello's presentations to allow the audience to further explore the Acquisition and Sustainment Risk Management. The remainder of the ESOH track presentations will address specific acquisition ESOH issues, to include using Digital Engineering to manage ESOH risks and requirements, how to manage ESOH in Rapid Acquisitions, software system safety, hazardous materials regulations and management impacts on programs, environmental liabilities, environmental sustainability, and lessons learned about program office successes and failures in implementing the DoDI 5000.02 acquisition ESOH policy.

HUMAN SYSTEMS INTEGRATION (HSI)

Track Chair: Matthew Risser, *Pacific Science*
Patrick Fly, *The Boeing Company*

The HSI sessions include technical papers aligned with DoD HSI policy, standards and guidance. The goal is to address HSI implications in the design of complex systems in support of systems engineering and include HSI methods, metrics, and best practices, process improvements, applications and approaches to program integration.

INTEROPERABILITY/NET - CENTRIC OPERATIONS

Track Chairs: Jack Zavin, *OUSD/ATL*
John Daly, *Booz-Allen-Hamilton*

Interoperability is ability to operate in synergy in the execution of assigned tasks both within the DoD and its external mission partners. Net Centric Operations supports interoperability by providing the POPIM solution sets that allows the DoD and its mission partners to share information/data/knowledge when needed, where needed, and in a form they can understand and act on with confidence, while protecting it from those who should not have it. Net Centric Operations/Interoperability includes technologies such as Service Oriented Architecture, Data Center, Cloud Computing, information transport [e.g. internet, web, radios, data links], as well as both hardware and software [aka Information and Communicative Technology] together with people, operating alone or in organizations, as part of the System of Systems Systems Engineering.

MISSION ENGINEERING

Track Chair: Judith Dahmann, *MITRE*

Mission engineering (ME) is the deliberate planning, analyzing, organizing, and integrating of current and emerging operational and system capabilities to achieve desired warfighting mission effects. This track focuses on current directions in Defense ME and approaches to applying SoS and SE approach to ME.

MODELING AND SIMULATION (M&S)

Track Chairs: David Allsop, *The Boeing Company*
Chris Schreiber, *Lockheed Martin Corpration*

The M&S Track highlights the use of models and simulations in the systems engineering process. Included are presentations on integrated environments, tools & technologies, and M&S applications in several SE process phases. Topics focused specifically on Digital Engineering/Model-based Systems Engineering are contained in a separate track on this topic.

PROGRAM MANAGEMENT

Track Chairs: Ken Nidiffer, *Software Engineering Institute*

Program Managers and chief Systems Engineers should be the "joined-at-the-hip" leads on all programs that wish to be successful. This session will address some of the issues that our program managers face in the execution of programs.

SOFTWARE ENGINEERING

Track Chairs: Ken Nidiffer, *Software Engineering Institute*

Software is often overlooked when talking systems engineering yet software is a key element of most designs today and must always be part of the systems engineer's portfolio of responsibility. This session will highlight a few significant software development issues.

SYSTEMS ENGINEERING EFFECTIVENESS

Track Chairs: Tim White, *Raytheon Company*
Joe Elm, *L3 Technologies*

Systems Engineering Effectiveness is obvious to some and quite esoteric to others. The goal though, improving the value obtained for each SE dollar spent, is shared by each who joins the discussion. Please attend the SE Effectiveness track to learn how your peers are implementing practical measures to better quantify the benefits of Systems Engineering and its value to Product Users and Developers alike. Early and effective Systems Engineering has been shown to return excellent value to all project stakeholders. This Track will highlight the latest DoD policy and guidance, define new approaches, and provide some practical experiences to assist the DoD and defense industry SE community in achieving a quantifiable and persistent improvement in program outcomes through appropriate application of systems engineering principles and best practices.

SYSTEMS OF SYSTEMS (SOS)

Track Chairs: Judith Dahmann, *MITRE*
Rick Poel, *The Boeing Company*
Jennie Horn, *Raytheon Company*

The System of Systems track will feature papers highlighting development SoS engineering approaches, particular SoS SE application areas, and SoS tools and modeling, including SoS SE applied to defense missions in mission engineering. See directly related track in Mission Engineering, above.

SYSTEM SECURITY ENGINEERING (SSE)

Track Chairs: Holly Dunlap, *Raytheon Company*
Melinda Reed, *DASD/SE*

System Security Engineering has become one of the most important aspects in the design of DoD systems. This track will focus on system security engineering and a holistic approach to program protection.

Monday, October 23

8:00AM - 12:00PM **Display Move In**

12:00PM - 5:30PM **Registration Open**

1:00 PM - 5:30 PM **Tutorials**

			1:00PM - 1:30PM	1:30PM - 2:00PM	2:00PM - 2:30PM	2:30PM - 3:00PM
Track 4	Gibson	**Tutorial: Modeling and Simulation (M&S)** 1C4	19696 Half-Day Tutorial: Modeling and Simulation in the Systems Engineering Process ▶ Dr. Jim Coolahan, Coolahan Consultants, LLC			
Track 5	Sellier	**Tutorial: Applying MIL-STD** 1C5	19702 Tutorial: Tutorial: Applying Focused MIL-STD-882E Software Safety Level of Rigor ▶ Mr. Stuart Whitford, *Booz Allen Hamilton*			
Track 6	Korman	**Tutorial: Communication and Analysis** 1C6	19713 Effective Communication and Analysis in the Age of MBSE ▶ Mr. Ronald Kratzke, *Vitech Corporation*			

3:00PM - 3:30PM **Networking Break**

			3:30PM - 4:00PM	4:00PM - 4:30PM	4:30PM - 5:00PM	5:00PM - 5:30PM
Track 4	Gibson	**Tutorial: Modeling and Simulation (M&S) Cont'd** 1D4	19696 Half-Day Tutorial: Modeling and Simulation in the Systems Engineering Process ▶ Dr. Jim Coolahan, Coolahan Consultants, LLC			
Track 5	Sellier	**Tutorial: Applying MIL-STD Cont'd** 1D5	19702 Tutorial: Applying Focused MIL-STD-882E Software Safety Level of Rigor ▶ Mr. Stuart Whitford, *Booz Allen Hamilton*			
Track 6	Korman	**Tutorial: Communication and Analysis Cont'd** 1D6	19713 Effective Communication and Analysis in the Age of MBSE ▶ Mr. Ronald Kratzke, *Vitech Corporation*			

5:30PM **Adjourn**

Tuesday, October 24

7:00AM - 5:00PM **Registration Open**

7:00AM - 8:15AM **Networking Breakfast**

8:15AM - 8:30AM **Opening Remarks**

Mr. Robert Rassa, *Director, Engineering Programs, Raytheon Company; NDIA Systems Engineering Conference Chair*

Mr. Frank Serna, *Principal Director, Strategic Initiatives, Draper Laboratory; Chair, NDIA Systems Engineering Division*

8:30AM - 9:30AM **Keynote Presentation**

VADM Paul Grosklags, *NAVAIR, Commander, Naval Air Systems Command*

9:30AM - 10:00AM **Networking Break**

10:00AM - 11:15AM **DoD Executive Panel: DoD Systems Engineering**

Moderator: Mrs Kristen Baldwin, *Deputy Assistant Secretary of Defense, Systems Engineering (Acting)*

Panelists:

- Col Laird Abbott, *USAF, Chief, Engineering and Force Management Division, Deputy Assistant Secretary for Science, Technology, and Engineering, SAF-AQR*
- Mr. William Bray, *USN, DASN RDT&E and Chief Systems Engineer*
- Mr. Douglas Wiltsie, *USA, Executive Director, SoSE&I, ASA ALT (invited)*

11:15AM - 12:30PM **Executive Panel: Interagency Systems Engineering**

Moderator: Ms. Kristen Baldwin, *Deputy Assistant Secretary of Defense, Systems Engineering (Acting)*

Panelists:

- Mr. Albert "Benjie" Spencer, *National Oceanic and Atmospheric Administration*
- Mr. Jon Holladay, *Technical Fellow for Systems Engineering, National Aeronautics and Space Admnistration*
- Mr. Kent Jones, Assistant Deputy Administrator for Systems Engineering and Integration, Defense Programs, DOE *National Nuclear Security Administration*
- Mr. Joseph Post, *Deputy Director, NAS Systems Engineering & Integration Federal Aviation Administration*
- Mr. James Tuttle, Deputy Director, CDS and Chief Systems Engineering, *Department of Homeland Security*

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12:30PM - 1:30PM **Networking Luncheon**

1:30PM - 2:45PM **Industry Executive Panel: Model-Based Systems Engineering: How is it Helping?**

Mr. Frank Serna, *Principal Director, Strategic Initiatives, Draper Laboratory; Chair, NDIA Systems Engineering Division*

Panelists:

- Ms. Christi Gau Pagnanelli, *Director, BDS Systems Enginnering and Engineering Multi-Skilled Leadership, Boeing Defense, Space & Security*
- Mr. Randall Lum, *Corporate Director, Engineering, Northrop Grumman Corporation*
- Mr. Tim Walden, *Chief Engineer and Fellow, Lockheed Martin Corporate Engineering and Production Operations*
- Mr. Scott Welles, *Vice President, Booz Allen Hamilton*

2:45PM - 3:00PM **Presentation of Lt Gen Thomas R. Ferguson Systems Engineering Excellence Awards**

3:00PM - 3:30PM **Networking Break**

3:30PM - 5:00PM **Executive Panel: Program Managers**

Moderator: Col. David McIllece, USAF

Panelists:

- Col Edward Hospodar, USAF, *GPS User Equipment Senior Materiel Leader*
- COL Mike Milner, USA, *Armored Multi-Purpose Vehicle (AMPV) Program Manager*
- Col Amanda Myers, USAF, *Deputy Director, Global Reach Programs, Former C-17 System Program Manager*
- CAPT Seiko Okano, USN, *PEO Integrated Wardare Systems (IWS) 2.0 Program Manager*

5:00pm - 6:30pm **Networking Reception**

Wednesday, October 25

7:00AM-5:15PM **Registration**

7:00AM-8:00AM **Networking Breakfast**

Track	Chair	Session	8:00AM - 8:25AM	8:25AM - 8:50AM	8:50AM - 9:15AM	9:15AM - 9:40AM
Track 1	Singleton	**Human Systems Integration** 3A1	19516 Enhancing Future Soldier Systems through the use of the Systems Modeling Language to Incorporate Human Aspects into the Soldier as a System Definition ▶ Mr. Sean Pham, *U.S. Army ARDEC*	19641 HSI Best Practice Standard ▶ Dr. Patrick Fly, *The Boeing Company*	19739 The Human Systems Integration Partnership:: Delivering the HSI Capability to the Air Force Systems Engineering Process ▶ Mr. Derek Johnston, *United States Air Force*	19919 Adaptive Automation for UAV Pilot Vehicle Interfaces ▶ Mr. Jeff O'Hara, *Georgia Tech Research Institute*
Track 2	Miller	**Net Centric Operations & Interoperability** 3A2	19752 Kick Off/Context for NCO/I Track ▶ Mr. Jack Zavin, *DoD/OUSD(AT&L)*	19815 ISO/IEC/IEEE8 15288 System Interoperability Considerations ▶ Mr. John Daly, *Booz Allen Hamilton*	19759 JITC Executes DoD Mobility Field Assessments ▶ Mr. Khoa Hoang, *Joint Interoperability Test Command*	19764 Interface Management for Interoperability– from Theory to Modeling ▶ Mr. Matthew Hause, *PTC*
Track 3	Von Sternberg	**Engineering & Model-based Systems Engineering** 3A3	19819 DoD Digital Engineering Strategy ▶ Ms. Philomena Zimmerman, *Department of Defense*	19879 Model Centric Engineering Enabling a New Operational Paradigm for Acquisition ▶ Dr. Mark Blackburn, *Stevens Institute of Technology*	19853 Joint NDIA SSE & SwA Committee and Joint Federated Assurance Center, Government SwA Gap Analysis Workshop Summary ▶ Ms. Holly Dunlap, *Raytheon Company*	19855 MBSE and Systems Engineering Transformation ▶ Mr. Troy Peterson, *INCOSE*
Track 4	Gibson	**Modeling & Simulation** 3A4	19691 An Autonomous Sensor Tasking System ▶ Ms. Quintina Jones, *Raytheon Missile Systems*	19711 Best Practices for the Architecture, Design, and Modernization of Defense Models and Simulations ▶ Mr. Michael Heaphy, *AT&L/DMSCO*	19725 VV&A of Models and Simulations: The Power of Independent Cumulative Analyses ▶ Ms. Natalie Plotkin, *Raytheon Company*	19916 Formalized Execution of Model Integrated Descriptive Architecture Languages ▶ Mr. Gregory Haun, *Analytical Graphics, Inc.*
Track 5	Sellier	**Agile** 3A5	19877 Research Gone "Agile" A Case Study on Using an Enterprise Transformation Process to Enable Agile Methods in a Research Program ▶ Dr. Rosa Heckle, *The MITRE Corporation*	19726 Issues anOpportunities in Accelerated Software Development for Next Generation DoD Applications ▶ Dr. Craig Arndt, *Defense Acquisition University*	19755 A System Dynamics Model of the Scaled Agile Framework (SAFe) to Quantify the Effects of Management Decisions on Capability Development and Acquisition Outcomes ▶ Mr. Sean Ricks, *The MITRE Corporation*	19777 "Elicitation of Robust and Quality Agile User Stories Using QFD" ▶ Ms. Sabrina Ussery, *The George Washington University*
Track 6	Korman	**Software** 3A6	19745 Software Complexity Modeling ▶ Mr. Thuc Tran, *Capital One*	19749 Harnessing the Beast: Using Model Based Systems Engineering (MBSE) to Manage Complex Research Software Environments ▶ Ms. Jennifer Turgeon, *Sandia National Laboratories*	19758 Software Systems Maturity Analysis ▶ Mr. Christopher Dieckmann, *Idaho National Laboratory*	19816 Free and Open Source Tools to Assess Software Reliability and Security ▶ Mr. Lance Fiondella, *University of Massachusetts*

Wednesday, October 25 - Continued

9:40AM-10:15AM **Networking Break**

Track	Chair	Session	10:15AM - 10:40AM	10:40AM - 11:05AM	11:05AM - 11:30AM	11:30AM - 11:55AM
Track 1	Singleton	**Human Systems Integration** / **Systems Security Engineering** 3B1	19784 A Wearable Vision+Inertial Navigation System for Assessing Volumetric Utilization and Task Geometry Efficiency ▶ Mr. Kevin Duda, *Draper Laboratory*	19740 Fisher vs. Taguchi Experimental Design Methods in Human Factors ▶ Ms. Sarah Ewing, *Idaho National Laboratory*	19854 NDIA Welcome and Review of Accomplishments ▶ Ms. Holly Dunlap, *Raytheon Company*	19881 DoD Cyber Resilient Weapon Systems ▶ Ms. Melinda Reed, *Department of Defense*
Track 2	Miller	**Net Centric Operations & Interoperability** / **Mission Engineering** 3B2	19923 Joint and Mission Partner Interoperability ▶ Mr. Mike Richards, *Joint Staff J6*	19499 Real Life Cloud Acquisition and Adoption Across Agencies and Cloud Providers ▶ Mr. Mun-Wai Hon, *Noblis*	19849 Mission Integration Management, NDAA 2017 Section 855 ▶ Mr. Robert Gold, *Department of Defense*	19838 Systems of Systems Engineering Technical Approaches as Applied to Mission Engineering ▶ Dr. Judith Dahmann, *MITRE*
Track 3	Von Sternberg	**Digital Engineering & Model-based Systems Engineering** 3B3	19793 Model-Centric Decision Making: Insights from an Expert Interview Study ▶ Dr. Donna Rhodes, *Massachusetts Institute of Technology*	19890 Using MBSE to Communicate and Gain Acceptance of your Analysis ▶ Mr. Frank Salvatore, *Engility*	19795 New Innovations in Digital Systems Engineering ▶ Dr. Edward Kraft, *University of Tennessee Space Institute*	19920 Key MBSE Enablers with Examples ▶ Mr. Nicholas Driscoll, III, *Raytheon Company*
Track 4	Gibson	**CREATE Computational Research & Engineering Acquisition Tools and Environments** 3B4	20010 Digital Engineering (DE) and Computational Research and Engineering Acquisition Tools and Environments (CREATE) ▶ Ms. Philomena Zimmerman, *Department of Defense*	19721 CREATE: Accelerating Defense Innovation with Computational Prototypes and High Performance Computers ▶ Dr. Douglass Post, *DoD HPCMP*	19730 Physics-Based Simulation in Support of Acquisition program and Fleet Operations ▶ Mr. Steven Donaldson, *Naval Air Systems Command*	19728 Capstone: A Patform for Geometry, Meshing and Attribution Modeling for Physics-based Analysis and Design ▶ Dr. Saikat Dey, *US NRL Code 7131*
Track 5	Sellier	**Agile** / **Environment Safety & Occupational Health** 3B5	19902 Software Development Challenges in AFMC (Agile Software Development and Data Rights) ▶ Mr. Andrew Jeselson, *Air Force Materiel Command*		19701 Leveraging Cybersecurity Tools for Software Safety: Focusing (Some) Static Analysis on Safety-Critical Software ▶ Mr. Stuart Whitford, *Booz Allen Hamilton*	20028 Joint Software System Safety Implementation Guide ▶ Mr. Bob Smith, *Booz Allen Hamilton*
Track 6	Korman	**Systems Engineering Effectiveness** 3B6	19850 Engineering Autonomy ▶ Mr. Robert Gold, *Department of Defense*	19882 The Drive for Innovation in Systems Engineering ▶ Mr. Scott Lusero, *Department of Defense*	19814 DoD Systems Engineering Policy, Guidance and Standardization ▶ Ms. Aileen Sedmak, *Department of Defense*	19835 Helix: Understanding Systems Engineering Effectiveness through Modeling ▶ Ms. Nicole Hutchison, *Stevens Institute of Technology*

11:55AM - 1:00PM **Networking Luncheon**

Wednesday, October 25 - Continued

			1:00PM - 1:25PM	1:25PM - 1:50PM	1:50PM - 2:15PM	2:15PM - 2:40PM
Track 1	Singleton	**System Security Engineering** 3C1	19852 NDIA Cyber Resilient & Secure Systems Summit Summary ▶ Ms. Holly Dunlap, *Raytheon Company*	19839 Unified Architecture Framework (UAF) Profile for Risk Assessment Methodology ▶ Ms. Tamara Hambrick, *Northrop Grumman Corporation*	19913 Considerations to Address Dependably Secure System Function in System Capability, Requirements, and Performance Artifacts ▶ Mr. Michael McEvilley, *The MITRE Corporation*	19866 AF Cyber Campaign Plan - Weapon Systems Focus ▶ Mr. Daniel Holtzman, *U.S. Air Force*
Track 2	Miller	**Mission Engineering** / **System of Systems** 3C2	19706 Model Based Systems of Systems Engineering ▶ Mr. Francis McCafferty, *Vitech Corporation*	19868 Mission Threads: Linking Mission Engineering and Systems Engineering ▶ Dr. Greg Butler, *Engility Corp*	19718 Developing Standards for Systems of Systems (SoS) Engineering ▶ Dr. Judith Dahmann, *The MITRE Corporation*	19804 Scaling Model-Based System Engineering Practices for System of Systems Applications: Software Tools ▶ Ms. Janna Kamenetsky, The *MITRE Corporation*
Track 3	Von Sternberg	**Digital Engineering & Model-based Systems Engineering** 3C3	19545 Pulling the Digital Thread with Model Based Engineering ▶ Mr. Christopher Finlay, *Raytheon Company*	19906 Modeling the Digital System Model Data Taxonomy ▶ Ms. Philomena Zimmerman, *Department of Defense*	19746 Developing and Distributing a CubeSat Model-Based Systems Engineering (MBSE) Reference Model – Interim Status #2 ▶ Dr. David Kaslow, *S.E.L.F*	19872 Enabling Design of Agile Security with MBSE ▶ Mr. Barry Papke, *No Magic*
Track 4	Gibson	**CREATE: Computational Research & Engineering Acquisition Tools and Environments Engineering** 3C4	19779 High-Fidelity Electromagnetic Modeling with CREATE-RF Tools ▶ Dr. Daniel Dault, *Air Force Research Lab*	19809 Physics Based Modeling & Simulation For Shock and Vulnerability Assessments - Navy Enhanced Sierra Mechanics ▶ Mr. Jonathan Stergiou, *Naval Surface Warfare Center, Carderock Division*	19823 The Role of CREATE-AV in Realization of the Digital Thread "Authoritative Truth Source" ▶ Dr. Edward Kraft, *University of Tennessee Space Institute*	19753 A Networked Frigate Concept Design Space Exploration Using the Rapid Ship Design Environment ▶ Dr. Douglas Rigterink, *Navel Surface Warfare Center, Carderock Division*
Track 5	Sellier	**Environment Safety & Occupational Health** 3C5	19912 DASD (SE) Risk, Issue, and Opportunity (RIO) Management and Independent Technical Risk Assessments (ITRAs) ▶ Mr. James Thompson, *Department of Defense*	19697 ESOH Risk Management ▶ Mr. David Asiello, *OASD(EI&E)*	19908 DoD Acquisition ESOH IPT Q&A Panel ▶ Mr. David Asiello, *OASD(EI&E)*	
Track 6	Korman	**Systems Engineering Effectiveness** 3C6	19790 Systems Engineering Research Needs and Workforce Development Study ▶ Dr. Dinesh Verma, *Systems Engineering Research Center (SERC)*	19744 Technical Performance Risk Management for Large Scale Programs ▶ Mr. Brian Davenport, *Raytheon Company*	19742 The Design of a Cone Penetrometer System ▶ Dr. Doris Turnage, *U. S. Army Engineer Research & Development Center*	19781 Additive Manufacturing – Challenges for the Systems Engineer and Program Manager ▶ Mr. William Decker, *Defense Acquisition University*

Wednesday, October 25 - Continued

2:40PM - 3:15PM **Networking Break**

Track	Chair	Session	3:15PM - 3:40PM	3:40PM - 4:05PM	4:05PM - 4:30PM
Track 1	Singleton	**System Security Engineering** 3D1	19861 Cyber Resilient and Secure Weapon Systems Acquisition/Proposal Discussion & Summary ▶ Ms. Holly Dunlap, *Raytheon Company*	19771 When the Right Answer is Not What NAVSEA Normally Does ▶ Mr. Peter Chu, *NAVSEA 05*	19870 Can't We Just Get Along: Engineering Trade Decisions VS RMF at the System Level ▶ Mr. Don Davidson, *DoD CIO*
Track 2	Miller	**System of Systems** 3D2	19802 Scaling Model-Based System Engineering Practices for System of Systems Applications: Analytic Methods ▶ Dr. Aleksandra Markina-Khusid, The *MITRE Corporation*	19757 Defense System of Systems Gap Analysis ▶ Mr. Christopher Dieckmann, *Idaho National Laboratory*	19878 Enterprise Implications of Family of Systems (FoS) Acquisition ▶ Dr. Garrett Thurston, *Dassault Systemes*
Track 3	Von Sternberg	**Digital Engineering & Model-based Systems Engineering** 3D3	19775 Digital System Model Ice ▶ Dr. David Hench, *Eagle Ray R&D*	19871 Enabling Repeatable SE Cost Estimation with COSYSMO and MBSE ▶ Mr. Barry Papke, *No Magic*	19888 MBSE to Address Logical Text-Based Requirements Issues ▶ Dr. Saulius Pavalkis, *No Magic*
Track 4	Gibson	**CREATE: Computational Research & Engineering Acquisition Tools and Environments Engineering** 3D4	19693 Program Management in CREATE for the Development of Large-scale Physics-based Software Development Projects for Engineering Design and Analysis ▶ Dr. Richard Kendall, *DoD HPCMP*	19704 Computational Research and Engineering Acquisition Tools and Environments – Ground Vehicles (CREATE-GV) ▶ Dr. Christopher Goodin, *U.S. Army ERDC*	19715 Physics-based, Multidisciplinary Analysis of Fixed-Wing Aircraft with HPCMP CREATE(TM)-AV/Kestrel ▶ Dr. David McDaniel, *DoD HPCMP/CREATE*
Track 5	Sellier	**Environment Safety & Occupational Health** 3D5	19770 Assessing the impacts of Amended Toxic Substances Control Act to the DoD Mission and the Defense Industrial Base Panel ▶ Ms. Amy Borman, *U.S. Army* ▶ COL Joseph Constantino *(SAF/IEE)* ▶ Mr. Shane Esola, *DCMA* ▶ Mr. Jim Rudroff, (ODASN(E)) ▶ Dr. Patricia Underwood, *OASD(EI&E)*		
Track 6	Korman	**Systems Engineering Effectiveness** 3D6	19738 Improving Effectiveness with respect to Time-To-Market and the Impacts of Late-stage Design Changes in Rapid Development Life Cycles ▶ Mr. Parth Shah, *George Washington University*	19716 Integrity System Security Engineering into System Engineering ▶ Mr. Ken Barker, *USAF*	19824 Implementation of the R&M Engineering Body of Knowledge ▶ Mr. Andrew Monje, *Department of Defense*

Wednesday, October 25 - Continued

			4:30PM - 4:55PM	4:55PM - 5:20PM	
Track 1	Singleton	**System Security Engineering** 3D1	19880 Engaging the DoD Enterprise to Protect U.S. Military Technical Advantage: Joint Acquisition Protection and Exploitation Cell Update ▶ Mr. Brian Hughes, *Department of Defense*	19798 Using Real Options Analysis to develop Resiliency in System Security Architectures ▶ Mr. Chris D'Ascenzo, *Defense Acquisition University*	
Track 2	Miller	**System of Systems** 3D2	19736 "Defense Acquisition System" System of Systems Engineering ▶ Mr. Larry Harding, *Idaho National Laboratory*		
Track 3	Von Sternberg	**Digital Engineering & Model-based Systems Engoneering** 3D3	19763 The Digital Engineering Journey ▶ Mr. Mathew Hause, *PTC*	19833 Digitalization of Systems Engineering –Examples and Benefits for the Enterprise ▶ Mr. Sanjay Khurana, *Dassault Systemes*	
Track 4	Gibson	**CREATE: Computational Research & Engineering Acquisition Tools and Environments Engineering** 3D4	19776 Weapons System Innovation through Workflow-based Computational Prototyping ▶ Mr. Loren Miller, *DataMetric Innovations, LLC*	19786 Rotorcraft Acquisition: Development of Modeling and Simulation Procedures ▶ Dr. Marvin Moulton, *U.S. Army*	
Track 5	Sellier	**Environment Safety & Occupational Health** 3D5	19770 Assessing the impacts of Amended Toxic Substances Control Act to the DoD Mission and the Defense Industrial Base Panel ▶ Ms. Amy Borman, *U.S. Army* ▶COL Joseph Constantino *(SAF/IEE)* ▶ Mr. Shane Esola, *DCMA* ▶ Mr. Jim Rudroff, (ODASN(E)) ▶ Dr. Patricia Underwood, *OASD(EI&E)*		
Track 6	Korman	**Systems Engineering Effectiveness** 3D6	19762 Decision-Driven Product Development ▶ Mr. Matthew Hause, *PTC*	19830 Are We Doing Enough in Requirements Management? ▶ Dr. Steven Dam, *SPEC Innovations*	

5:20PM **Adjourn**

Thursday, October 26

7:00AM-5:15PM **Registration**

7:00AM-8:00AM **Networking Breakfast**

			8:00AM - 8:25AM	8:25AM - 8:50AM	8:50AM - 9:15AM	9:15AM - 9:40AM
Track 1	Singleton	**System Security Engineering** 4A1	19796 Cyber Systems Risk – an Opportunity for Model Based Engineering & Design ▶ Dr. Jerry Couretas, *Booz Allen Hamilton*	19785 Cybersecurity As An Integral Part of Systems Engineering ▶ Mr. William Decker, *Defense Acquisition University*	19741 Security at Design Time: Addressing Resilience in Mission Critical Cyber-Physical Systems ▶ Mr. Thomas McDermott, Jr., *Georgia Tech Research Institute*	19911 Achieving DoD Software Assurance (SwA) ▶ Mr. Thomas Hurt, *Department of Defense*
Track 2	Miller	**Developmental Test & Evaluation** 4A2	19792 An Approach to Verification of Complex Systems ▶ Dr. Wilson Felder, *Stevens Institute of Technology*	19925 Improving Distributed Testing with TENA and JMETC ▶ Mr. Ryan Norman, *TENA / JMETC*	19774 Identifying Requirements and Vulnerabilities for Cybersecurity; Or How I Learned to Stop Worrying and Love the Six-Phase Cybersecurity T&E Process ▶ Mr. David Brown, *Electronic Warfare Associates (EWA)*	19831 How Can We Use V&V Techniques in Early Systems Engineering? ▶ Dr. Steven Dam, *SPEC Innovations*
Track 3	Von Sternberg	**Engineered Resilient Systems** 4A3	20009 Digital Engineering and ERS ▶ Mr. Robert Gold, *Department of Defense*		19845 ERS: Influencing Acquisition Innovation ▶ Dr. Owen Eslinger, *U.S. Army Engineer Research and Development Center*	19907 Scaling Data Analytics for ERS ▶ Mr. David Stuart, *U.S. Army Engineer Research and Development Center*
Track 4	Gibson	**Create: Computational Research & Engineering Acquisition Tools and Environments Engineering** 4A4	19887 Multi-Disciplinary Integration of ModSim for Navy Applications ▶ Dr. Greg Bunting, *Sandia National Laboratories*	19729 Academic Deployment of the HPCMP CREATE Genesis Software Package ▶ Dr. Robert Meakin, *U.S. DoD HPCMP*	19875 Secure Web-Based Access for Productive Supercomputing ▶ Ms. Laura Ulibarri, *Air Force Research Laboratory*	19800 CREATE-SH IHDE: Workflow Process Improvements for Hydrodynamics Characterization of Ship Designs ▶ Mr. Wesley Wilson, *Naval Surface Warfare Center, Carderock Division*
Track 5	Sellier	**Environment, Safety & Occupational Health** 4A5	19773 Model Based Systems Engineering (MBSE) Considerations for Environment Safety and Occupational Health (ESOH) ▶ Mr. Leo Kilfoy, *MSC Software*	19772 A Pragmatic Approach to System Modeling for Hazard Identification and Risk Management ▶ Mr. Michael Vinarcik, *Booz Allen Hamilton*	19708 Unmanned System (UxS) Safety Engineering Precepts - an OSD Guide - update of the 2007 OSD UxS Safety Guide ▶ Mr. Michael Demmick, *NOSSA*	19754 Divergent Oscillating Refueling Probe on the HH-60G Pavehawk ▶ Mr. Joseph Jones, *SAF/AQRE*
Track 6	Korman	**Architecture** 4A6	19820 MOSA Considerations in Systems Engineering Through the Lifecycle ▶ Ms. Philomena Zimmerman, *Department of Defense*	19821 Implementing a MOSA to Achieve Acquisition Agility in Defense Acquisition Programs ▶Ms. Philomena Zimmerman, *Department of Defense*	19837 Challenges to Implementing MOSA for Major DoD Acqusition Programs ▶ Mr. Edward Moshinsky, *Lockheed Martin Corporation*	19778 Investigating Approaches to Achieve Modularity Benefits in the Defense Acquisition Ecosystems ▶ Dr. Navindran Davendralingam, *Purdue University*

Thursday, October 26- Continued

9:40AM-10:15AM **Networking Break**

Track	Chair	Session	10:15AM - 10:40AM	10:40AM - 11:05AM	11:05AM - 11:30AM	11:30AM - 11:55AM
Track 1	Singleton	**System Security Engineering** 4B1	19853 Joint NDIA SSE & SwA Committee and Joint Federated Assurance Center, Government SwA Gap Analysis Workshop Summary ▶ Ms. Holly Dunlap, *Raytheon Company*	19698 Program Manager's Guidebook for Integrating Software Assurance into Defense Systems During the System Acquisition Lifecycle ▶ Dr. Kenneth Nidiffer, *Software Engineering Institute*	19735 Reducing Software Vulnerabilities – The "Vital Few" Process and Product Metrics ▶ Mr. Girish Seshagiri, *Ishpi Information Technologies, Inc.*	19910 DoD Joint Federated Assurance Center (JFAC) 2017 Update ▶ Mr. Thomas Hurt, *Department of Defense*
Track 2	Miller	**Education & Training** 4B2	19813 Shaping the Department of Defense Engineering Workforce ▶ Ms. Aileen Sedmak, *Department of Defense*	19794 Review of Best Practices for Technical Leadership Development ▶ Dr. Wilson Felder, *Stevens Institute of Technology*	19805 Development of a Defense Mission Engineering Competency Model ▶ Dr. Nicole Hutchison, *Stevens Institute of Technology*	19789 The Capstone Marketplace: Growing our Technical Workforce through Systems Oriented Senior Design Projects ▶ Ms. Megan Clifford, *Systems Engineering Research Center*
Track 3	Von Sternberg	**Engineered Resilient Systems** 4B3	19844 Tradespace: Informed Decision making for Acquisition ▶ Mr. Timothy Garton, *Engineer Research and Development Center*	19834 Building an Agile Framework for the Analysis of Environmental Impacts on Military Systems ▶ Dr. Dharhas Pothina, *Engineer Research and Development Center*	19859 Introducing Lifecycle Cost to Early Conceptual Tradespace Exploration ▶ Mr. Erwin Baylot, *Engineer Research and Development Center*	19806 Overcoming the Government - Industry Collaboration Hurdle ▶ Dr. Patrick Martin, *BAE Systems*
Track 4	Gibson	**Create: Computational Research & Engineering Acquisition Tools and Environments Engineering** 4B3	19694 Software Engineering for Physics-based HPC Applications for Engineering Design and Analysis in CREATE ▶ Dr. Richard Kendall, *DoD HPCMP*	19703 Verification and Validation in CREATE Multi-Physics HPC Software Applications ▶ Dr. Lawrence Votta, *Brincos Inc.*	19709 DoD Risk Management Deficiencies...And How to Fix Them ▶ Mr. Richard Sugarman, *U.S. Air Force*	19724 Tools for Acquiring Highly Maintainable Software-Intensive Systems ▶ Dr. Barry Boehm, *USC*
Track 5	Sellier	**Environment, Safety & Occupational Health** 4B5	19767 Rapid Equipping – Immediate Need to Equip and Protect Soldiers ▶ Mr. George Evans, *Prospective Technology Inc. (SAAL-PE/PTI ctr)*	19769 ESOH Risk Management and Applying MIL-STD-882E Principles to Programs that Deviate from Standard Acquisition Models ▶ Mr. Jefferson Walker, *Booz Allen Hamilton*	19732 Hazardous Materials Risk Management Using MIL-STD-882E ▶ Ms. Lori Hales, *Booz Allen Hamilton*	19836 Leveraging the International Aerospace Environmental Group (IAEG) Defense Acquisition Materials Declaration Process ▶ Ms. Karen Gill, *Booz Allen Hamilton*
Track 6	Korman	**Architecture** 4B6	19780 Cybersecurity and a Modular Open Systems Approach ▶ Mr. William Decker, *Defense Acquisition University*	19743 If System Architectures are So Useful, Why Don't We Use Them More? ▶ Mr. Robert Scheurer, *NDIA SE Architecture Committee*	19873 A Reverse Chronology of Evolutionary Architecture and Agile Development ▶ Mr. Thomas Mielke, *CACI International Inc.*	19903 Efficient Use of Enterprise and System Architecting in Combined Environment ▶ Dr. Howard Gans, *Harris Corporation*

Thursday, October 26 - Continued

11:55AM - 1:00PM **Networking Luncheon**

Track	Chair	Session	1:00PM - 1:25PM	1:25PM - 1:50PM	1:50PM - 2:15PM	2:15PM - 2:40PM
Track 1	Singleton	**System Security Engineering** 4C1	19862 Long-Term Strategy for DoD Trusted and Assured Microelectronics Needs ▶ Dr. Jeremy Muldavin, *Department of Defense*	19747 SSE Abstract: Developing Trust For a Secure Microelectronics Supply Chain ▶ Dr. Michael Fritze, *Potomac Institute for Policy Studies*	19731 SSE: Trusted Microelectronics Joint Working Group ▶ Dr. Brian Cohen, *Institute for Defense Analyses*	19700 Managing Risk with Trusted ASICs: Introducing to the SSE Community a Guidebook to Using Trusted Suppliers ▶ Mr. Jim Gobes, *Intrinsix Corp.*
Track 2	Miller	**Education & Training** 4C2	19811 Version 1.0 of the New INCOSE Competency Framework ▶ Mr. Don Gelosh	19515 A Proposed Engineering Training Framework and Competency Methodology ▶ Dr. Eric Dano, *BAE Systems*	19695 Educating Engineers or Training Technicians ▶ Mr. Zane Scott, *Vitech Corporation*	19734 Solving Cybersecurity Skills Shortage With Apprenticeships & Certifications – A Case Study ▶ Mr. Girish Seshagiri, *Ishpi Information Technologies, Inc.*
Track 3	Von Sternberg	**Engineered Resilient Systems** 4C3	19783 The Language of Complexity: Ontology in Systems Design and Engineering ▶ Mr. Abe Wu, *Raytheon Missiles*	19846 Physics and Model Based Aerodynamic Design and Analysis at GA ▶ Mr. Pritesh Mody, *General Atomics Aeronautical Systems, Inc.*	20050 Automation and Integration for Complex System Design ▶ Mr. Scott Radon, *Phoenix Integration*	19825 Application of CREATE Tools for High Fidelity Design Space Exploration ▶ Mr. Antonio De La Garza, *Lockheed Martin Aeronautics Company*
Track 4	Gibson	**Program Management** 4C4	19751 A Capability Value Frontier in Support of Acquisition Approaches to Enable Military Effectiveness ▶ Dr. Marilyn Gaska, *Lockheed Martin Corporation*	19782 Technical Data Package and Intellectual Property Rights ▶ Mr. William Decker, *Defense Acquisition University*		19827 Policy Engineering: Applying Systems Engineering to Develop Better Policies ▶ Dr. Steven Dam, *SPEC Innovations*
Track 5	Sellier	**Environment, Safety & Occupational Health** 4C5	19714 DoD's REACH Strategy and its Impact to Acquisition and Sustainment ▶ Dr. Patricia Underwood, *OASD(EI&E)*	19705 Environmental Liabilities for DoD Weapons Systems ▶ Ms. Patricia Huheey, *OASD(EI&E)*	19810 *Environmental Life Cycle Assessment of Commercial Transportation Activities* ▶ Ms. Sheila Neumann, *University of Texas at Arlington*	19699 LIfe Cycle Assessment: A Tool for Protecting Defense Assets ▶ Dr. Kelly Scanlon, *OASD(EI&E)*
Track 6	Korman	**Architecture** 4C6	19748 Advancing U.S. Marine Corps Warehouse Management Operations Through System Architecture and Analysis ▶ Mr. Christopher Melkonian, *Marine Corps Systems Command*	19828 From Architecture to Operations – Using Your Architecture Work in Operations ▶ Dr. Steven Dam, *SPEC Innovations*		

Thursday, October 26 - Continued

2:40PM - 3:15PM **Networking Break**

Track	Chair	Session	3:15PM - 3:40PM	3:40PM - 4:05PM	4:05PM - 4:30PM
Track 1	Singleton	**System Security Engineering** 4D1	19864 Field Programmable Gate Array (FPGA) Assurance ▶ Mr. Ray Shanahan, *Department of Defense*	19891 Using Cyber Resiliency Frameworks to Engineer and Manage IT Services ▶ Dr. Subash Kafle, *The MITRE Corporation*	19863 Survey of Cyber Security Framework across Industries ▶ Mr. Ambrose Kam, *Lockheed Martin Corporation*
Track 2	Miller	**Education & Training** 4D2	19756 Teaching Executable Model-Based Engineering (MBE): Best Practices ▶ Mr. Matthew Cotter, *The MITRE Corporation*	19760 The Systems of Systems (SoS) Primer: A Guide to SoS for all Expertise Levels ▶ Ms. Laura Antul, *The MITRE Corporation*	19865 Breaking Out: Systems Engineering To Go ▶ Mr. Zane Scott, *Vitech Corporation*
Track 3	Von Sternberg	**Engineered Resilient Systems** 4D3	19712 Implementation of Clustering Analysis in Engineered Resilient Systems Tools for Enhanced Trade Space Exploration of Military Ground Vehicles ▶ Mr. Andrew Pokoyoway, *TARDEC*	19818 Tradespace Analysis and Exploration incorporating Reliability, Availability, Maintainability, and Cost ▶ Dr. Lance Fiondella, *University of Massachusetts*	19741 Security at Design Time: Addressing Resilience in Mission Critical Cyber-Physical Systems ▶ Mr. Thomas McDermott, *Georgia Tech Research Institute*
Track 4	Gibson	**Program Management** 4D4	19847 Proactively Managing Supplier Relationships for an Integrated Product Development Program ▶ Ms. Beth Layman, *Layman & Layman*	19932 Improving Efficiency in Assembly, Integration and Test (AI&T) ▶ Mr. Jeff Juranek, *The Aerospace Corporation*	19842 "Other Transactions" - An Alternative to Business as Usual ▶ Mr. Richard Dunn, *Strategic Inst for Innovation in Govt Contracting*
Track 5	Sellier	**Environment, Safety & Occupational Health** 4D5	19766 ESOH Management in Agile and Rapid Acquisitions Using Digital Engineering ▶ Mr. Sherman Forbes, *SAF/AQRE*		
Track 6	Korman	**Enterprise Health Management** 4D6	19523 Mission-Based Forecasting for the Sustainment Enterprise ▶ Col Greg Parlier, USA (Ret.), *GH Parlier Consulting*		

Thursday, October 26 - Continued

			4:30PM - 4:55PM	4:55PM - 5:20PM	
Track 1	Singleton	System Security Engineering 4D1	19722 The Systems Challenges of Cybersecurity ▶ Mr. Jeffery Zili, *Vitech*	19895 Modeling Cyber Security ▶ Mr. Ambrose Kam, *Lockheed Martin Corporation*	
Track 2	Miller	Education & Training 4D2	19914 Bridging the Gap to MBSE ▶ Mr. James Baker, *Sparx Systems*	19719 Introducing Cyber Resiliency Concerns Into Engineering Education ▶ Mr. Thomas McDermott, *Georgia Tech Research Institute*	
Track 3	Von Sternberg	Engineered Resilient Systems 4D3	19781 Additive Manufacturing – Challenges... Program Manager ▶ Mr. William Decker, *DAU Huntsville*	20051 Model-Based Engineering: Opportunities, Risks, and Best Practices ▶ Dr. Marc Halpern, *Gartner, Inc.*	

5:20PM **Adjourn Conference**

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Policy Engineering

Applying SE to Develop Better Policies

STEVEN H. DAM, PH.D., ESEP
CHRIS RITTER
SPEC INNOVATIONS
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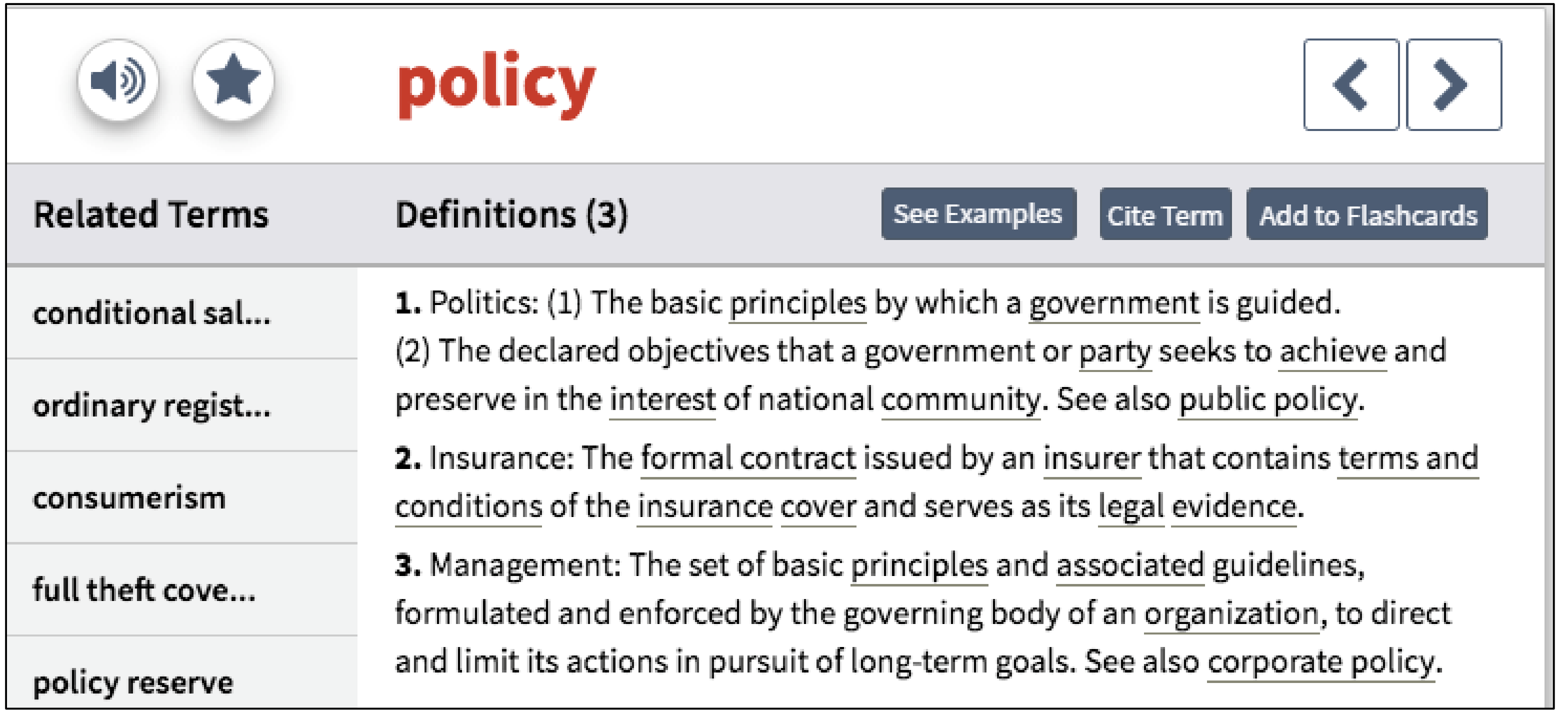
Outline

1. What Is a Policy?
2. How Can We Apply SE to Improve Policies?
3. How Can We Implement this Approach without Scaring Policy Makers?

1. WHAT IS A POLICY?

What's a Policy

- Lot's of definitions, but the "Business Dictionary" shows the key elements highlighted
  - Guiding principles
  - Organizational governance
- But what is it in Systems Engineering terms?



http://www.businessdictionary.com/definition/policy.html accessed 10/9/2017

Policies in SE Terms

- Policies contain *requirements and constraints* for the organization
- Those requirements and constraints are *allocated or traced* to different parts of the organization
- Policies also frequently contain processes or procedures which are essentially implementation *scenarios*

Why not apply systems engineering techniques to analyze these policies to make sure they work prior to implementation?

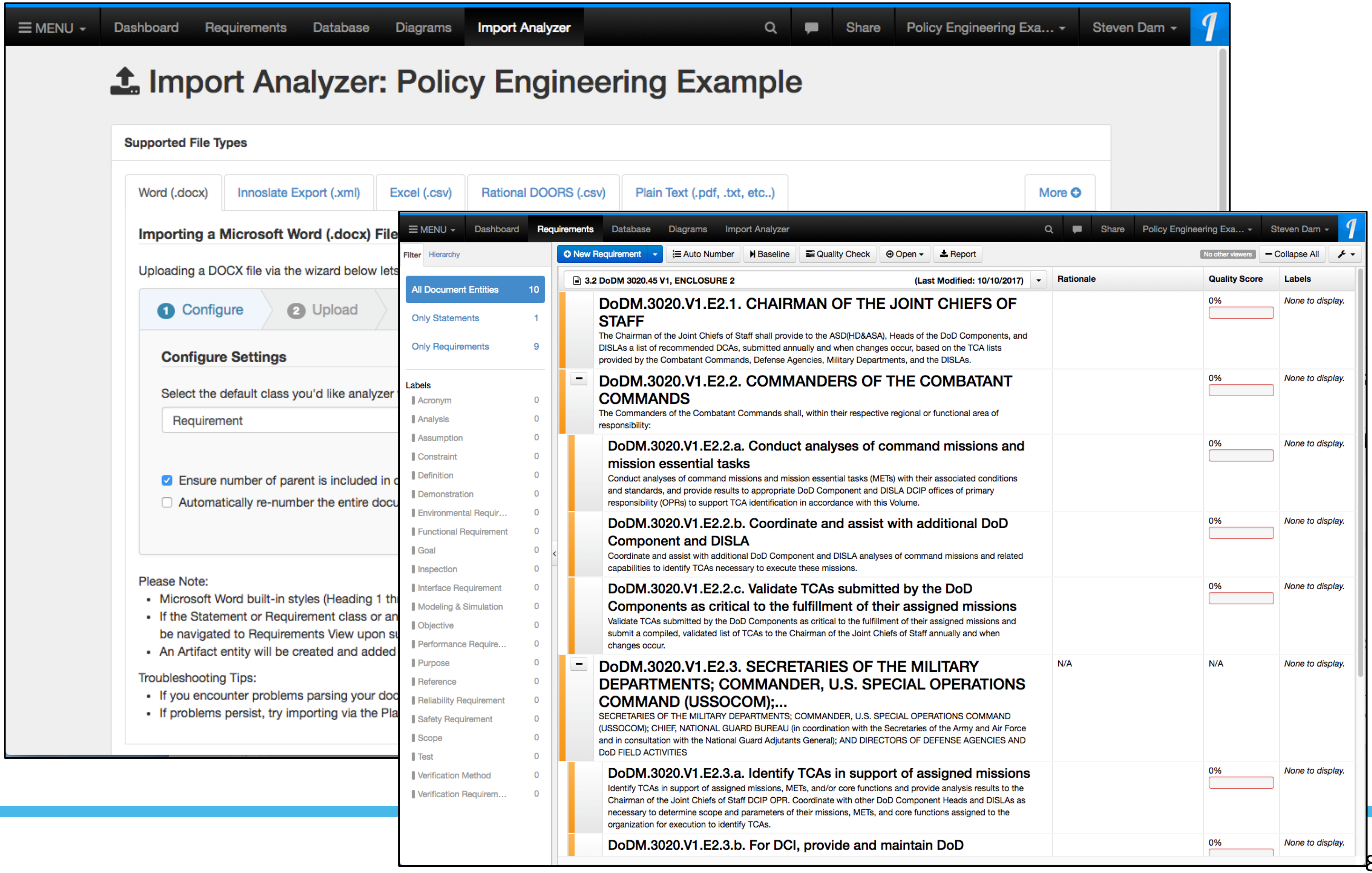
2. HOW CAN WE APPLY SE TO IMPROVE POLICIES?

Apply Requirements Analysis

- Treat the policy draft(s) as a requirements document
- Analyze for quality (clarity, completeness, etc.)
- Enhance the text using these quality criteria
- Use a “document view” for presentation to stakeholders
- Capture comments in tool and produce ”comment matrix”

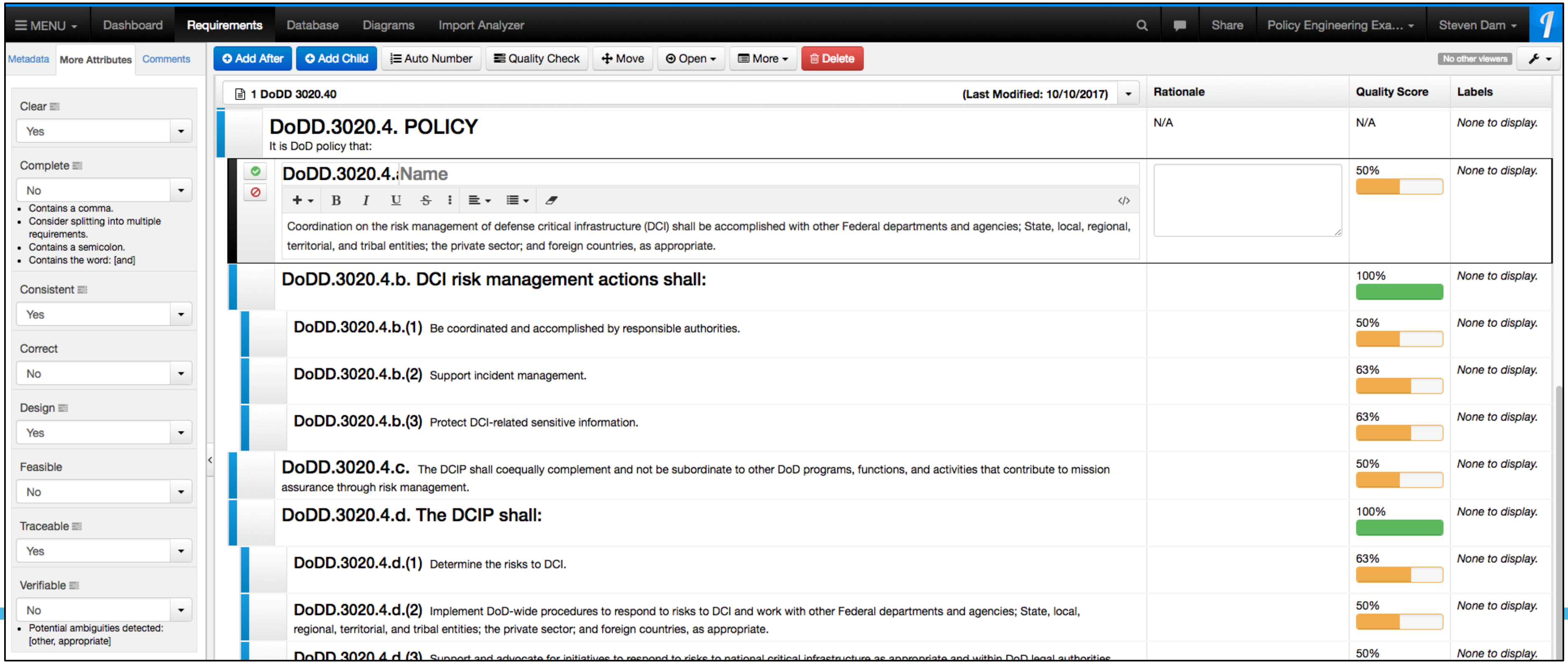
RA: Treat the policy draft(s) as a requirements document

- Import documents into a requirements analysis tool
- Break paragraphs into individual requirements for analysis
- Note many statements may not be written like a requirements, but still are requirements

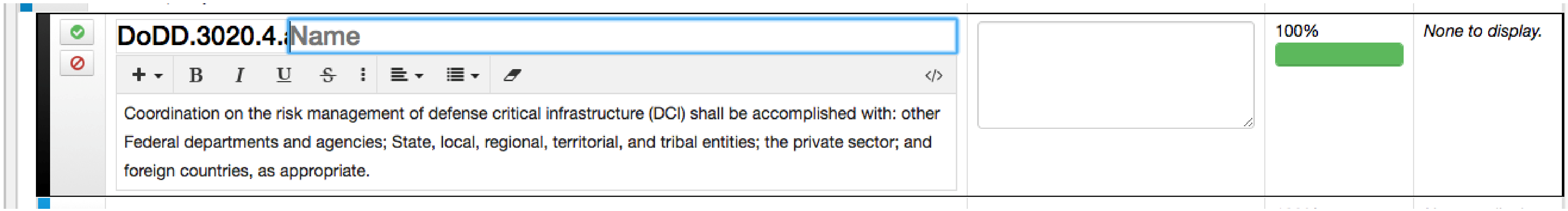


RA: Analyze for quality (clarity, completeness, etc.)

- A number of the standard quality factors apply directly to policies (clear, complete, consistent, and correct)
- Other may apply, depending on the specific policy (Design, Feasible, Traceable, Verifiable)



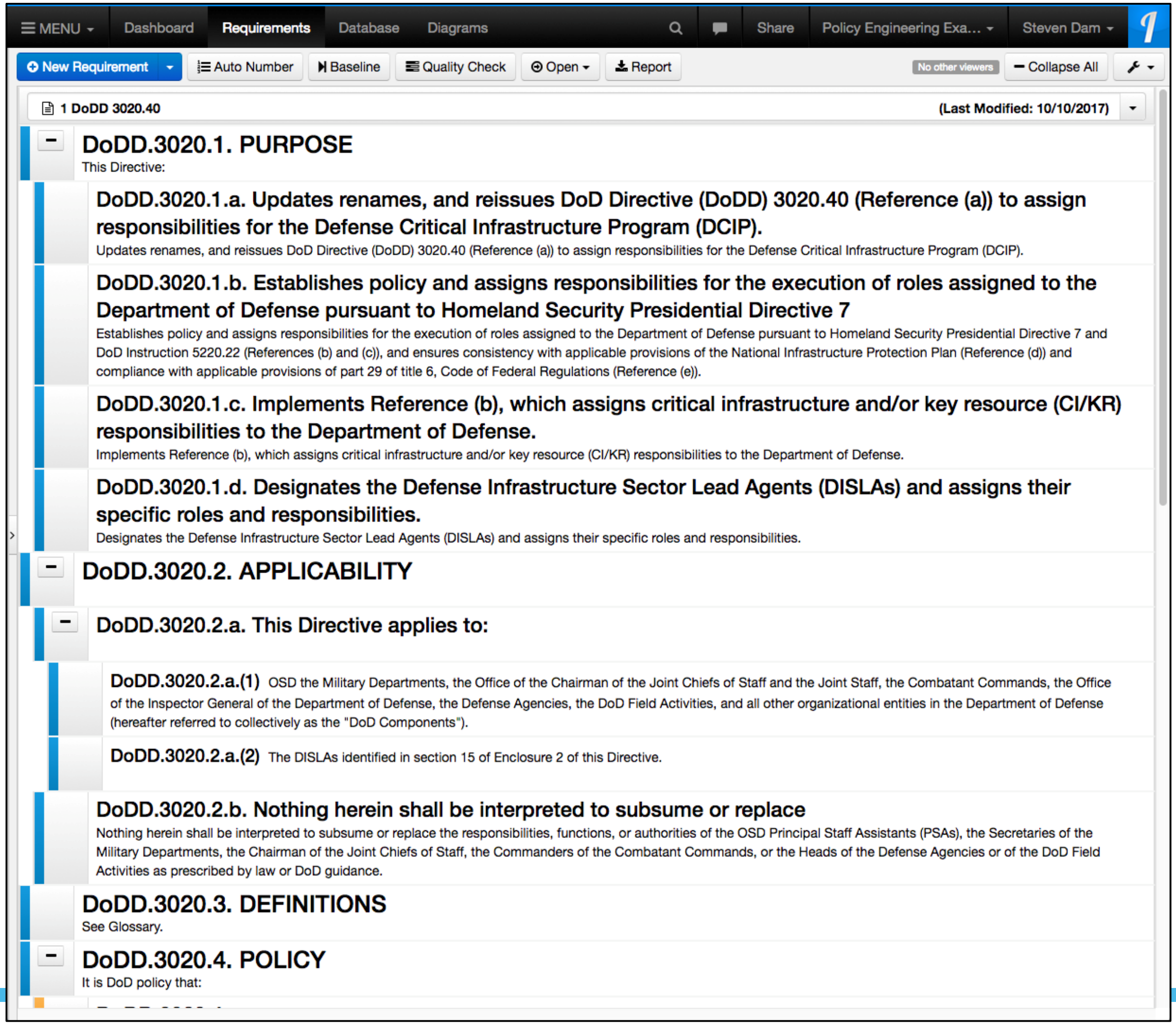
RA: Enhance the text using these quality criteria



- Enhance the grammar
- Simplify, where possible
- Break into separate requirements, if desirable

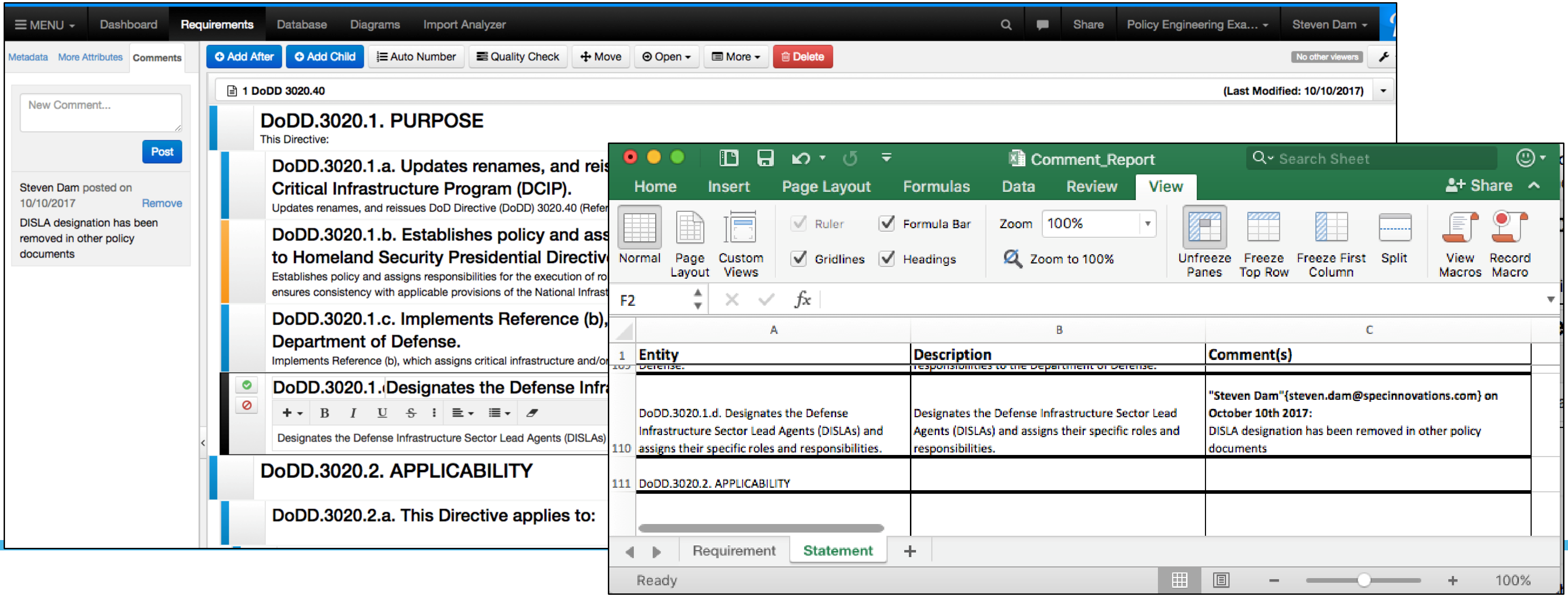
RA: Use a "document view" for presentation to stakeholders

- Hide information that may confuse a reader/viewer
  - e.g., columns with quality score, labels, other attributes
- Readers can then view it as they would a document in MS Word, but any comments and other information would be accessible at the paragraph level
- Hyperlinks can be provided to guide them to other documents



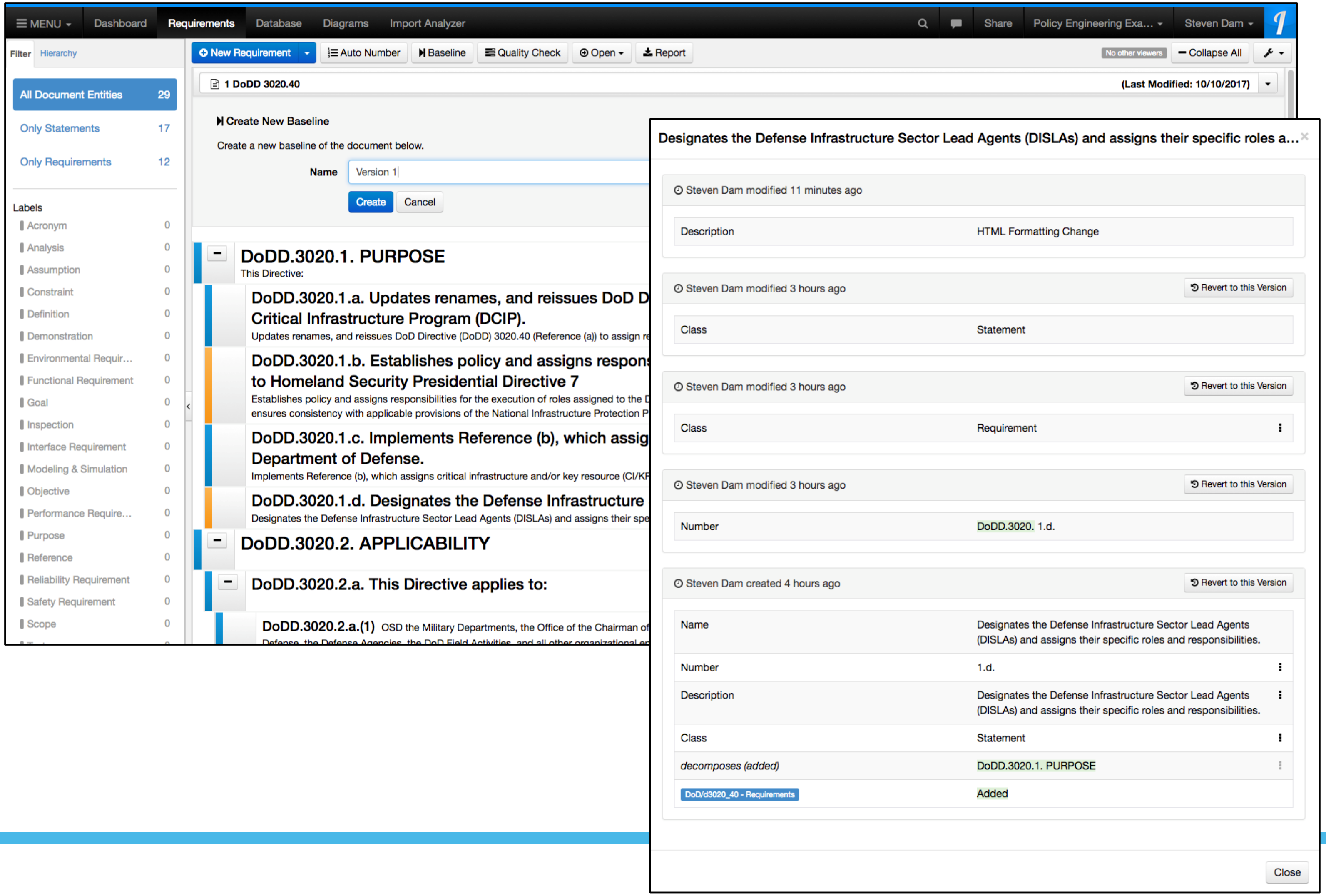
RA: Capture comments in tool and produce "comment matrix"

- Use commenting features where available
- Special reports may be desired



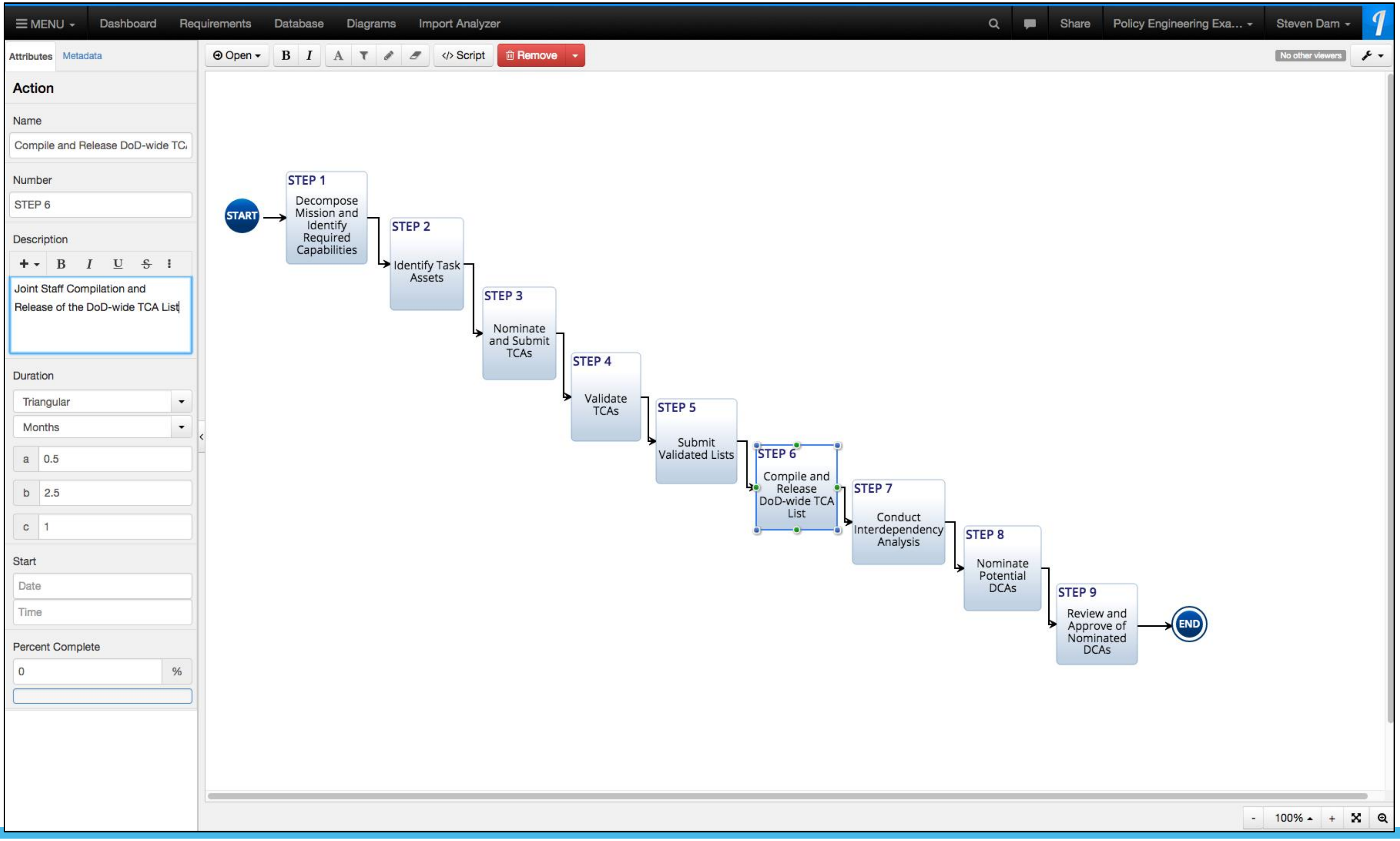
Configuration Manage Policy Documents

- Baseline
- Track change history
- Branch/fork for excursions
- Store files in database



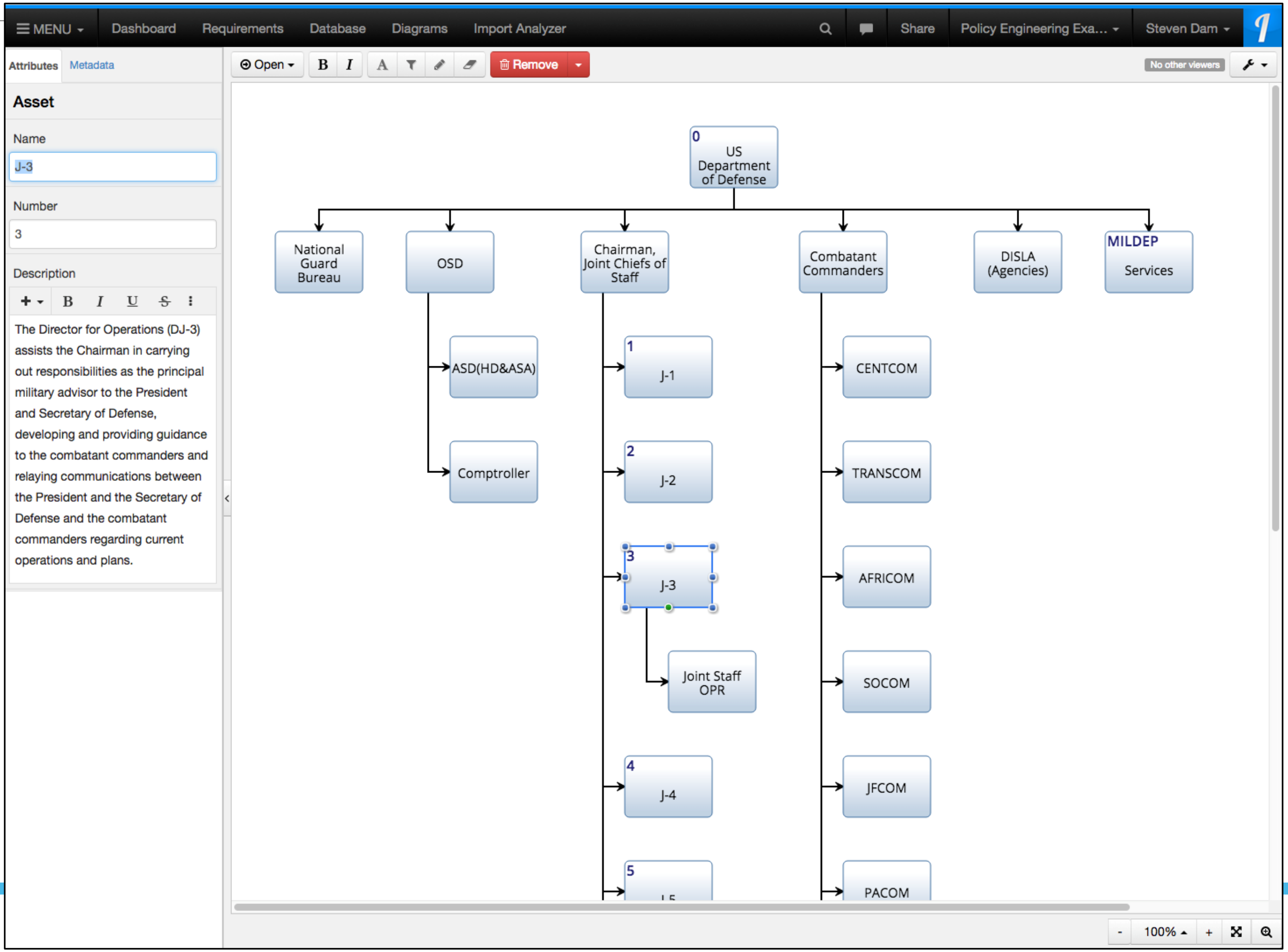
Model Processes and Procedures

- Review policies for processes and procedures
- Create a functional model
- Trace back to requirements
- Enter time distributions
- Associate costs
- Allocate to performing elements



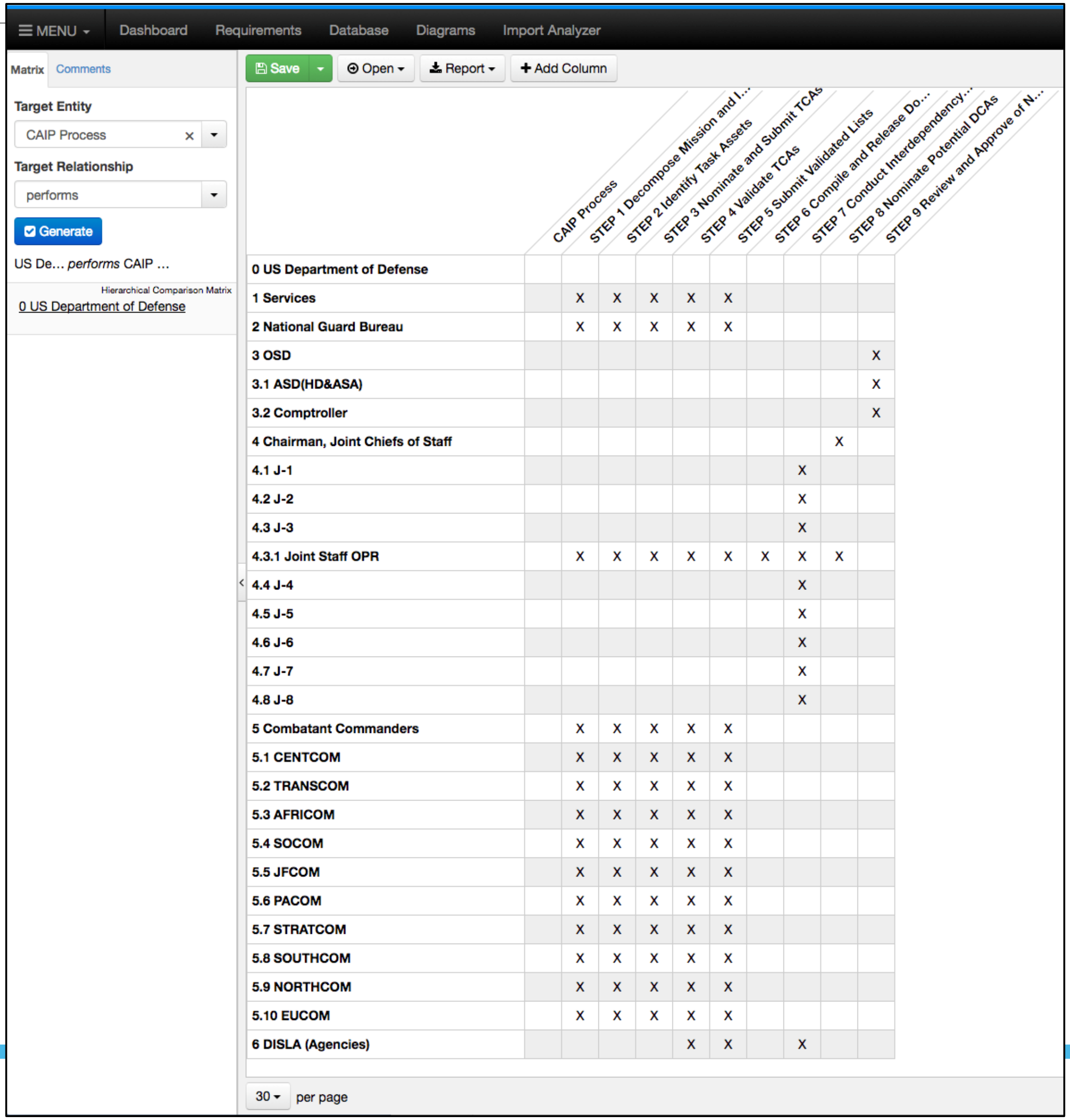
Capture Organization Information in Database

- Create hierarchy
- Allocate actions and requirements as appropriate



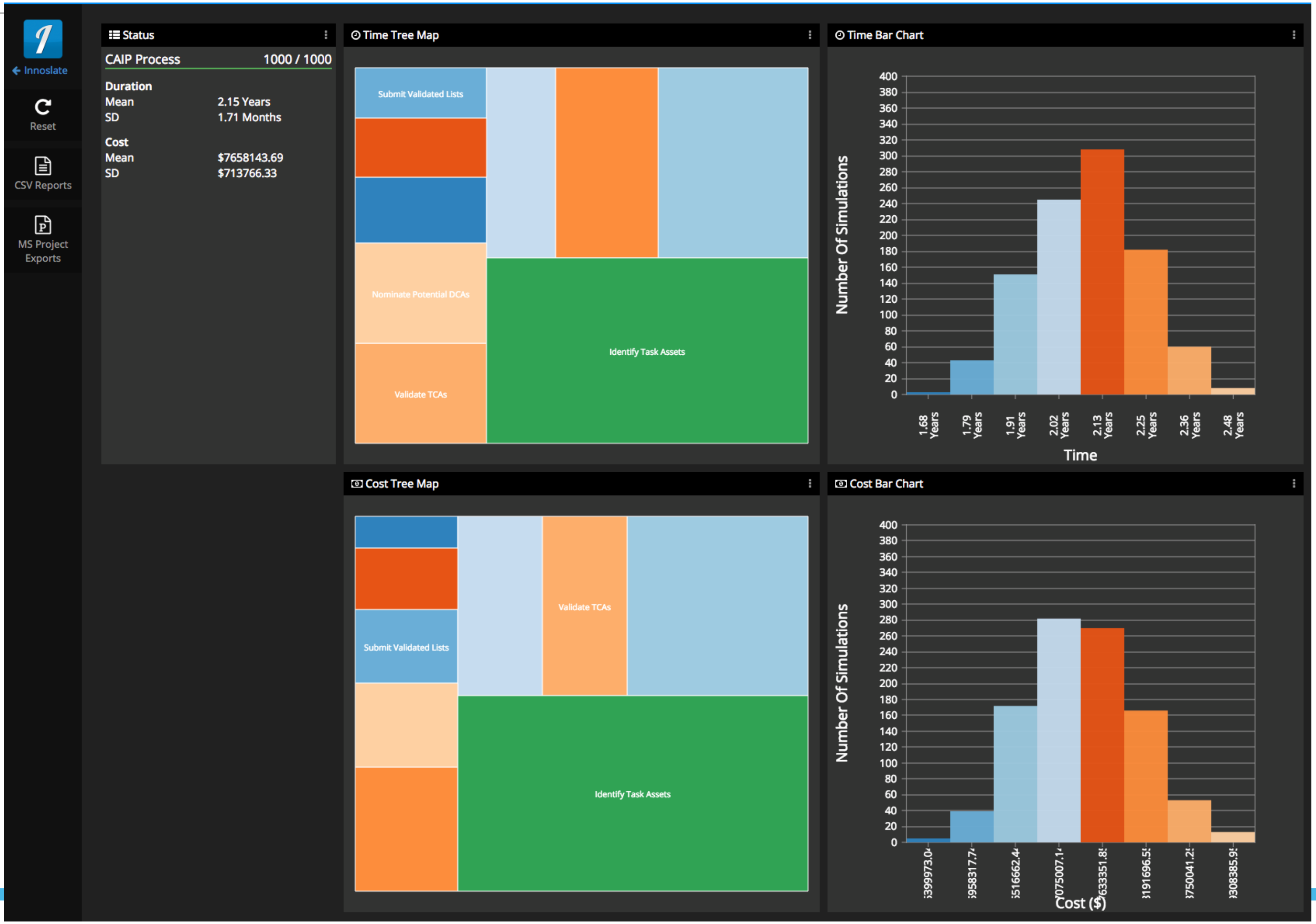
Allocate Tasks to Organizational Elements

- Create relationships between tasks and organizations, according to policies
- Use this information to determine if the correct organizations are being correctly tasked
- Suggest changes, as appropriate, and/or identify risks to the organization and mitigation strategies



Verify Processes Work through Simulation

- Uses timing and cost information for each step
- Distributions in time and cost provide a more realistic range of the process
- These distributions also provide a measure of cost and schedule risk



3. HOW CAN WE IMPLEMENT THIS APPROACH WITHOUT SCARING POLICY MAKERS?

Implementation Strategy

- Don’t tell them you are doing systems engineering
  - Most people think systems engineering only applies to hardware and software
- Perform the analysis, but only show results in a form that they will easily accept
  - No UML, SysML, IDEF0, etc. drawings
  - Simple summaries of changes (i.e., document markups and text summaries)
  - No engineering jargon!
- Wait for them to ask how you got the results
  - Then just show them the bare minimum of SE information
  - Once they buy into these, you can start show them more

Summary

- Systems engineering can dramatically improve policy development and implementation
- You must work fast in doing your analysis – use multi-purpose tools with analytics to speed up your analysis and delivery
- Only show results, not how you got there … until necessary

High Performance Computing Portal
Lowering Barriers / Modern HPC Ecosystems

NDIA 20th Annual Systems Engineering Conference
Oct 23-26, 2017

Ms. Laura J. Ulibarri, Maui High Performance Computing Center Director

Approved for Public Release 10-Oct-2017

HPC Portal

- **Secure, Web-based Access to DoD HPC Assets**
  - End-to-End, Full-Featured, Web-Based Workflow
  - Highly Productive User Experience
  - **Enabling Non-Traditional Users & Users with Constrained Desktops**

- **Transformative, Successful, Growing, Agile**

- **Enables 3rd Party Developers & Innovative Applications**
  - **A Simple Services API Abstracts the HPC Workflow**

Easy, Secure, & Powerful: Demolishes entry and access barriers to DOD HPC Services

Access: Game Changer for DOD HPC

Secure Sign On

DoD-Hosted OpenID 2-Factor Logon

No User Signups

"Zero Footprint" Browser Access

No Client Installs / Configurations

No Kerberos Kit Required

Software as a Service (SaaS)

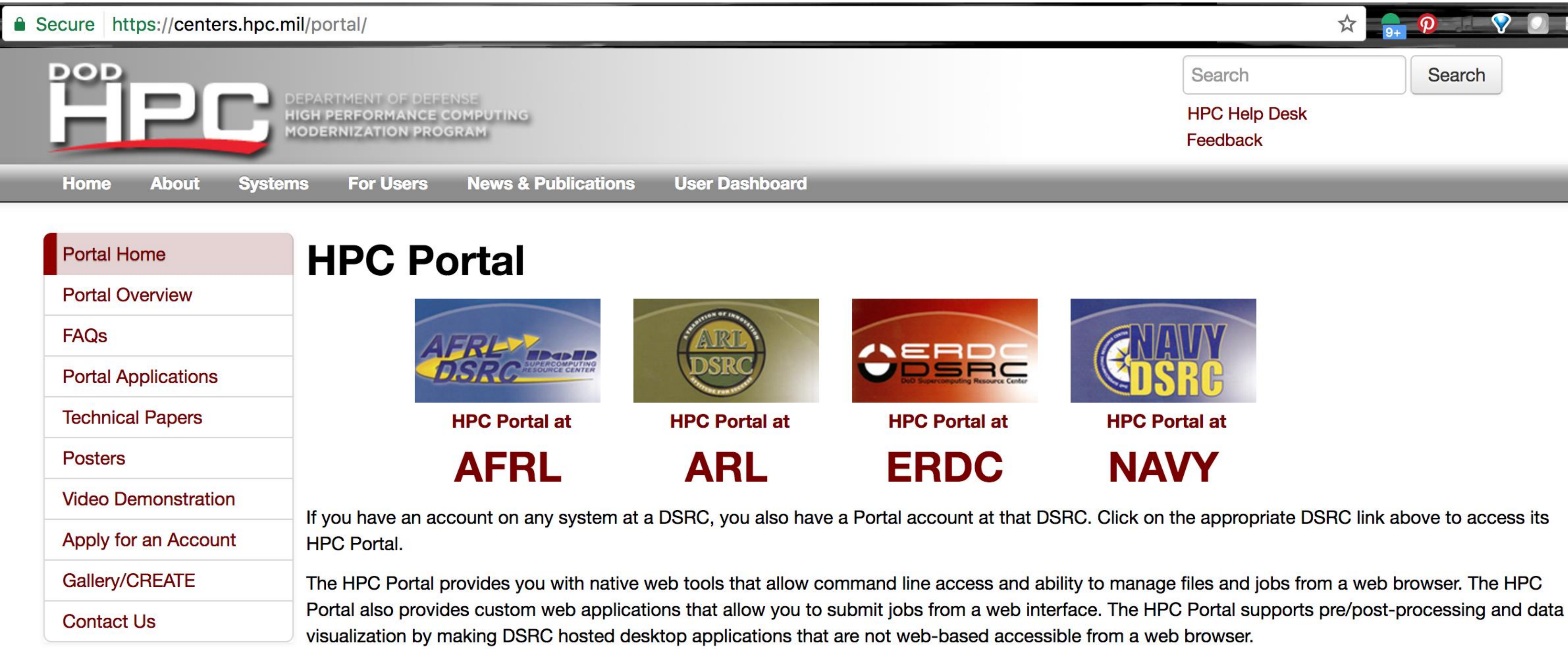
Instant Updates to Users

Manage Access through Accounts

Enforces Access Controls

Access from Any Network

Each DoD Supercomputing Resource Center has a Portal



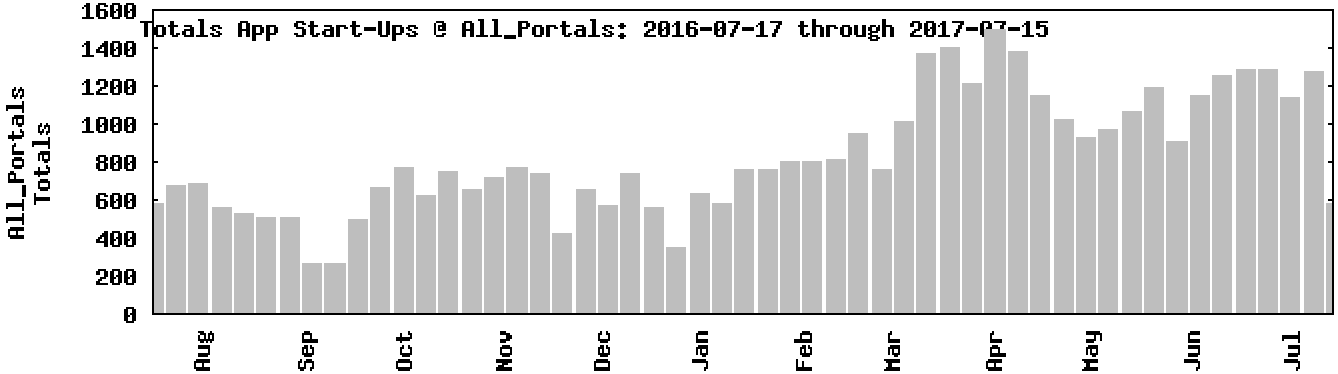
https://portal.hpc.mil*

* Note: DoD issues their own certificates, you may get an “unsafe error”

HPC Portal Adoption: APPLICATIONS

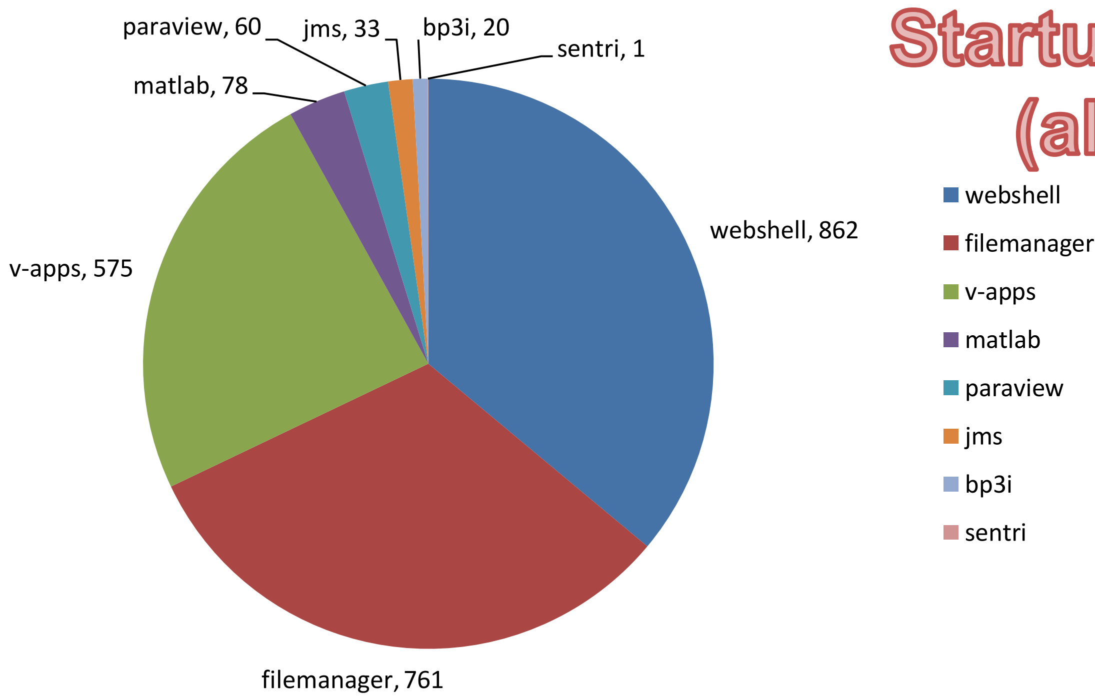
DOD HPC MODERNIZATION PROGRAM

Total Webapp Starts (last 52 weeks)



Webapp Starts (7/2 – 7/16)

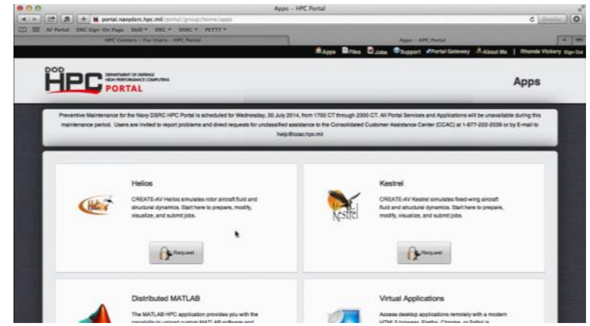
HPC Portal Application Startups ~ 1200/week (also doubled)



Portal for Users

- **Job Creation, Submission, Monitoring, Termination, Visualization**
  - ***Virtual Applications***
    - Pre/Post-Processing & Visualization
    - Access any X-Based Application
    - Quickly automate repetitive workflows
  - ***Native Web Applications***
    - Customized User Interfaces for data entry, control and analysis
- **Utilities**
  - **Command Line Interface**
  - **File Management**
  - **User Account Information**
  - **Help & Forums**

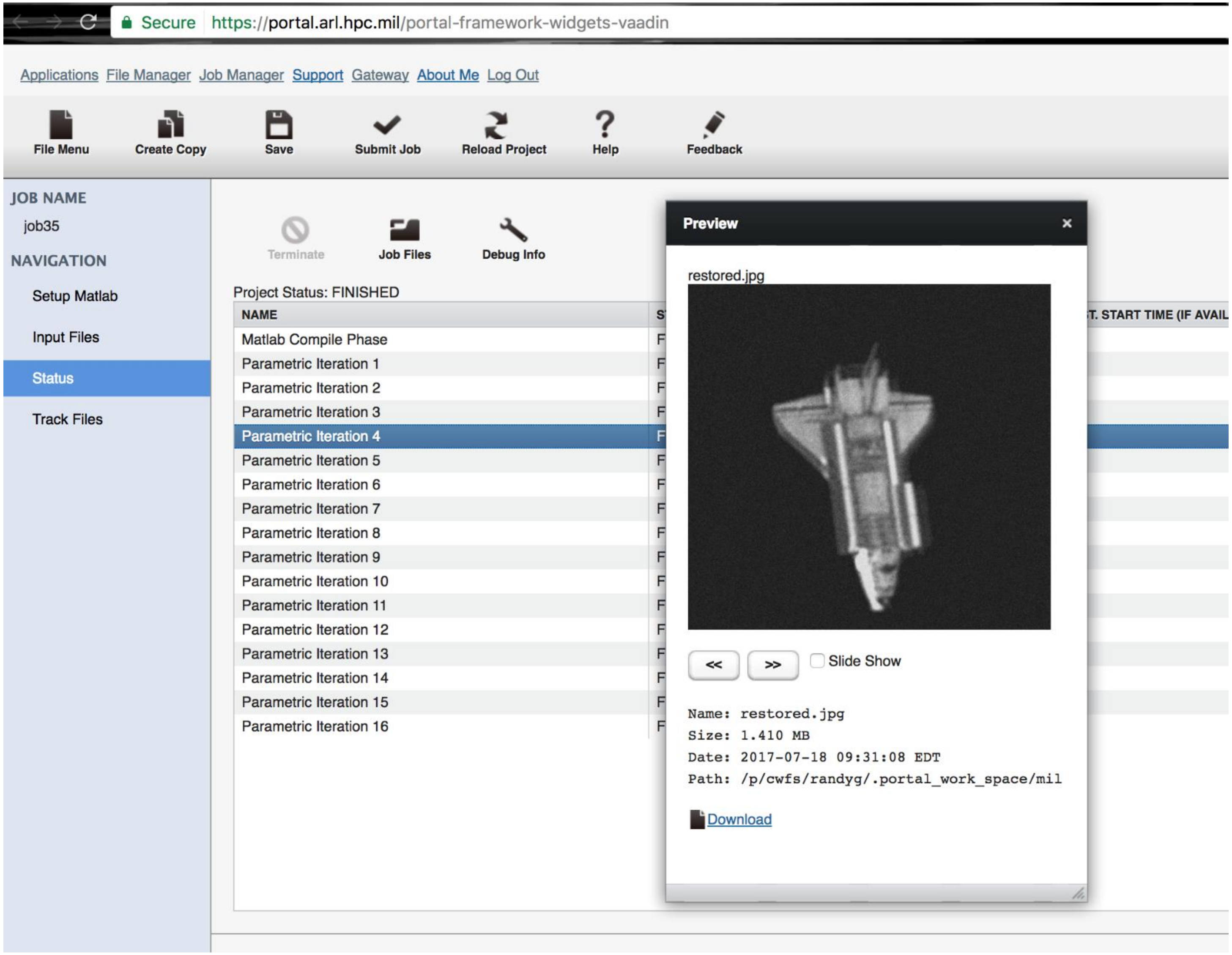
HPC Portal-Hosted Web Applications



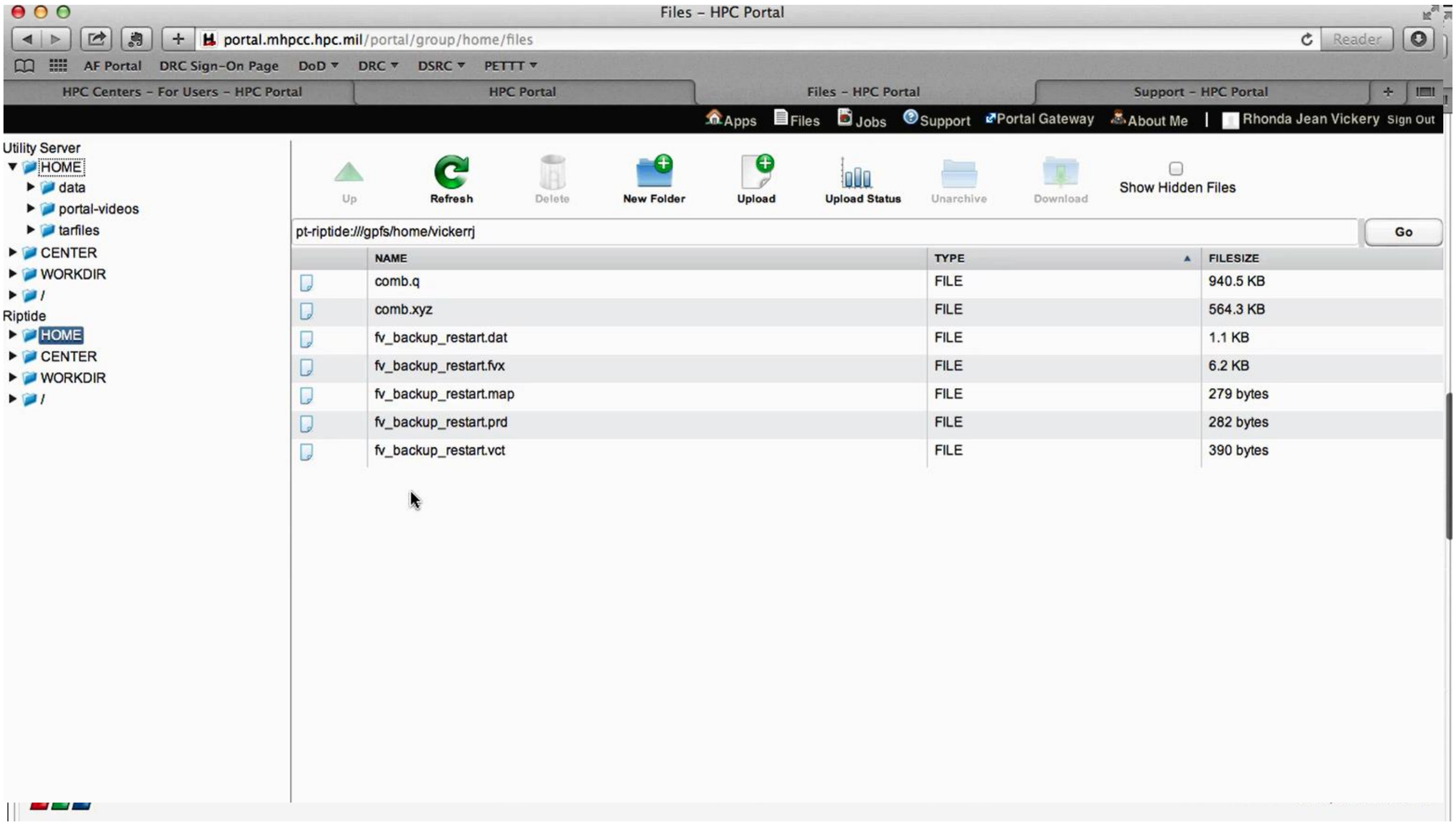
- **CREATE-AV Web Kestrel**
- **CREATE-RF WebSENTRi**
- **CREATE-MG WebCapstone**
- **CREATE-GV Mercury/MAT**
- **JMS/ARCADE (Space Situational Awareness)**
- **BP3I (Blast Protection Institute)**
- **ParaView Web (3D Visualizations on Utility Servers)**
- **Jupyter Notebooks (on HPC Resources)**
- **Distributed Matlab**
- **Collaboration / Repository Management—in work**

50,000+ application starts and growing!

Native Web Applications: Matlab

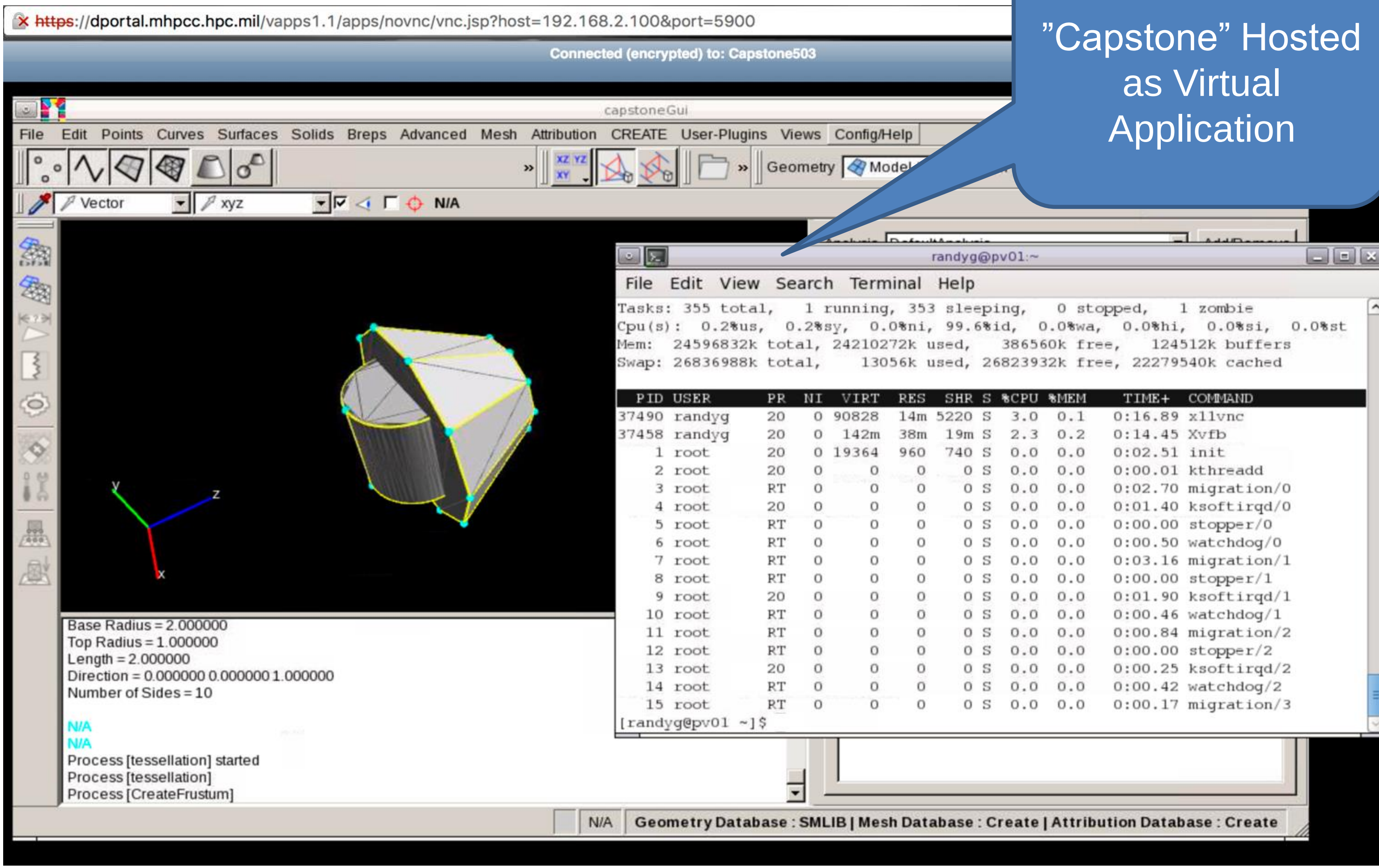


Native Web Apps: File Manager



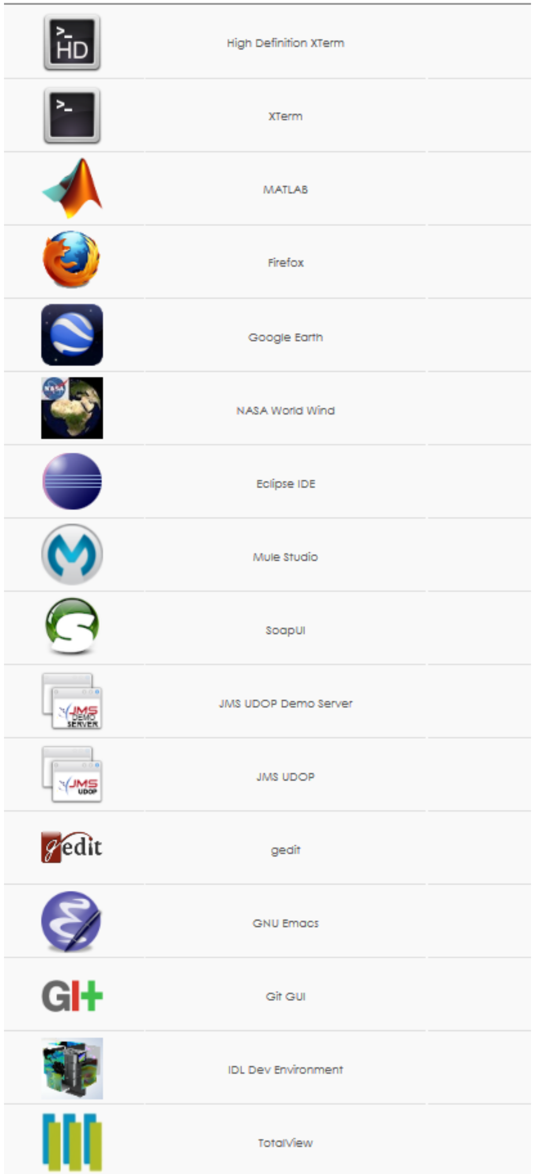
Virtual Applications

Remote Display of X-Based Applications

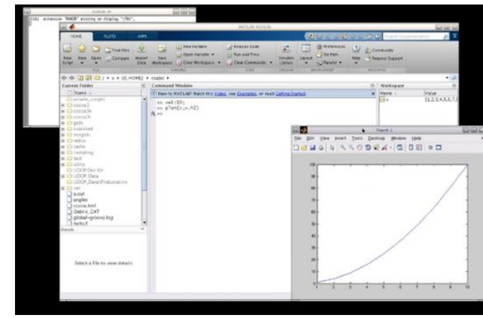


”Capstone” Hosted as Virtual Application

Portal for HPC Developers



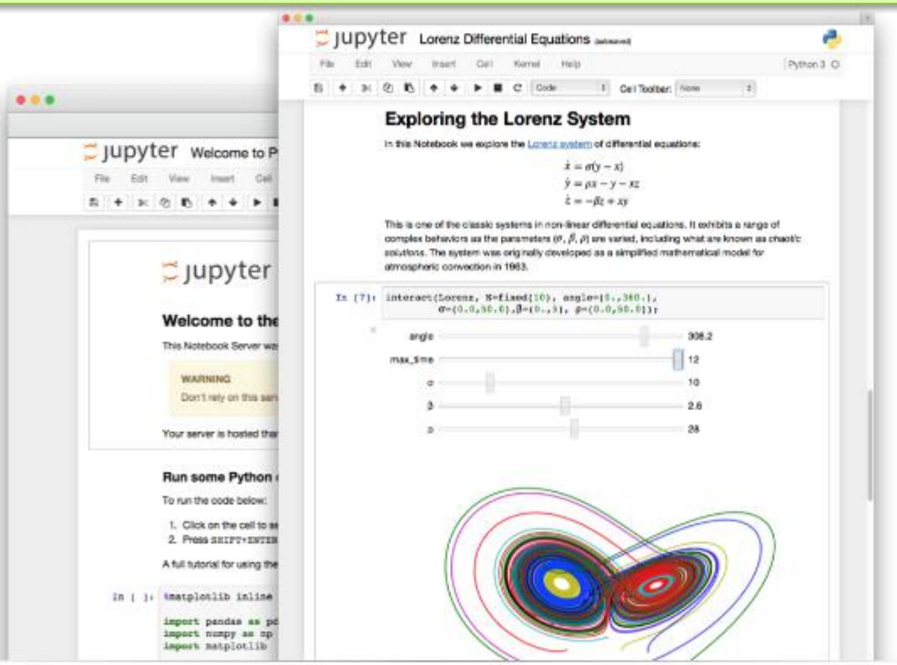
- **Integrated Development Environments**
- **Editors**
- **Debuggers**
- **Configuration management**
- **File manager**
  - Transfers to/from client machine
  - Permission editing
- **Command line**
- **Specialized HPC Workflows**
- **Visualization**



Matlab running through browser

Jupyter Notebooks on HPC Portal

Open source, interactive data science and scientific computing platform (web-based) supporting over 40 programming languages



The Jupyter Notebook

The Jupyter Notebook is a web application that allows you to create and share documents that contain live code, equations, visualizations and explanatory text. Uses include: data cleaning and transformation, numerical simulation, statistical modeling, machine learning and much more.

</> Language of choice

Share notebooks

Interactive widgets

Spark Big data integration

Focus is On Data Analytics & Reproducible Workflows for R&D

Portal Platform Enables Integrated M&S

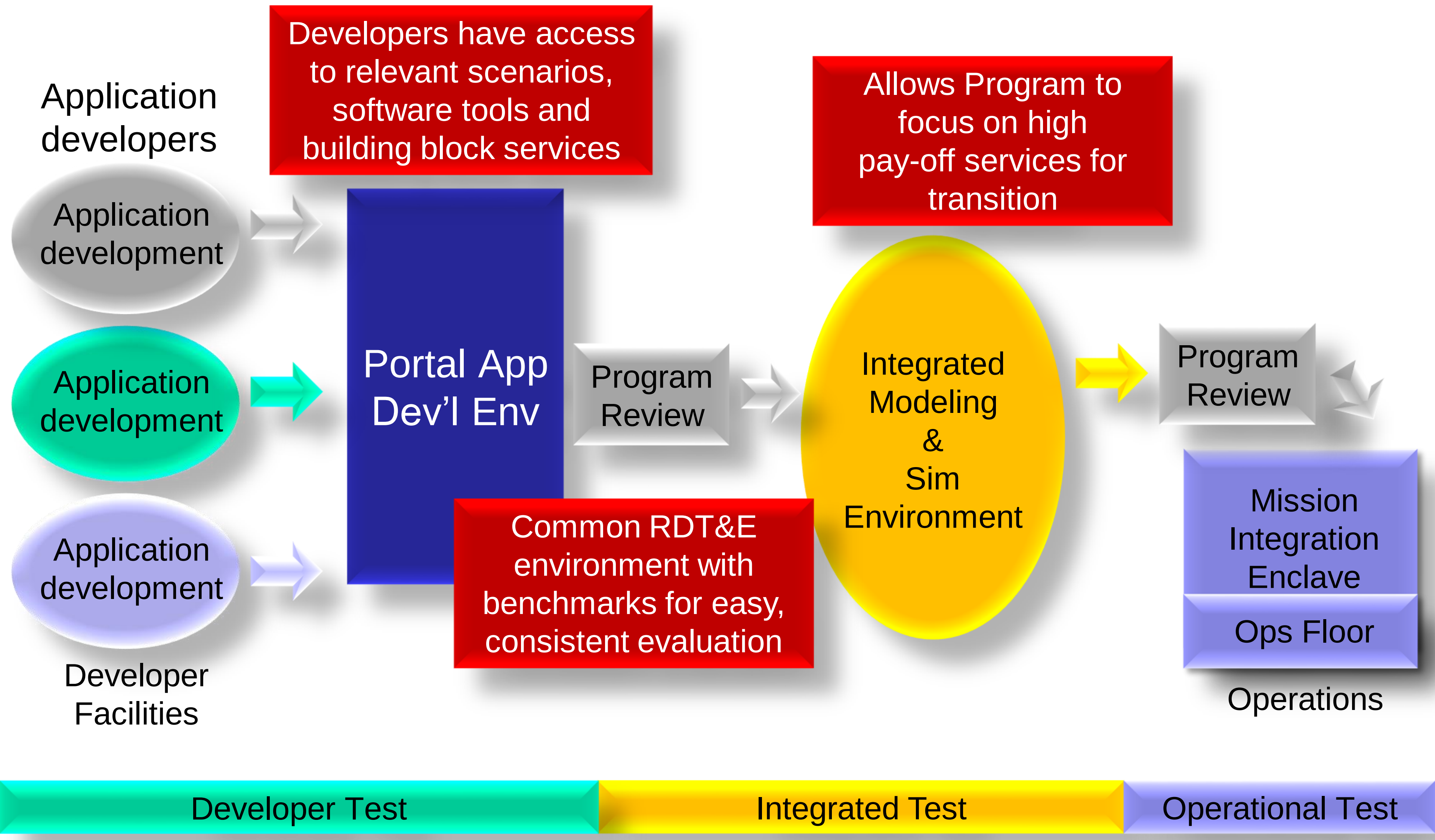
Web access to development tools and resources

Automated web-service generation from executables

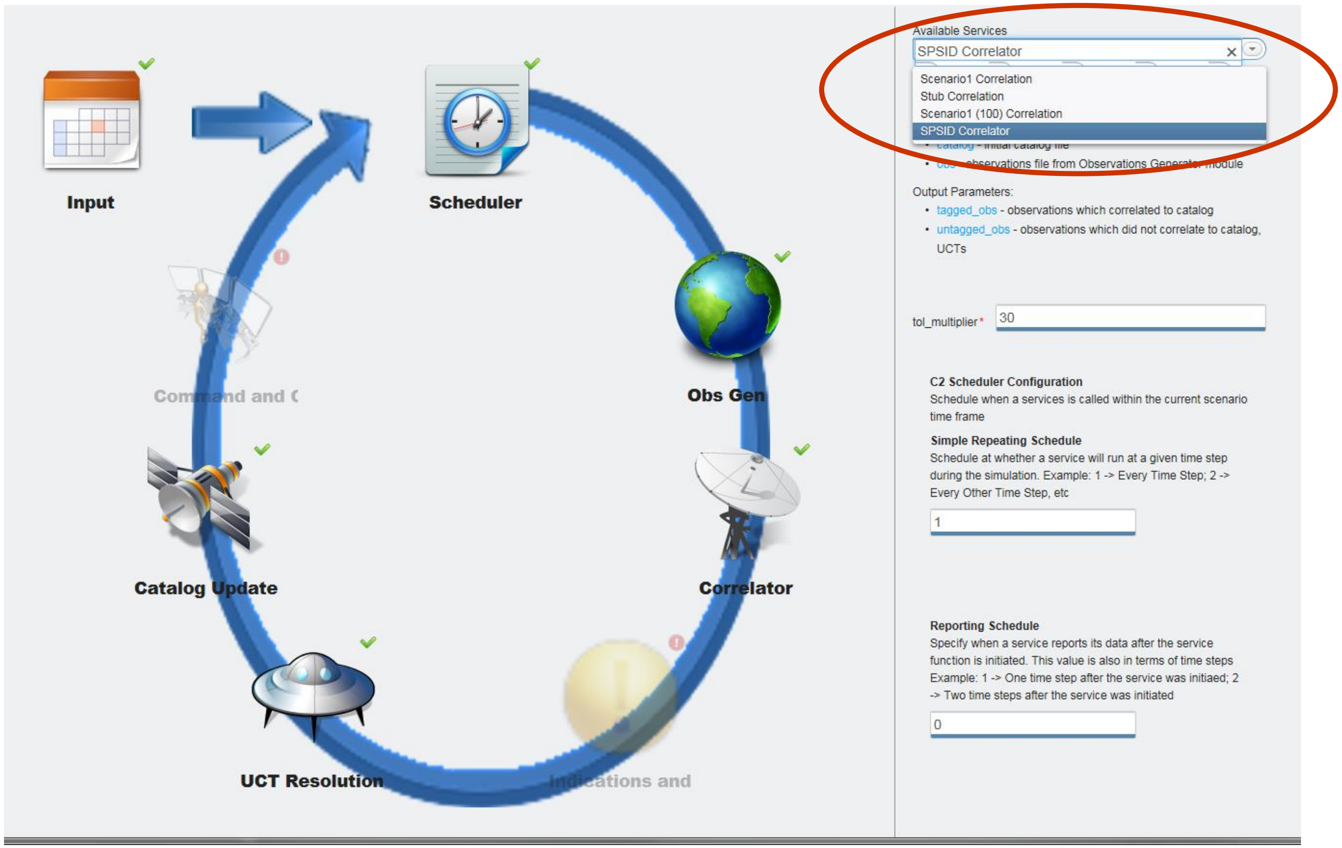
End-to-end performance testing in user sandbox

Collaboration and market survey tools and resources

Portal Supports Technology Integration into Acquisition: e.g., ARCADE



Example: Custom Workflow Tool for Trade-Space Exploration and Analysis



- **User can select services based upon group permissions**
  - Group permissions also used to protect intellectual property
- **Different combinations of capabilities can be tested to determine best approach**

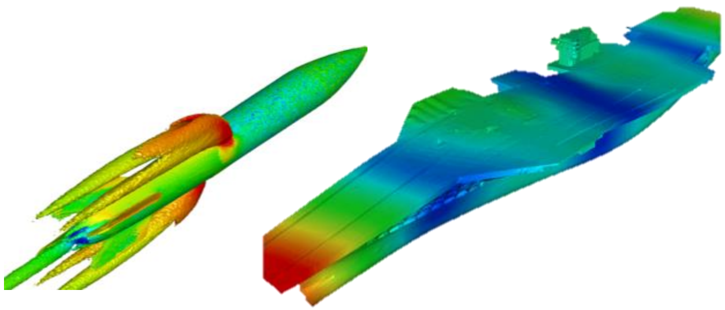
Key "Take Aways"… HPC Portal:

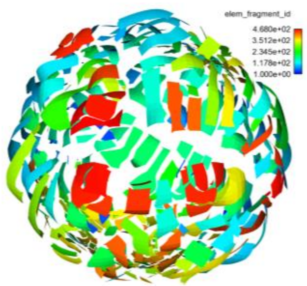
- Provides Modern/Productive Web-Based Workflow
- Demolishes Entry Barriers to DOD Supercomputing
- Enables 3rd Party Developers & Innovative Applications
- Supports a Modern HPC Ecosystem: *Portal as Platform for Innovative Solutions*
- Enables Collaboration, Advanced Work Flows & Acquisition Engineering

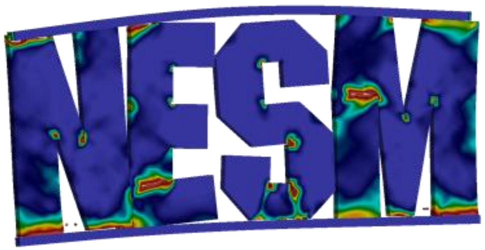
Questions?

Exceptional service in the national interest

Sandia National Laboratories







COMPSIM
LIKE IT REALLY HAPPENS

Multi-Disciplinary Integration of ModSim for Navy Applications

Greg Bunting, Garth Reese

gbuntin@sandia.gov 505-845-9708

U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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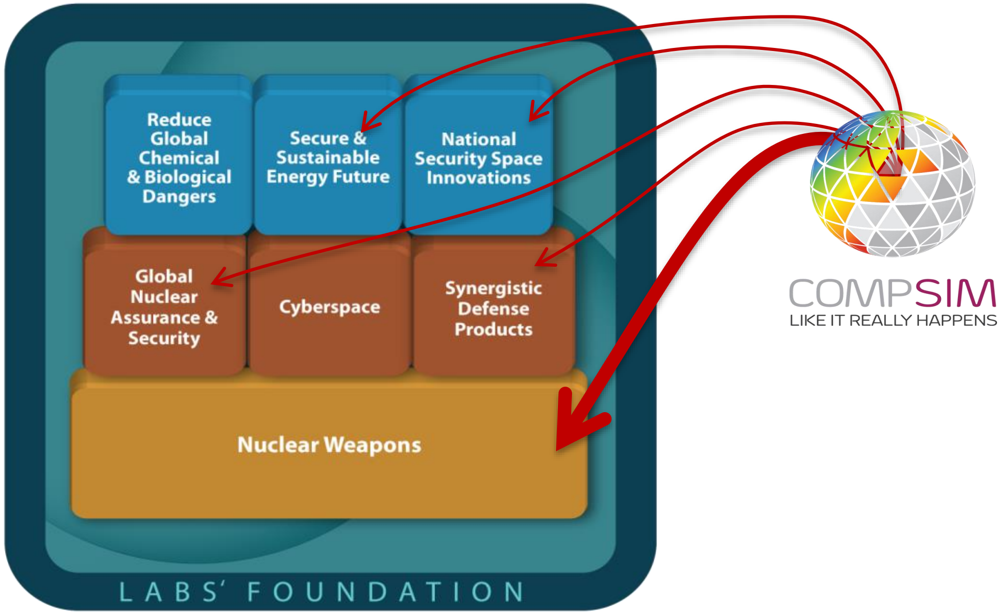
System Integration – Credible Solution

Our mission statement …..

Develop and deliver engineering-mechanics simulation applications & expertise for **credible** National Security decision making.

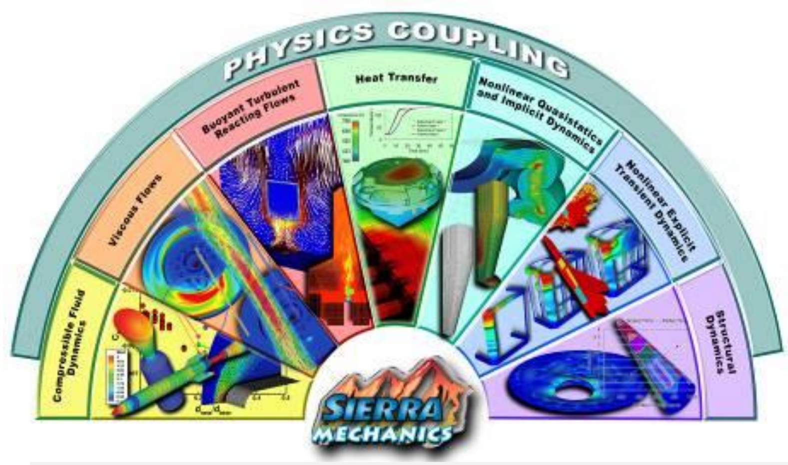


What we offer

SIERRA offers a wide range of simulation capabilities

- Solid mechanics
- Structural dynamics
- Acoustics
- Thermal analysis
- Fluid dynamics
- Aerodynamics

COMPSIM
LIKE IT REALLY HAPPENS



All built on common infrastructure

- Sierra also couples with other Sandia tools
  - Pre and post processing (Cubit, Paraview, SAW)
  - Design and optimization (Dakota)
  - Other computational simulation capabilities (CTH, Alegra, ITS)

Distinguishing strengths are

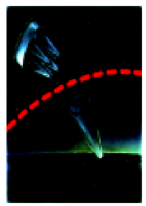
- Robustness: production code (SQE)
- Performance: parallel scalability, focus on NGP
- Credible: V&V, UQ, QMU
- Multi-scale and multi-physics
- Access controlled code for support of National Security Mission

Our customers
Nuclear Weapons Program & Analysts

- NW Program is the principal driver for Sandia's Computational Simulation efforts

Delivery

Separation shock/ Aerodynamic Heating



Staging shock

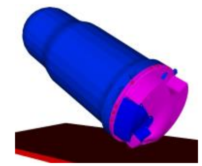
Random vibration

Survivability

Radiation Effects

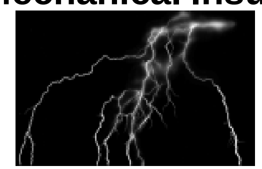
Assured Performance & Manufacturing

Assured Safety and Security



Mechanical Insult

Thermal Insult



Electromagnetic Insult

Security Components

Safe & Secure Transport

SNL Engineering Codes are positioned to support the engineering needs of the complex

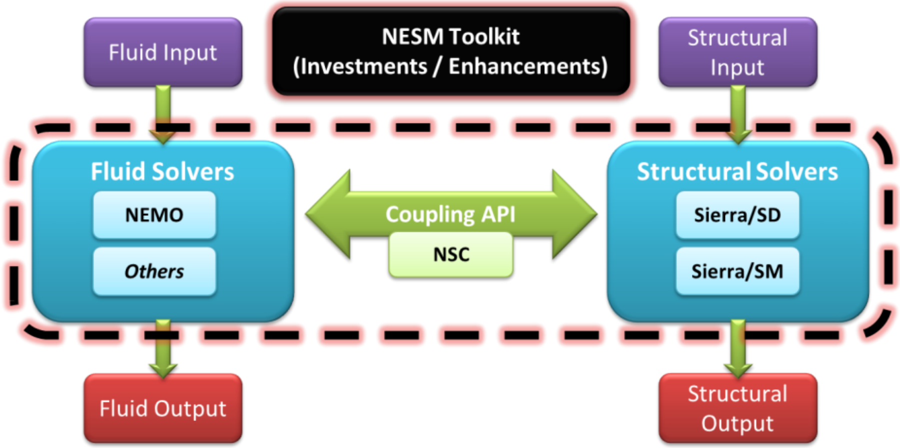
Navy Enhanced Sierra Mechanics (NESM) Acoustics

- NESM Capability for transient acoustic loading
  - Acoustic approximation of UNDEX loading
  - Scattering (split-field) formulation to allow for easy specification of sources
  - Various sources: plane/spherical step wave, spherically spreading source, Hicks Bubble.
  - Ellipsoidal infinite elements for far-field boundary condition
    - Allows large aspect ratio ellipsoids for slender structures
  - Parallel and scalable

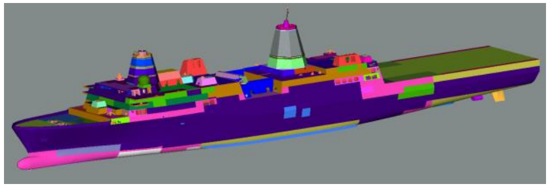
Overview - NEMO

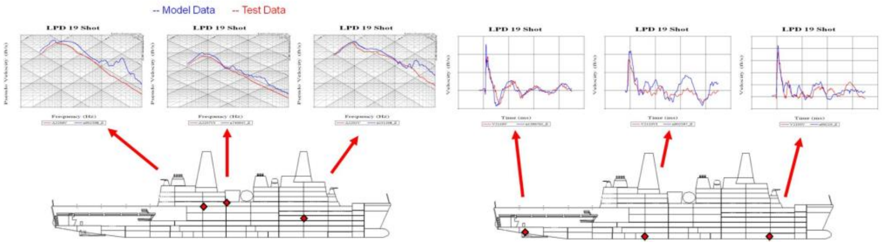
Navy Enhanced Sierra Mechanics (NESM)

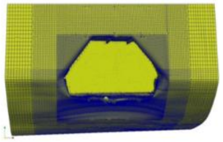
- Massively Parallel, Enhanced, Physics Based M&S Suite For Prediction Of Ship Shock Response & Damage Due To Weapon Engagements
- Modern Software Engineering Designed For Evolution
- Developed To Address Validation Of The Integrated Ship System Shock Hardness IAW OPNAVINST 9072.2A As Well As Live Fire Test & Evaluation (LFT&E) Needs
- **Leverages DOE-ASC Investment In Sierra Mechanics**
- **Leverages ONR Investment In The Implosion Program**

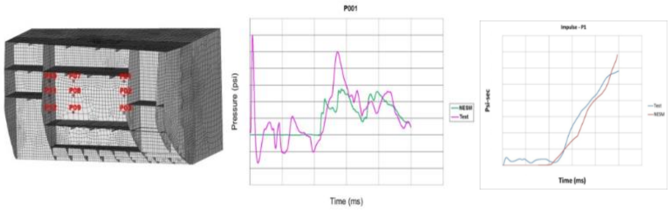


Emphasis on Validation for Both Shock Response & Ship Damage Compared to Physical Testing









Compsim Organization

1) Organized into several SCRUM-Teams, each developing and support a set or products
    1) Structural Dynamics (Linear)
    2) Solid Mechanics (Nonlinear)
    3) Thermal Fluids
    4) Toolkit
    5) Meshing
    6) Dev Ops
    7) Topology Optimization
    8) Verification & Validation

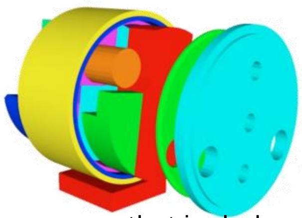
COMPSIM
LIKE IT REALLY HAPPENS

Computational Structural Dynamics

Structural Dynamics – Linear, static, implicit dynamic & modal response

Shared mechanics capabilities

- small deformations, small-strain linear material behavior
- solid & structural elements, constraint elements
- transient–modal–modal transient solution switching, multi-sequence analyses
- non-linear pre-load transfer from Sierra/SM



shock response that includes Sierra/SM preloads

Time domain, statics & transients

- parallel scalable domain decomposition solver with many constraints
- joint models with dissipation
- material property inversion
- stochastic material (elastic) properties

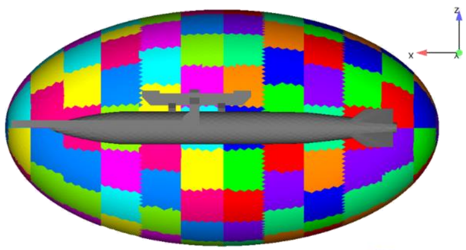
Frequency domain

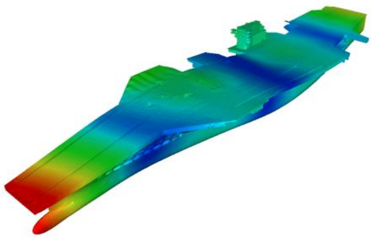
- Helmholtz solver, performance

Acoustics – linear

- absorbing boundaries
- acoustic pressure source inversion
- monolithic coupling with structural response

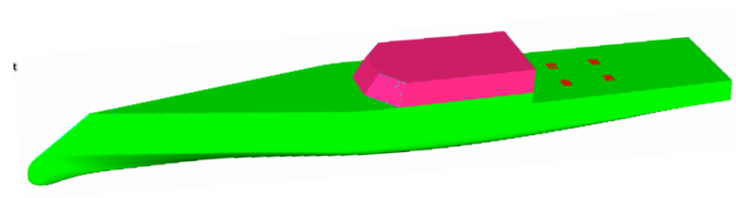
acoustic field modeling

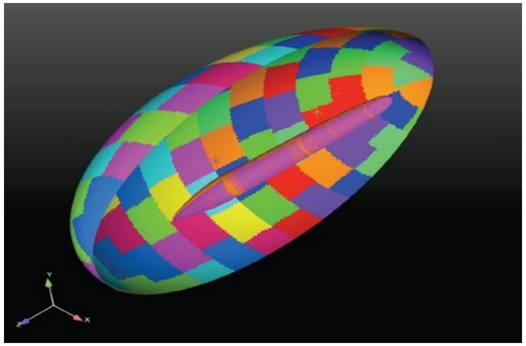




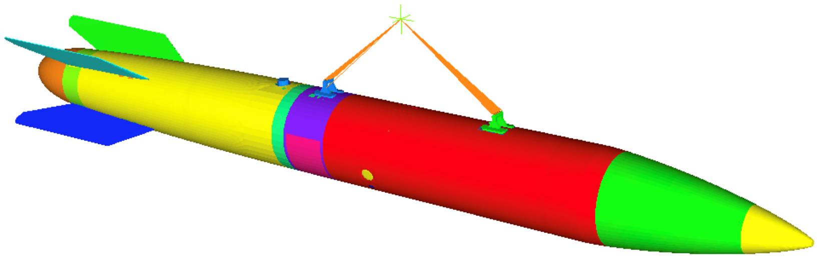
Capabilities Applicable to DoD Needs

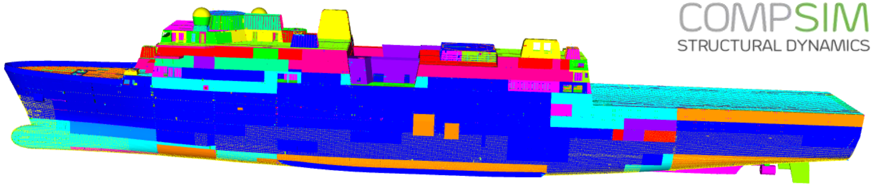
- Full Support for Structural Dynamics
  - Full element library, materials.
  - Modal, Transient Dynamics, Frequency Response. Superelements.
  - SRS, random vibration
  - Quadratic Eigen Value Analysis
  - Geometric and joint-type nonlinearities
- Full Support for Acoustics and Structural Acoustics
  - Mesh tying, infinite elements, PML, mild nonlinearity
  - QEV, Transient, Frequency Domain
- Inverse Methods Capability
- Coupled Physics
  - Fluids: nemo, aero and sigma
  - Thermal (unidirection): fuego
  - Nonlinear Mechanics



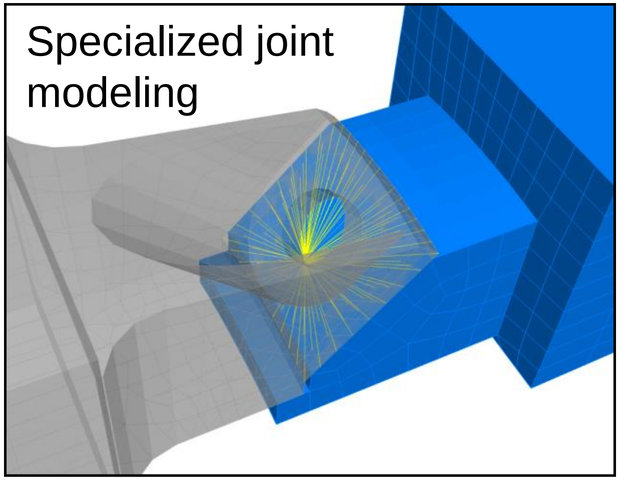


Full Support for Structural Dynamics





- Modal, modal superposition
- Frf
- Transient Dynamics
- Superelements



Computational Solid Mechanics

COMPSIM SOLID MECHANICS

Sandia National Laboratories

Solid Mechanics – Quasi-static, implicit & explicit transient dynamic response

Shared capabilities

- large deformations, large-strain nonlinear material behavior
- implicit-explicit solution switching, multi-sequence analyses
- continuum & structural finite elements, particle methods
- parallel scalable accurate frictional contact
- common & unique material models: 50+
- geometric and temporal multi-scale methods

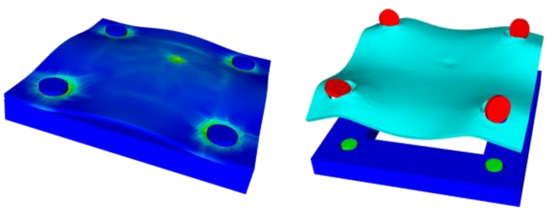
Implicit Solid Mechanics

- coupled thermal-mechanical modeling, with failure
- preloads
- encapsulation & cure, incompressible material behavior

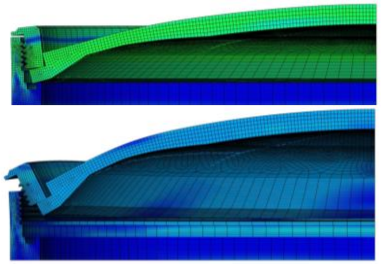
Explicit Solid Mechanics

- energy-dependent material models
- fracture & failure modeling (cohesive zones, XFEM, remeshing)
- empirical blast pressure loads (CONWEP)
- coupled to CTH shock-hydro, Alegra EM

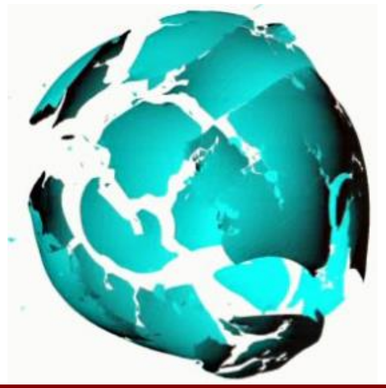
Implicit→explicit switching



pressure & temperature loading
snap-thru & disassembly



2D XFEM Fracture Simulation

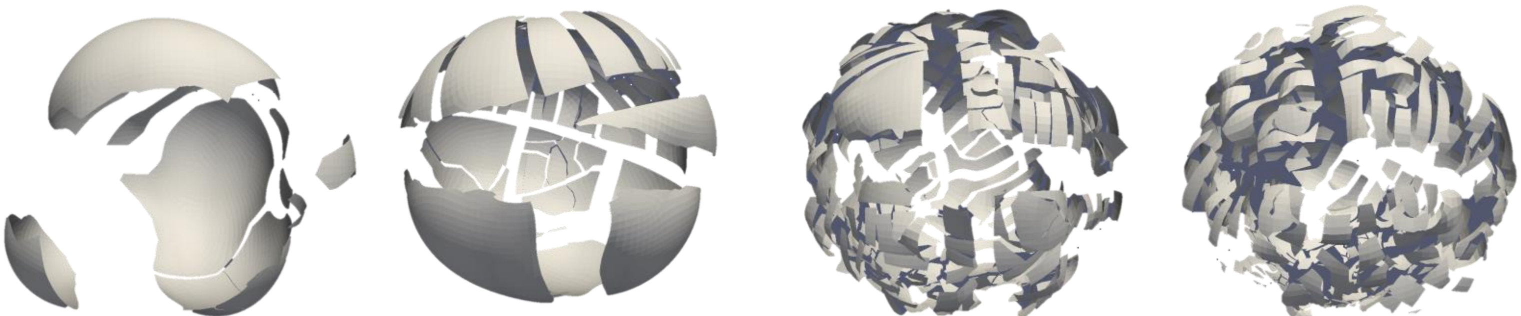


Sierra/SM Capabilities

Recent developments

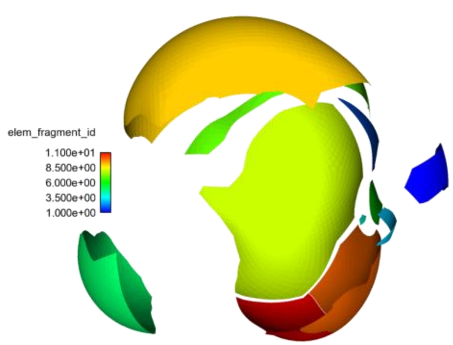
- New XFEM fracture and fragmentation capabilities
- Now production-izing 3D XFEM capabilities (2D in place)

SM brittle fracture modeling



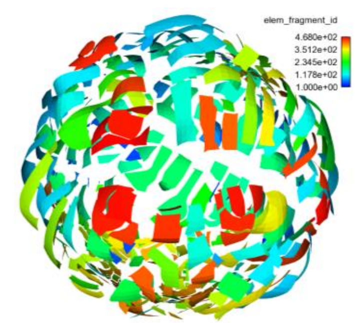
loading (pressurization) rate 1x, 2x, 3.5x, 5x

frag ID, mass balance



Fragment ID	Mass
1	0.106928
2	0.0409208
3	0.024103
4	0.00205816
5	0.553441
6	0.0326549
7	0.144147
8	0.749031
9	1.24167
10	0.382143
11	0.335603
total mass	**3.6127**

Fragment ID	Mass
…	
461	0.00826664
462	0.00932047
463	0.0140141
464	0.0059543
465	0.00110272
466	0.00673505
467	0.0138907
468	0.0111858
total mass	**3.6127**

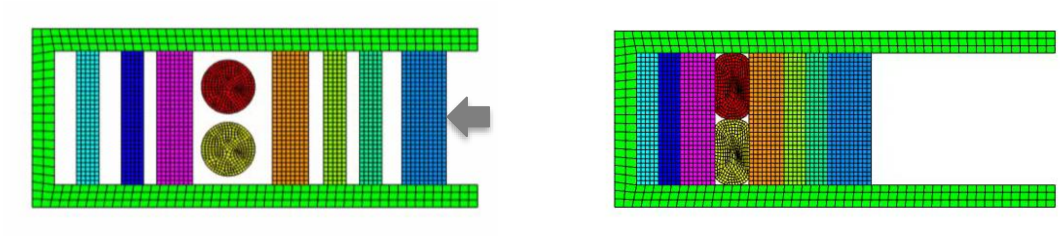


Sierra/SM Capabilities

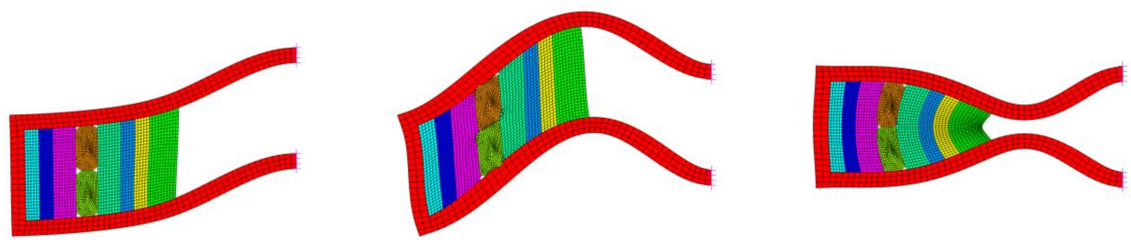
Recent developments

- SM preload effects in SD
  - Improve accuracy of SD direct transient or modal analyses by including the MPCs (thru file) generated from an SM preload

SM preload



SD modal



Mode 1 Mode 2 Mode 3

Sierra/SM Capabilities

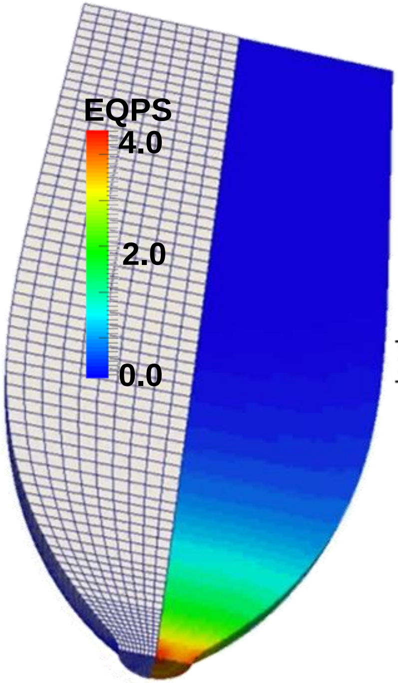
Recent developments

- Large deformation remeshing/remapping in SM

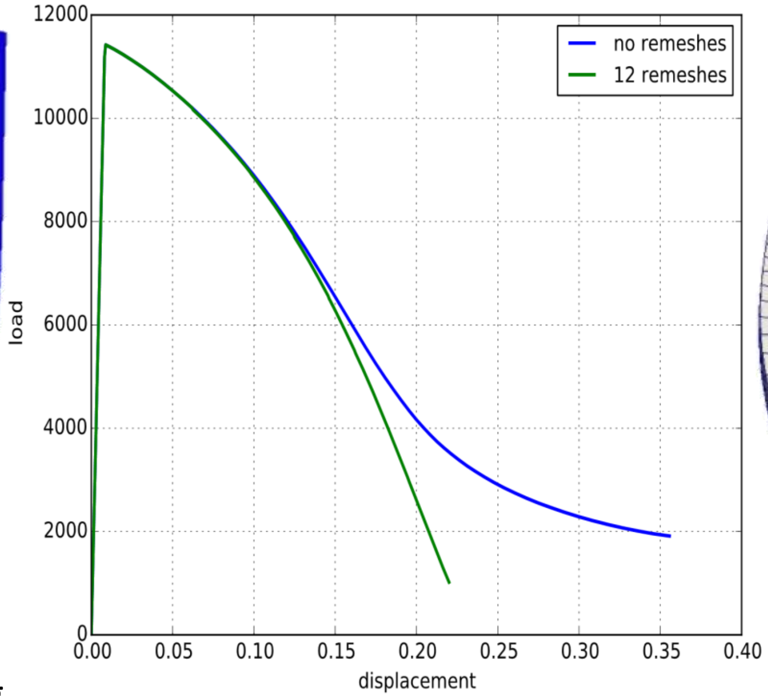
  Tensor preserving mapping

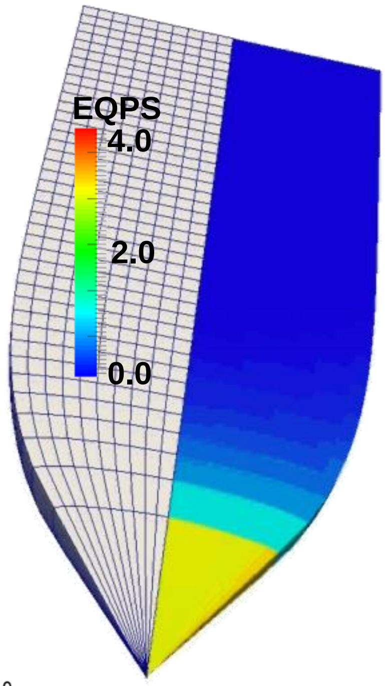
SM material parameter calibration

Global L_2-projection transfer



w/ adaptive remeshing



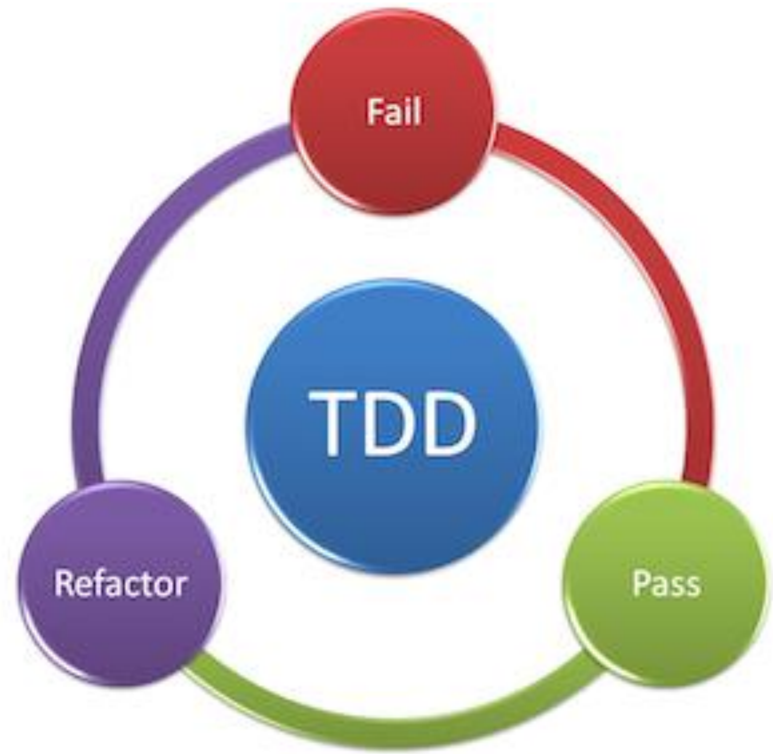


no remeshing

SQE Practices – Test Driven Development (TDD)

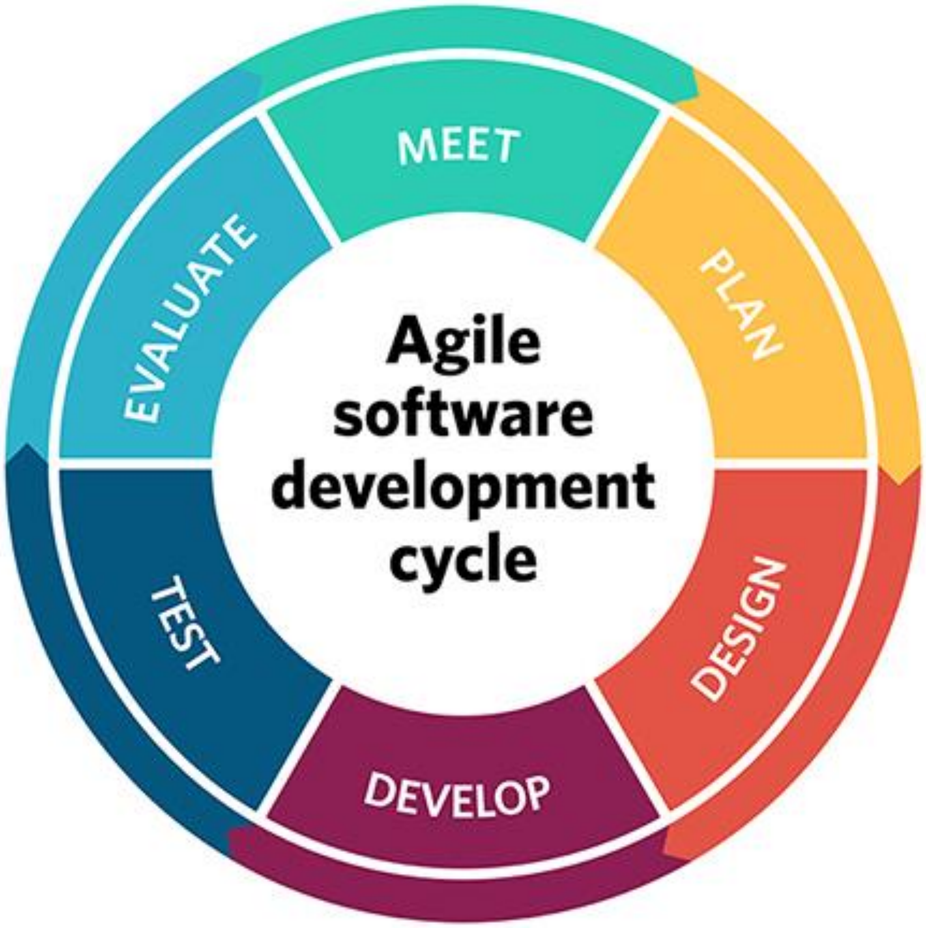
Develop Scalable, Maintainable Software

1. Write a failing test
   - Known Solution
2. Make Test Pass
   - Smallest amount of code possible
3. Refactor
   - Improve code quality

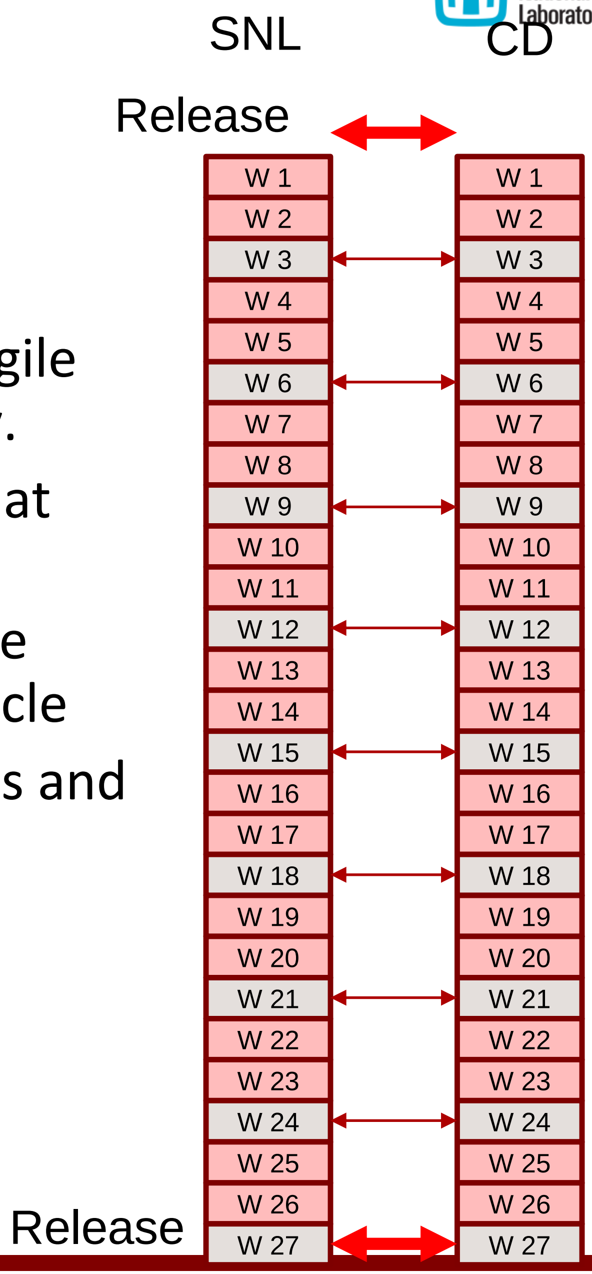


SQE Practices – Scrum / Agile

- React to changing requirements to meet customer needs



Sync Release/Sprint



Requirements

- Coordinate effort.
- Allow rapid testing of features.
- Avoid unnecessary cost.

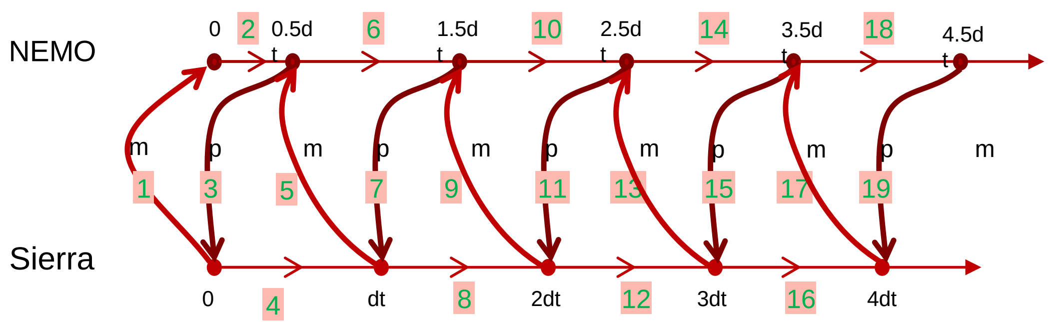
Approach

- Use the same Agile sprint boundary.
- Sync code-base at end of sprint.
- Adjust to use the same release cycle
- Communications and data transfer throughout.

The Key is a **collaborative**, partnership relationship.

Flexible Coupling Approaches

- There are many coupling algorithms. For example, iteration may or may not be required on each advance.
- Focus on a flexible strategy that permits evaluation of these algorithms.
- Use standard verification methods to ensure proper accuracy.



Coupler has unit tested capability for each of the steps of the coupling. Surrogate drivers permit integration testing independent of the region.

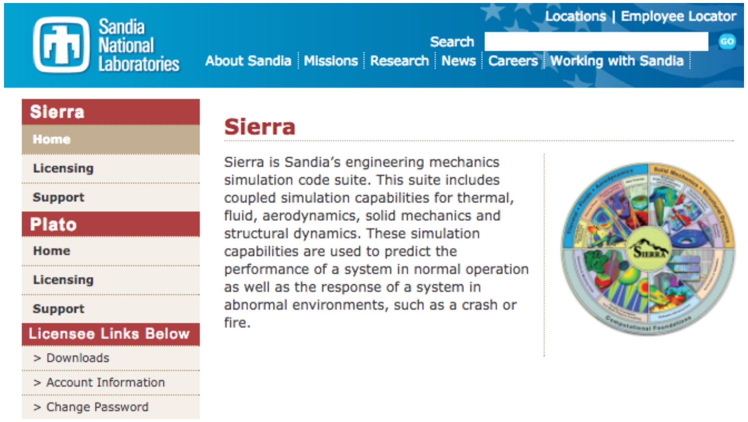
Sierra DevOps

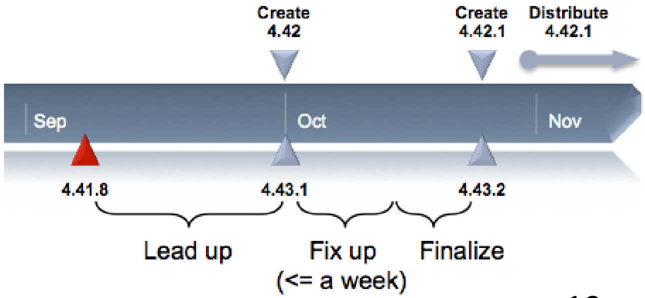
COMPSIM
DEV OPS

Sierra DevOps team enables development and distribution of the Sierra suite of applications.

- Tools and configurations for:
  - Build system
  - Test harness
  - Automated testing processes management
  - Testing dashboard
- Configuration & testing for a wide range of compilers and platforms
- Licensing management, packaging tools, internal & external delivery
- Software quality engineering & assurance testing (coverage, memory, static analysis)
- Build, installation, and execution support
- Management of software component & library integration and coupling
- Release branch creation, testing, and maintenance

Site	Build Name	Update	Build		Test			Build Time	Labels
		Files	Error	Warn	Not Run	Fail	Pass		
ascic112	Linux-intel-17.0.1-debug	6	0	0 -2	0	24 +2 -5	7657 +6 -2	Jan 23, 2017 - 17:04 MST	(6 labels)
ascic111	Linux-gcc-4.9.3-debug	6	0	0	0	15 -1	7697 +2	Jan 23, 2017 - 17:02 MST	(6 labels)
ascic126	Linux-intel-17.0.1-release	6	0	0 -2	0	10 -3	7671 +4	Jan 23, 2017 - 17:03 MST	(6 labels)

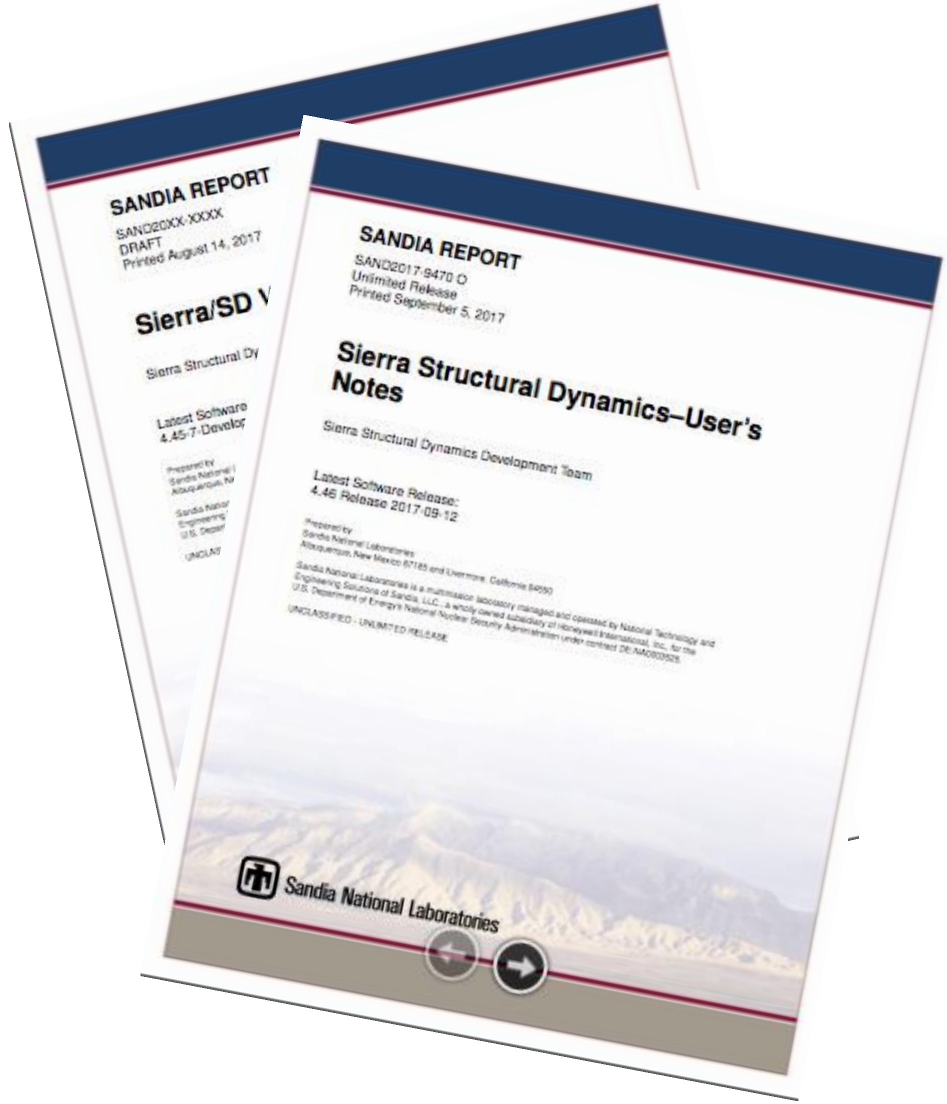




Integration – Verification Tests

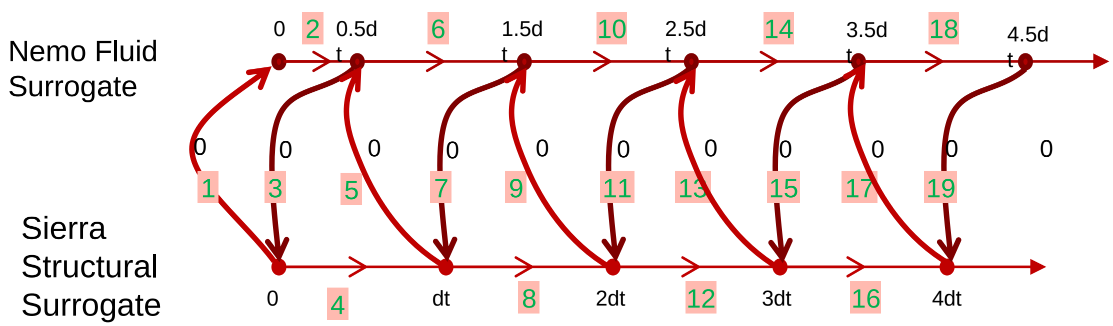
- Small verification tests are performed at Sandia and Document
- Verification tests are run before every sprint and full release
  - Verified and serial and parallel
- Verification document is built from passing tests

- Navy also verifies capability

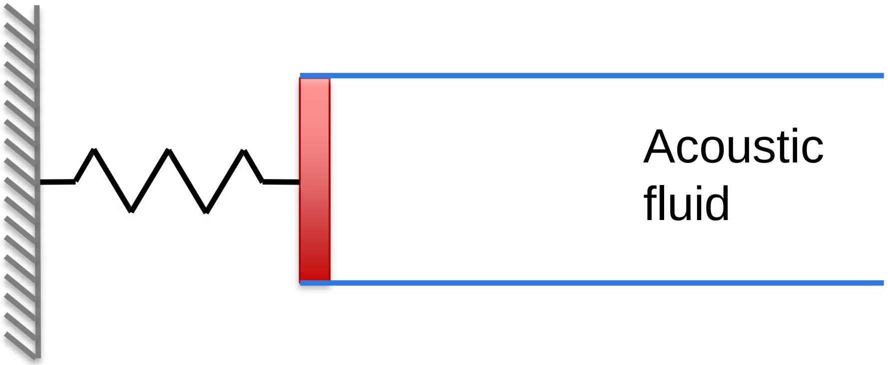


Integration - Surrogates

- Mock executables demonstrating Sierra and Nemo were created to facilitate development efforts
- Surrogates run as executables, but with empty data structures and without solves
- Allow separation between “coupling” error, and “physics” errors



Verification: 1d acoustic piston



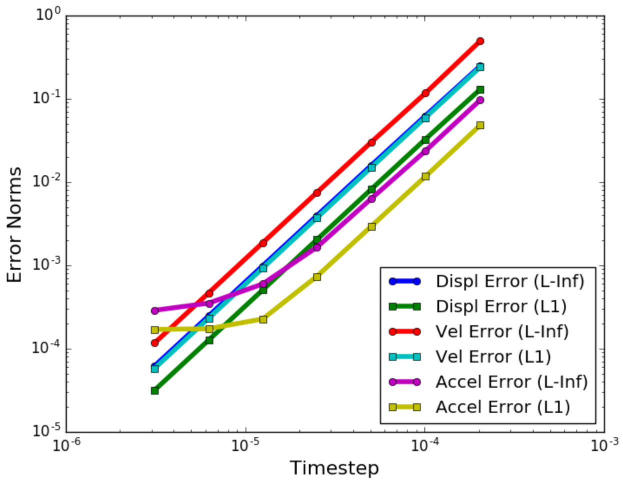
Goal: *test loosely coupled algorithms to assess temporal accuracy*

Structure displacement

$$u_s(t) = \mathrm{e}^{-dt}\,(a\cos\omega t + b\sin\omega t) + \nu(t-\beta)$$

Fluid solution

$$v_a(t) = \dot{u}_s(t - x/c_a)H(t - x/c_a)$$
$$p_a(t) = p_\infty + \rho_a c_a v_a(t)$$



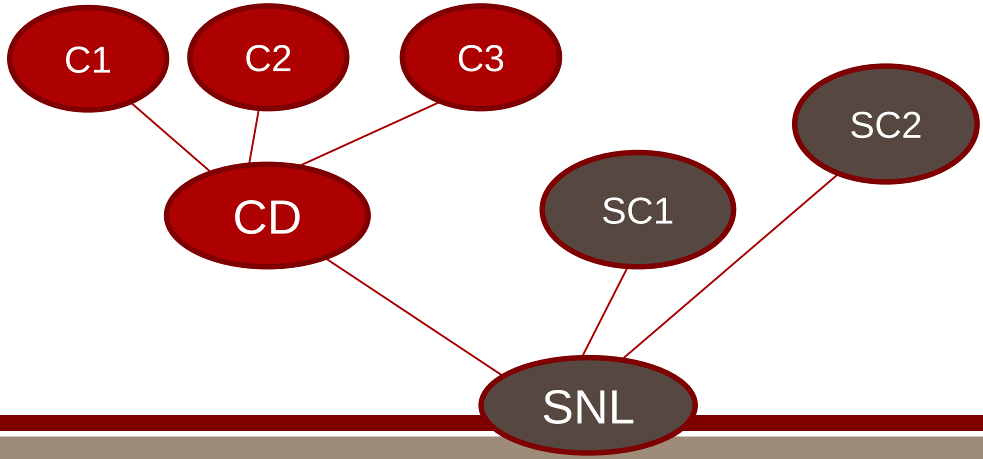
User Support Model

Requirements

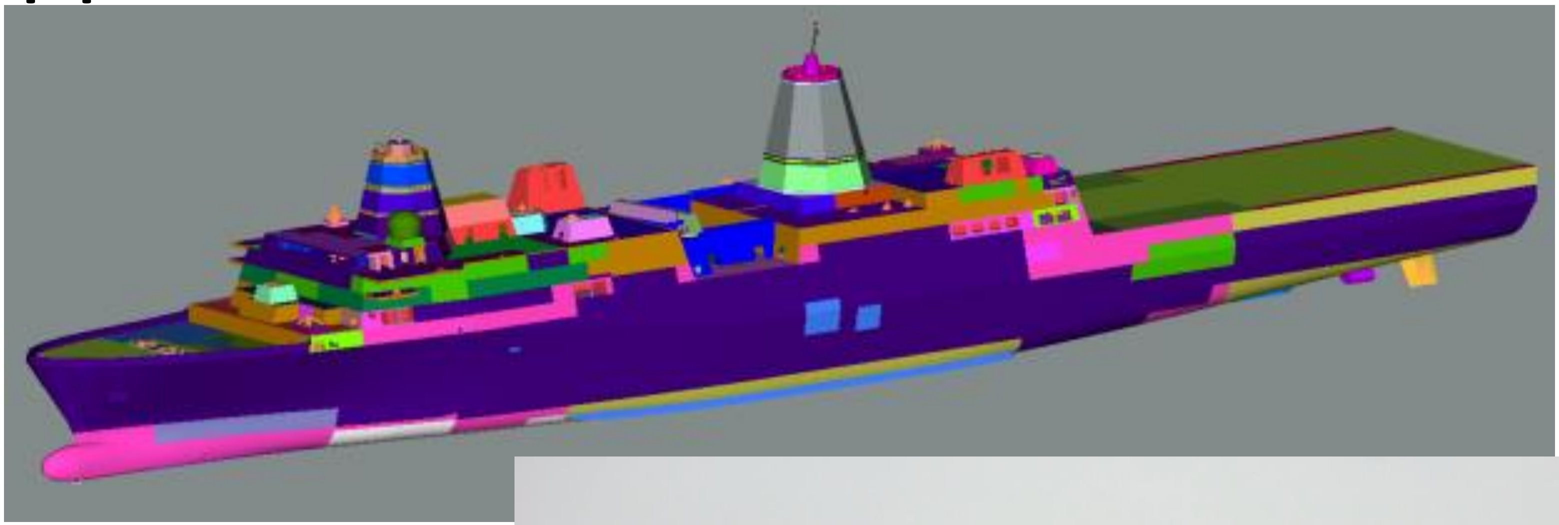
- Avoid overload of developers.
- Provide Support as near customer as possible.
- Build a sustainable system.

Approach

- First Line Support at NSWC/CD.
- CD forwards triaged issues to SNL development.
- Support tickets are maintained and tracked at relevant sites.



Applications



Questions?

20th Annual

NDIA Systems Engineering Conference

Springfield, Virginia

October 23-26, 2017

Integrating DoD Explosives Safety Tenets and Requirements Into Acquisition and Infrastructure Planning

Thierry Chiapello

Executive Director

Department of Defense Explosives Safety Board

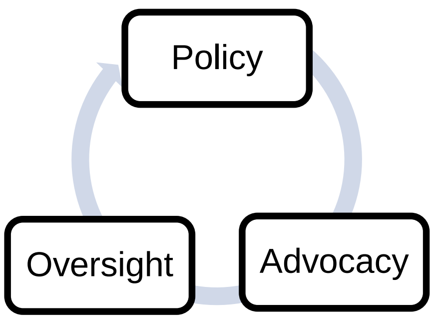
The DoD Explosives Safety Board (DDESB)

Major Functions

- **Develop and maintain the DoD Explosives Safety Program**
- **Support Combatant Commanders Mission where DoD Munitions are involved**
- **Support Multinational Organizations and Operations (NATO, UN, and State Dept)**
- **Support Joint Staff Assessments**
- **Develop and maintain DoD Explosives Safety Policy and Regulations**
- **Evaluate Explosives Safety Programs**
- **Perform R&D**

Organization - 27

- **22 Civilians**
- **1 Contractor**
- **4 Military**



Origin: Established in 1928 by Congress after a major disaster at the Naval Ammunition Depot, Lake Denmark, New Jersey in 1926. The accident virtually destroyed the depot, causing heavy damage to adjacent Picatinny Arsenal and the surrounding communities, killing 21 people, and seriously injuring 53 others.

Strategic Stakeholders

- **Secretary of Defense** (USD – Policy (P), Acquisition, Technology & Logistics (AT&L), ASD(Energy, Installations & Environment) (EI&E), and International Programs
- **Chairman of the Joint Chiefs of Staff** (Joint Staff J2/J3/J4/J5/J7)
- **Combatant Commanders**
- **Military Services** (Army, Navy, Air Force, Marine Corps)
- **NATO** (Acquisition – Munitions Safety AC/326, Logistics AC/305, SHAPE)
- **DoD Support Agencies**

- **Charter:** Preclude & Prevent …

- DDESB, a statutorily established engineering organization, is responsible to:
  - ➢ Perform engineering tests, modeling, and analyses to establish physics-based explosives safety criteria
  - ➢ Oversight of Services/Agencies Explosives Safety Management (ESM) Program

DDESB Analyses – Data & Observations

- DDESB has observed tendencies that planning between the acquisition and infrastructure planning communities within the Department could be enhanced
  - Some system fieldings of the Department's weapon systems occurred with infrastructure deficiencies resulting in sub-optimal support for operating forces

Examples of Sub-Optimal Planning

- P-8 Poseidon
  - ➢Larger, heavier platforms damaged runways driving repairs and unanticipated construction and modification of hangars

Photo Source:
http://www.navy.mil/management/photodb/photos/170908-F-AV193-1064.JPG

- Virginia Class SSNs
  - ➢Block V variant driving many unanticipated waterfront MILCONs

Photo Source:
http://www.navy.mil/management/photodb/photos/160801-O-N0101-110.JPG

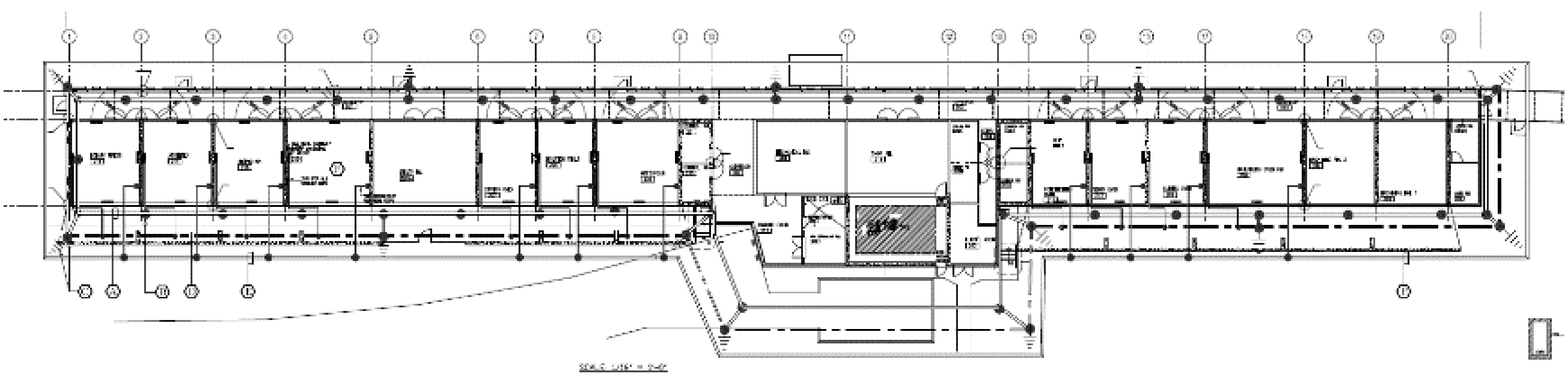
Examples of Sub-Optimal Planning

- HIMARS
  - ASP magazine doors could not accommodate the width of the HIMARS pallet.

Photo source:
https://media.defense.gov/2017/Jun/12/2001760810/-1/-1/0/170609-M-YF952-016.JPG

Examples of Sub-Optimal Planning

- Picatinny Explosives Research and Development Loading Facility
  - Lack of early design review and approval resulted in significant reduction of amounts of explosives allowed in facility
    - Desired HD 1.1 NEW limit = 2,410
    - Approved HD 1.1 NEW = 160-lbs



Actions Taken

- DDESB established a Working Group (WG) to determine if gaps existed:
  - WG consisted of Services and DDESB representatives
  - WG explored existing processes for gaps and best process techniques being employed
  - WG process explorations included:
    - Pre-production and production safety oversight of munitions and explosives
    - Integration of acquisition, logistics, and facilities and infrastructure planning for newly acquired systems
- WG identified pertinent gaps
  - Where gaps were identified, options to close the gaps was explored
  - Propose recommendations to solve the deficiencies

Findings

- Gaps have been identified in the integration of planning between:
  - The ‘acquisition’ and ‘logistics’ communities and
  - The ‘facilities and infrastructure’ planning community

- Policy/guidance gaps locations
  - Defense Acquisition System Procedures:
    - DoDI 5000.02, *Operation of the Defense Acquisition System*, paragraph 5. *Procedures*
      - *TMMR*
      - *E&MD*
  - Defense Acquisition System Life Cycle Sustainment Process:
    - DoDI 5000.02, *Operation of the Defense Acquisition System*, Enclosure 6, *Life Cycle Sustainment,* paragraph 2. *Sustainment Across the Life Cycle*
  - Real Property Policy:
    - DoDD 4165.06, *Real Property*, paragraph 4, *Policy*
    - DoDI 4165.70, *Real Property Management*, paragraph 5, *Responsibilities*

- Recommended changes entail minimal disruption or cost.
  - One Service currently employs an integrated process that meets the recommended policy

On-Going Actions

- Draft policy language to close gaps has been drafted:
  - ➢ Defense Acquisition System Procedures:
    - DoDI 5000.02, *Operation of the Defense Acquisition System*, paragraph 5. *Procedures*
    - DoDI 5000.02, *Operation of the Defense Acquisition System*, Enclosure 6, *Life Cycle Sustainment,* paragraph 2. *Sustainment Across the Life Cycle*
  - ➢ Real Property Policy:
    - DoDD 4165.06, *Real Property*, paragraph 4, *Policy*
    - DoDI 4165.70, *Real Property Management*, paragraph 5, *Responsibilities*
- Formulate impact to stakeholders

Way Ahead

- Brief leadership of detailed recommendations and plan to close the identified gaps
- Request concurrence with recommended policy enhancements to ‘acquisition’ and ‘real property (infrastructure)’ issuances
- Integrate recommended issuance changes into next issuance revision

Explosives Safety Board

DEPARTMENT OF DEFENSE

HPCMP CREATE™-Genesis CFD

Jim Forsythe, Ph.D., Quality Assurance
July 20, 2017
Distribution Statement A. Approved for public release: distribution unlimited

Overview

Genesis-CFD Components/Capabilities

- Single Mesh Unstructured Solver
  - Euler/Laminar/RANS/DES
  - Ideal Gas
  - Limited cores per job (128-256)
- Motion
  - Prescribed (including arbitrary)
  - 6-DOF without constraints
- Structures
  - Modal solver
- Plugins useable, but without SDK to develop
- Propulsion
  - 0-D Linear engine model for BC's
  - Rotating reference frame
  - Sliding interfaces
- Visualization features
  - Full Volume write to Tecplot, FieldView, Ensight
  - Extracts for FieldViewXDB, Silo, Tecplot, VTK
  - In-Situ using VisIt

Sample Curriculum

- Core courses
  - Fluids I (Incompressible)
  - Fluids II (Compressible)
  - Experimental Methods / Labs
- Electives
  - Applied CFD
  - Propulsion

Sample Curriculum - Fluids

- Lectures – Use canned CFD solutions for illustration (cylinder, sphere, airfoil), examples
  - Langrangian derivative terms on a cylinder, e.g. $v\frac{\partial u}{\partial y}$
  - Fluid "particle" deformation types (e.g. angular/linear deformation, rotation, strain, volume dilitation).
  - Gradients (e.g. pressure)
  - Steady vs. Unsteady
  - Streamlines, Streaklines, Pathlines

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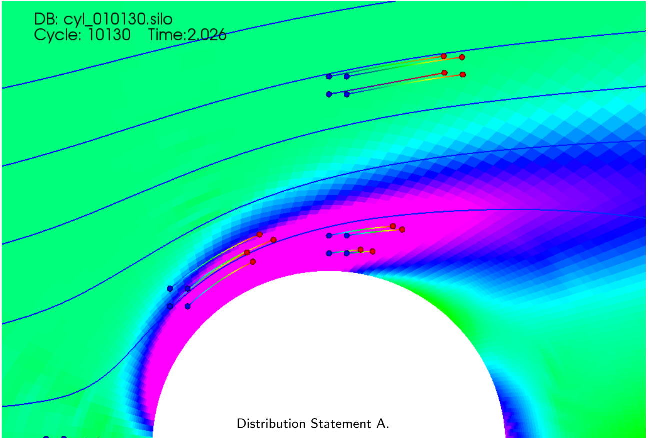

Sample Curriculum - Fluids

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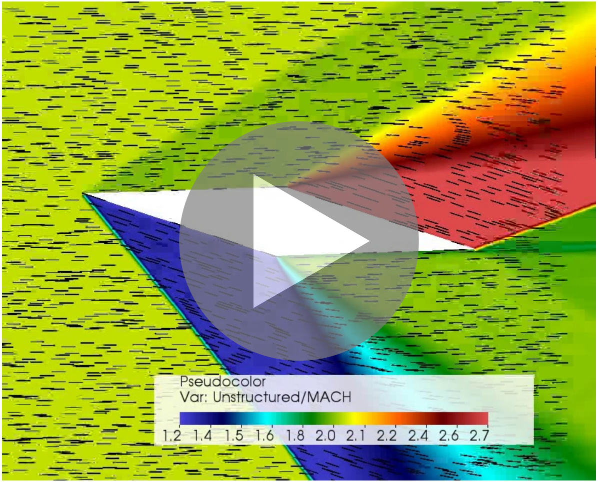
  - Gradients (e.g. pressure)
  - Steady vs. Unsteady
  - Streamlines, Streaklines, Pathlines
- Basics of CFD (1-2 lectures)
  - Show simple model problem (1-D linear convection, burgers eqn)
  - Finite difference derivation from Taylor series. Order of accuracy
  - Explicit vs. implicit
  - When to use CFD vs. potential based methods
- CFD project (sphere at various Re)
  - Simple geometry or provide meshes
  - Grid and/or timestep refinement
  - Comparison to experimental data

Sample Curriculum - Other

- Experiment/Lab course
  - Subset of students provide CFD support
  - Possible uses of CFD:
    - Analyze wind tunnel wall effects
    - Visualize the flow being measured
    - Test validity of CFD
- Propulsion
  - Single Stage Analysis using rotating reference frame and sliding interfaces
  - Inlet losses using Engine boundary condition
- Design
  - CFD of final designs using DaVinci
  - Verify performance
  - More advanced - look at dynamic stability derivatives

Examples - Diamond Airfoil

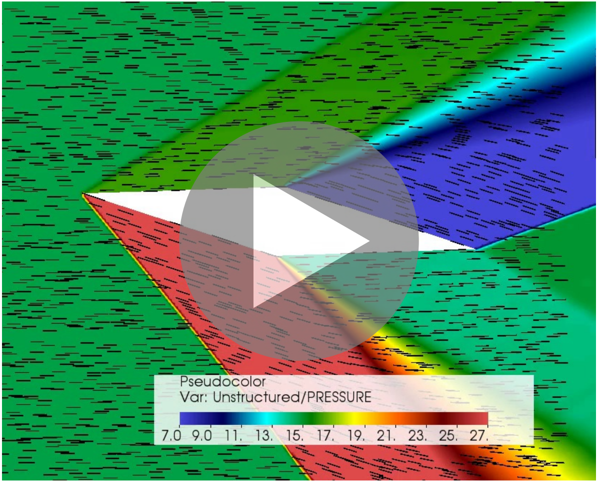
- Description:
  - Fluids II
  - Student project or as a lecture aid
  - Slow oscillating pitch motion to show effect of α
- Time:
  - Meshing: 15 minutes
  - Job Setup: 10 minutes
  - Post-processing: 30 minutes



Mach over Diamond Airfoil at Mach=2.0, $\alpha = \pm 10\,\text{deg}$

Examples - Diamond Airfoil

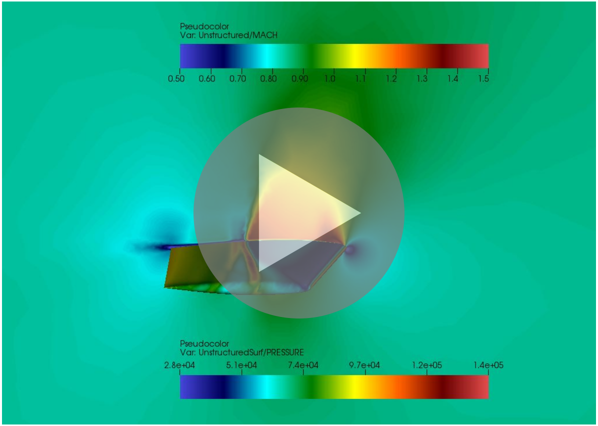
- Description:
  - Fluids II
  - Student project or as a lecture aid
  - Slow oscillating pitch motion to show effect of α
- Time:
  - Meshing: 15 minutes
  - Job Setup: 10 minutes
  - Post-processing: 30 minutes



Pressure over Diamond Airfoil at Mach=2.0, $\alpha = \pm 10\,\text{deg}$

Examples - Onera M6

- Description:
  - Fluids II
  - Student project or as a lecture aid
  - Shows transonic effects
- Time:
  - Meshing: Provided
  - Job Setup: 10 minutes
  - Post-processing: 30-60 minutes



Mach cutting plane with surface pressure on OneraM6 wing

NDIA #19694: Software Development Practices in HPCMP-CREATE™ (A Family of Large-scale, Physics-based, System-of-Systems, Software Development Projects)

An Application of Risk-based Software Development Practices

DOD HPC MODERNIZATION PROGRAM

Richard P Kendall, Ph.D. with
D.E Post, L.G. Votta, P.A. Gibson, L.A. Park, and S.M. Sundt
October 2017

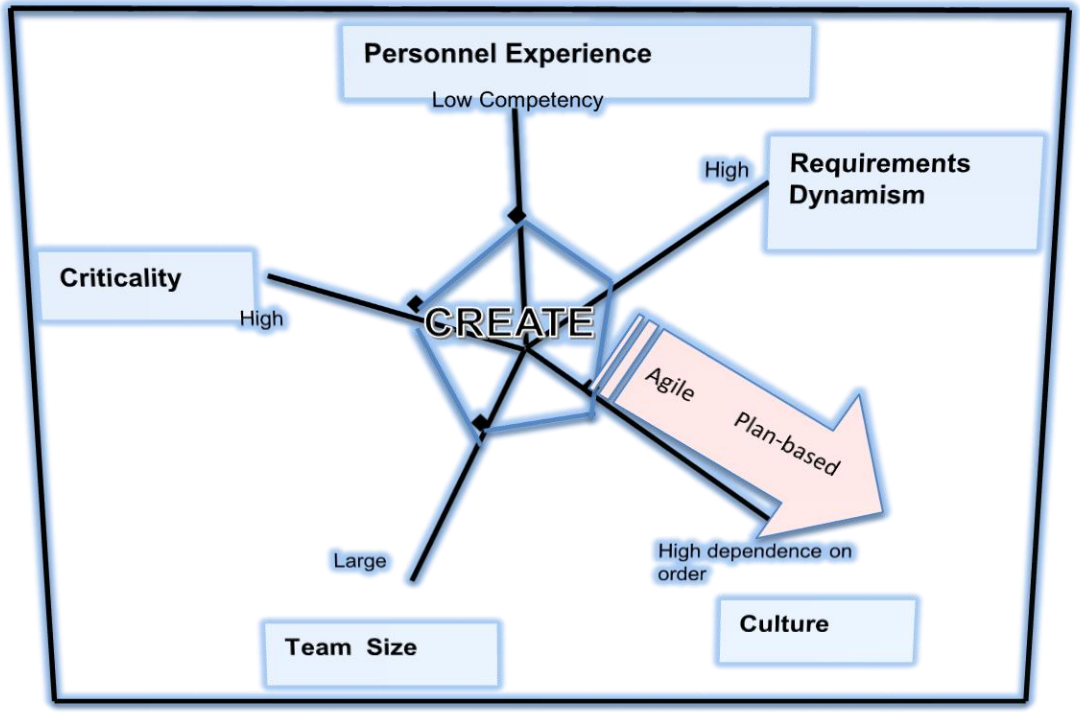
Risk-based Software Development Practices in CREATE

CREATE Core Software Development Risks

1. Misaligned requirements management
2. Workflow management for distributed teams across the Services
3. Team communications across different security enclaves
4. Testing
5. Product support with limited resources

Software Development Practice Drivers

Development Environment Indicators



Notional Home Ground Chart for CREATE
after Boehm, Using Risk to Balance Agile and Plan Driven Methods, IEEE Computer Society, 2003

The attributes of CREATE teams favor an Agile Development approach

Risk 1: Misaligned Requirements Management

Mitigating Practice. *Express requirements as use-cases in language that customers and developers share.*

CREATE-Capstone Foundational[1] Required Capabilities

ID	Description
MG-00	Import Externally Generated Geometry (C
MG-01	Create Parameterized Geometry
MG-02	Support Dependency-Based Associative /
MG-03	Repair Externally Generated (eg CAD) Ge
MG-04	Support De-featuring and Idealization of (
MG-05	Provide Robust Surface Meshing Algorithm
MG-06	Provide Robust Volume Meshing Algorithn
MG-07	Provide Geometry-based Mesh Generatic
MG-08	Support Multi-scale Models
MG-09	Support Legacy Component Integration
MG-10	Support Analysis Model Attribution
MG-11	Provide Accurate and Scalable Runtime (
MG-12	Core Framework (Internal requirements to above)

MG-06 Use-Cases

MG-06-UC-01	**Unstructured all-tetrahedral volume meshing**
MG-06-UC-02	**Unstructured hexahedral-dominated hybrid meshing**
MG-06-UC-03	**Boundary Layer meshing with triangular wedge elements in the viscous region transitioning to tet. No interference from other BL**
MG-06-UC-04	**MG07-UC04 with complex geometries and multiple intersecting boundary-layers**
MG-06-UC-05	**Boundary layer meshing with hex,prism in the viscous regin transitioning to hex/tet**
MG-06-UC-06	**MG06-UC05 with complex geometries & multiple intersections**
MG-06-UC-07	**Volume mesh handing for high order element (first approach)**
MG-06-UC-08	**Matching volume meshes for periodic boundary condition**
	en truncation boundary
	with sources
MG-06-UC-11	**Modeling and meshing for sliding planes for moving parts**
MG-06-UC-12	**Support for 'strand-meshing' paradigm**

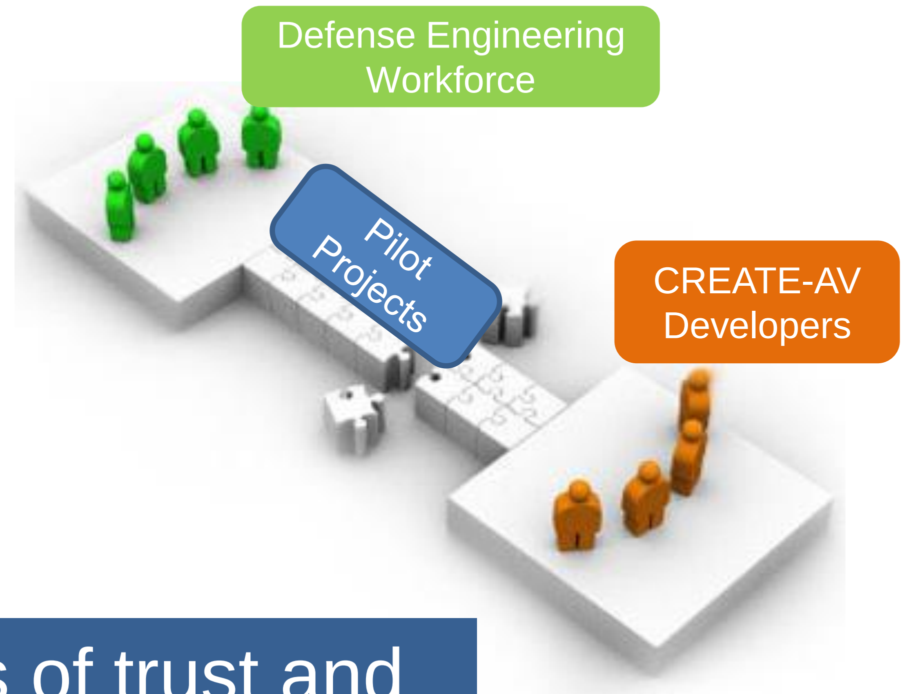
Use-Cases promote a shared view of requirements

[1] Established in 2008

Risk 1. Misaligned Requirements Management

Mitigating Practice: Pursue Pilot Projects

Annually execute between 4 and 6 Pilot Projects to "shadow" acquisition programs engineering workflows– 60+ Pilots since 2008!

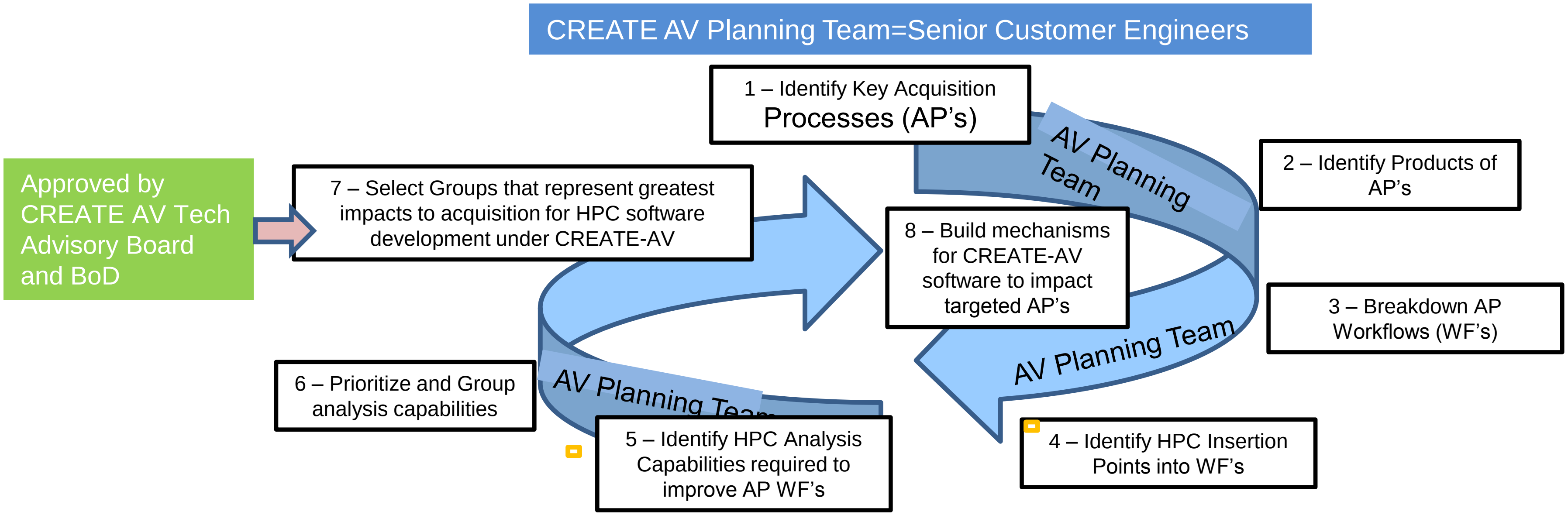


Pilots build bridges of trust and go deeper than product demos

Risk 1. Misaligned Requirements Management

- **Mitigating Practice: *Bring Senior Customer Engineers into the planning cycle for new processes/workflows***

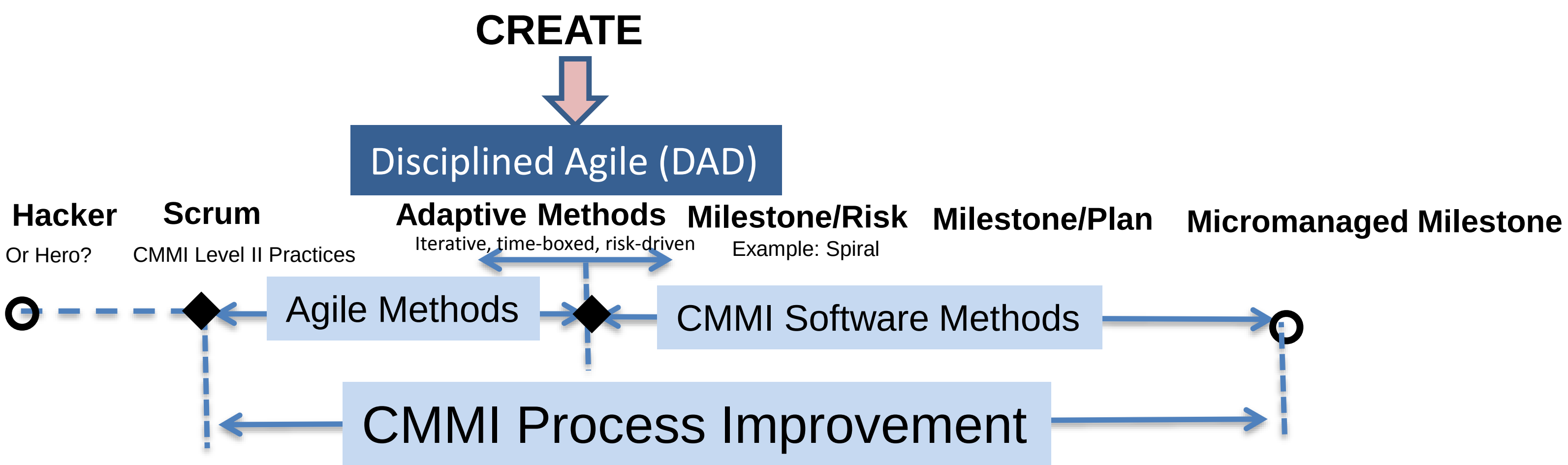
Example: CREATE-AV Planning Process for new Stakeholder Processes/workflows



This demonstrates that the product solves the customer's problem <u>and</u> that it can be used in the customer's workflow

Risk 2. Software Development Workflow for Distributed Teams

- **Mitigating Practice:** ***Balance flexible planning with milestone-based accountability.***

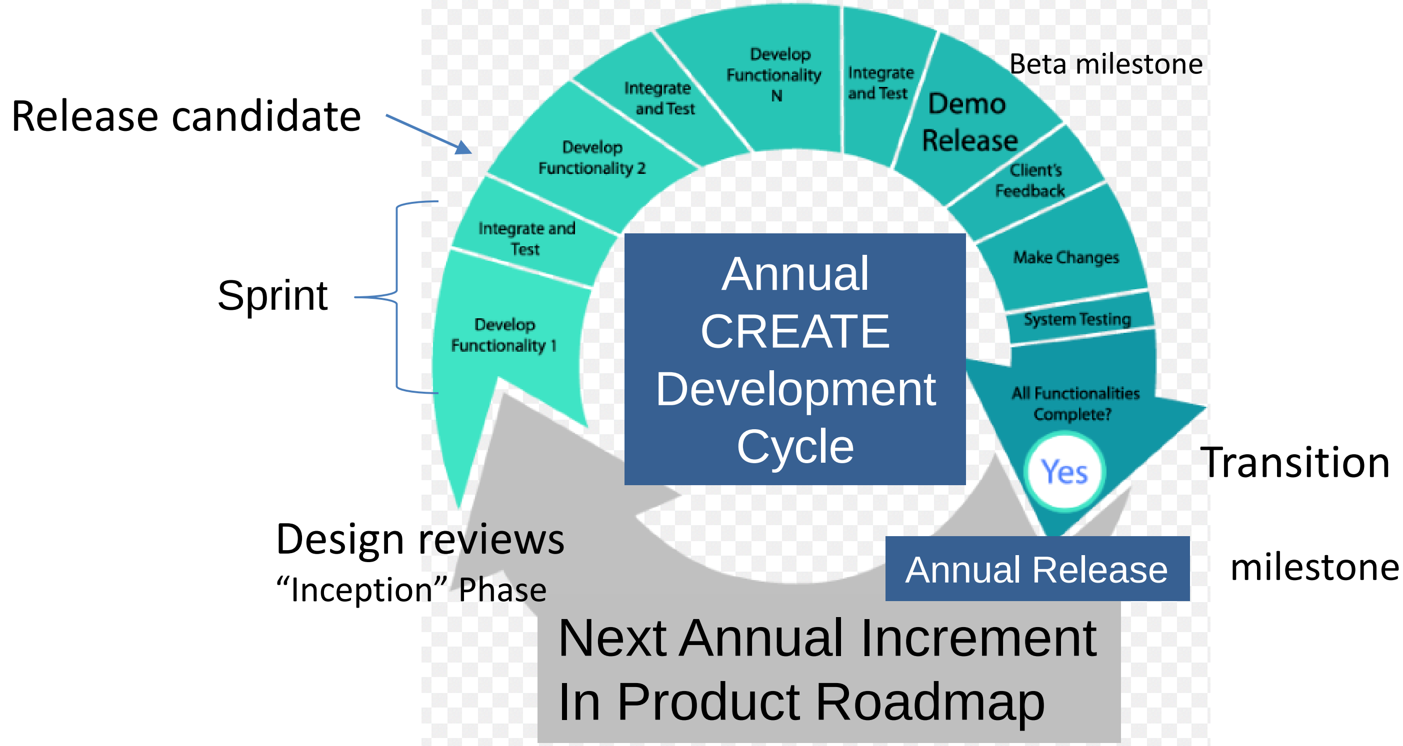


after Boehm, "Getting Ready for Agile Methods with Care," IEEE Software, 2002

CREATE: An disciplined agile approach with the features of Milestone/Risk and Agile Workflow Management

Risk 2. Software Development Workflow for Distributed Teams

The CREATE Approach—Disciplines Agile Development based on Scrum with Risk-based Milestones



Our approach couples flexibility with accountability

Figure after info@matrix-soft.org

Risk 2. Workflow Management for Distributed Teams

DOD HPC MODERNIZATION PROGRAM

- **Mitigating Practice:** ***Require at least one new "version" every year***

Fiscal Year	FY2011				FY2012				FY2013				FY2014			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
AV-Genesis Design					1							2				
AV-Helios					2				3			4				
AV-Kestrel			2						3			4				5
MG-Capstone	1				2				3				4			
RF-SENTRi				2					3				4			
Ships-IHDE	2				3				4				5			
Ships-NavyFOAM	1				2				3					4		
Ships-NESM	1				1.1					2					2.1	
Ships-RSDE					0.5				1				1.1			
GV-Mercury																

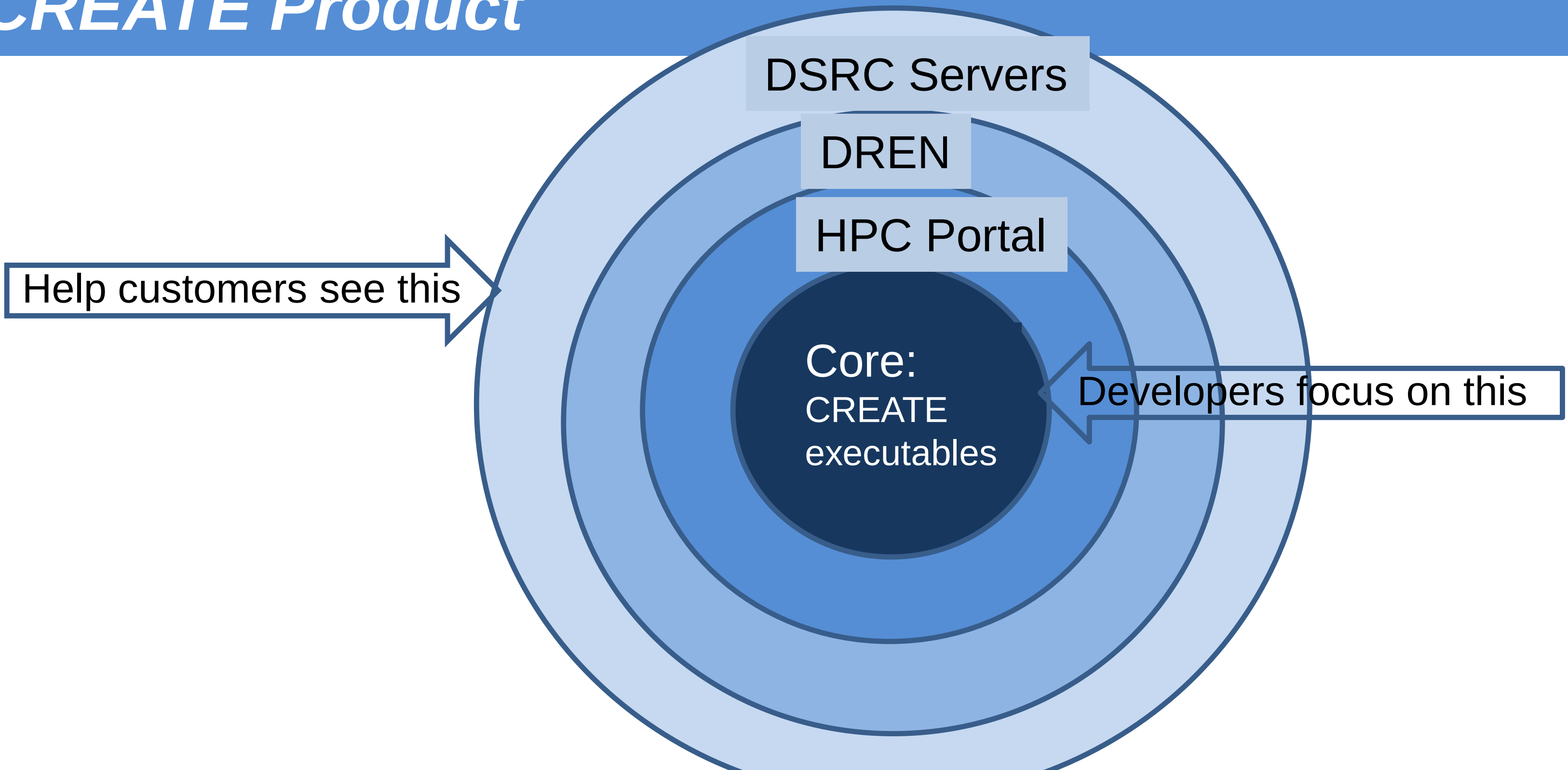
Fiscal Year	FY2015				FY2016				FY2017				FY2018			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
AV-Genesis Design				3					4			5				6
AV-Helios	5				6				7				8			
AV-Kestrel			6					7				8				9
MG-Capstone	5				6				7				8			
RF-SENTRi	5				6							7				8
Ships-IHDE	6				7				8				9			
Ships-NavyFOAM	5				6				7					8		
Ships-NESM			3				4				5				6	
Ships-RSDE	1.2					2							3.1			4
GV-Mercury												1				2

Fiscal Year	FY2019 Planned				FY2020 Planned				FY2021 Planned				FY 2022 Planned			
Quarter	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
AV-Genesis Design				7				8				9				10
AV-Helios	9				10				11				12			
AV-Kestrel				10				11				12				13
MG-Capstone	9				10				11				12			
RF-SENTRi				9				10				11				12
Ships-IHDE			10				11				12				13	
Ships-NavyFOAM		9				10				11				12		
Ships-NESM			7				8				9				10	
Ships-RSDE				5				6				7				8
GV-Mercury				3				4				5				6

Annual releases guarantee meaningful progress during the fiscal year

Risk 3. Communications across different Security Enclaves

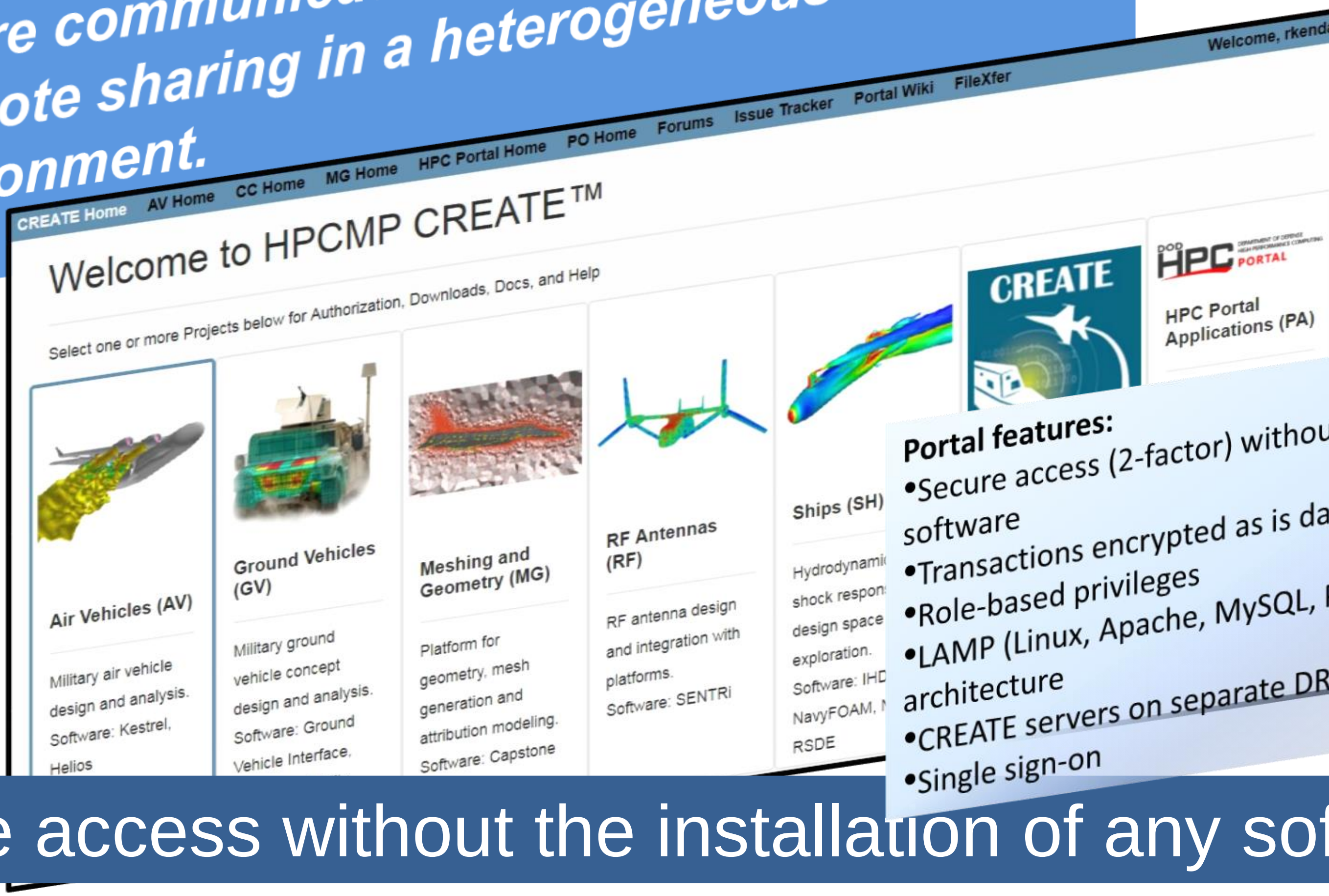
Mitigating Practice: ***Start with an extended view of the CREATE Product***



Ensure that Customers see the "whole" product

Risk 3. Communications across different Security Enclaves

Mitigating Practice: Make maximum use of secure communication technologies that promote sharing in a heterogeneous security environment.



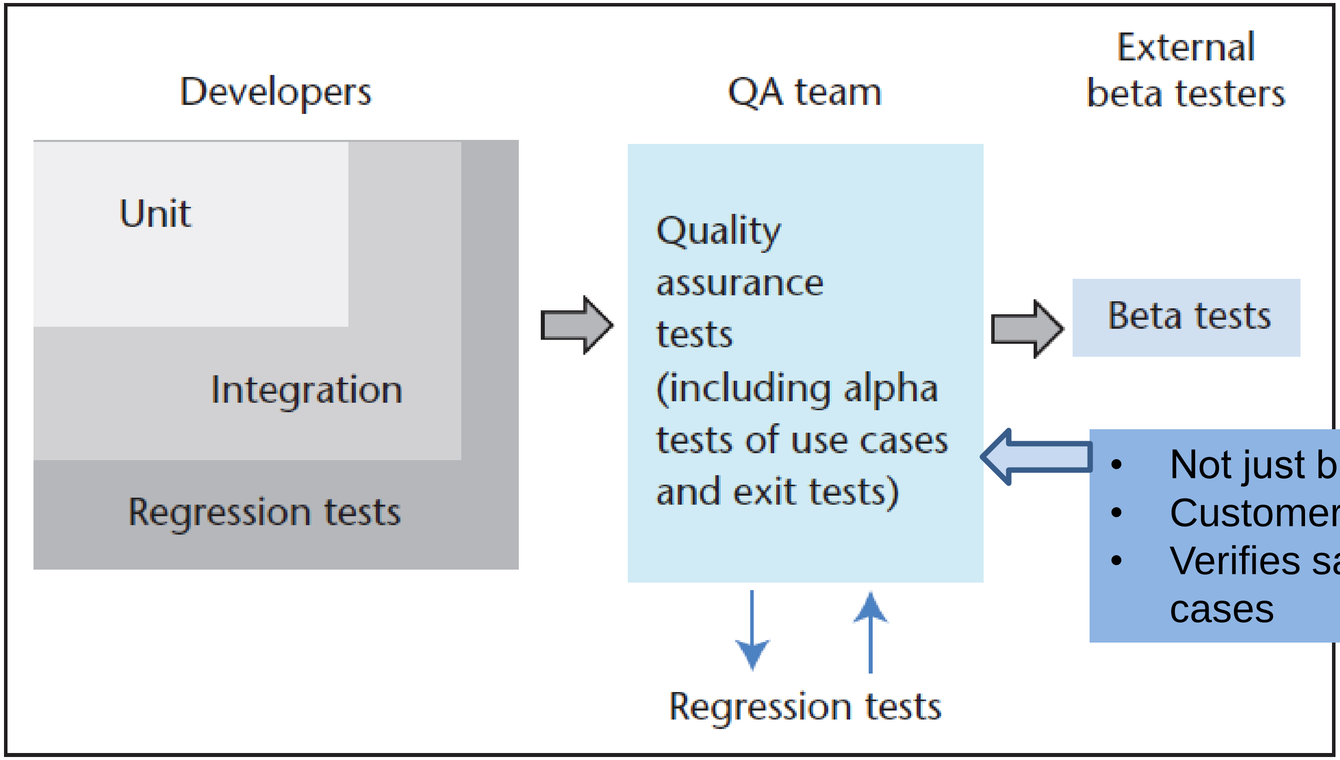
Portal features:

- Secure access (2-factor) without installation of any software
- Transactions encrypted as is data at rest
- Role-based privileges
- LAMP (Linux, Apache, MySQL, PHP/Perl) architecture
- CREATE servers on separate DREN network
- Single sign-on

Secure access without the installation of any software

Risk 4: Software testing

Mitigating Practice: *Implement a testing program compliant with National Research Council guidelines*



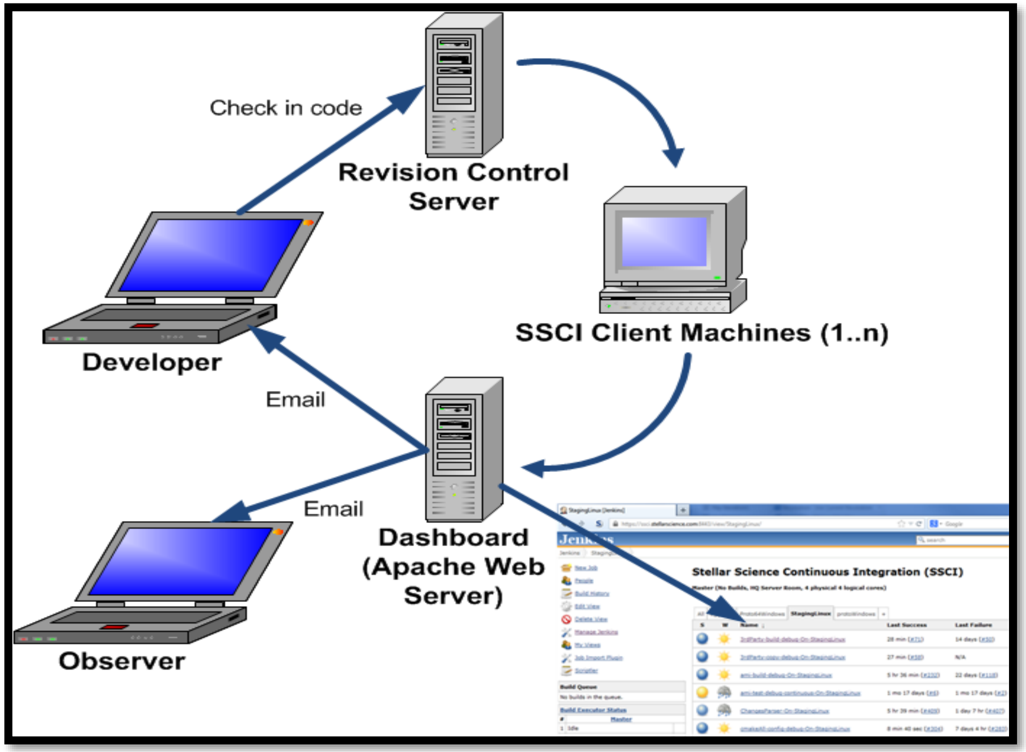
- Not just binary "yes" or "no"
- Customer view of testing
- Verifies satisfaction of use-cases

6 levels of testing in CREATE -AV!

Distribution A: Approved for Public release; distribution is unlimited.

Risk 4: Software Testing

Mitigating Practice: ***Strive for continuous integration with automated regression tests for each commit***



CREATE-RF Continuous Integration Platform

Discover problems before they are hard to fix

Risk 5. Inadequate Product Support

Mitigating Practice: *Maximize the use of self-help and user forums in the support model.*

Self-help scales as the user base grows

How Well Has this Worked?

DOD HPC MODERNIZATION PROGRAM

- Over 1600 current user licenses
- Over 180 organizations across DoD/Gov't, Industry, and Academia
- User organizations are split roughly 40% DoD/Gov't, 50% Industry, 10% Academia
- Impacting ~70 DoD programs of record and major S&T, T&E, and R&D efforts across the major warfare domains of Air, Sea, Land, and EM spectrum throughout the acquisition cycle
- Constant positive growth of user licenses since (~7% growth in the past 6 months)

NAVSEA

DDG-1000

CVN-78 Class

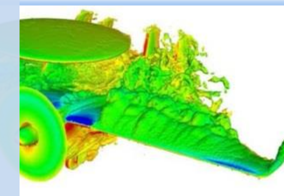
SSBN

LX(R)

NAVAIR

Aerostar & Raven UAVs

F/A-18 E/F/G

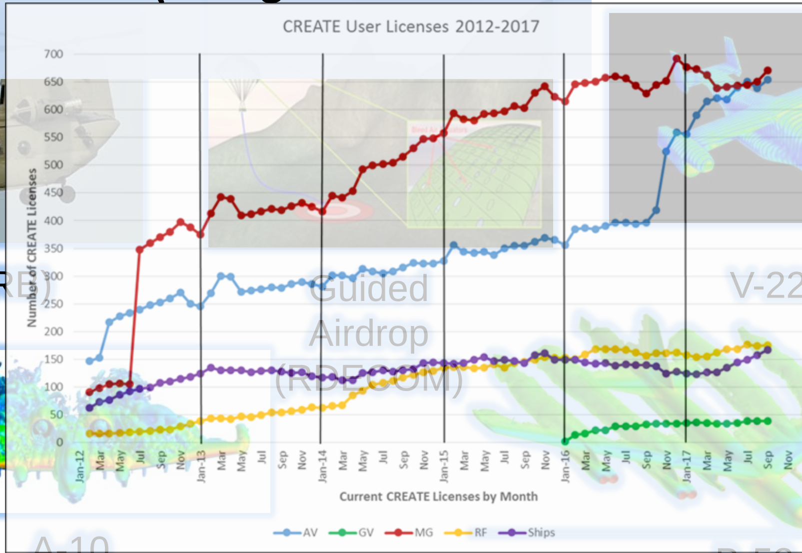


E-2D

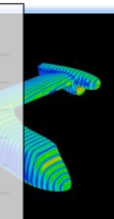
ARMY/USMC

UH-60

CH-47 (ACRE)

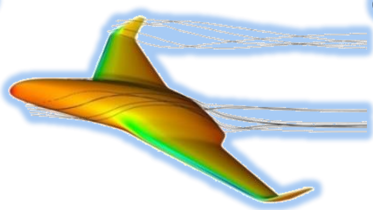


Guided Airdrop (RDECOM)

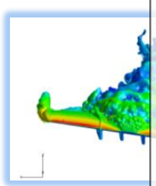


V-22

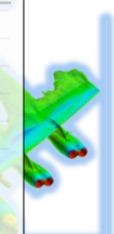
F-15 SA/DB-110



Strategic Airlift CP&A



A-10



B-52

NDIA #19694

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NDIA #19703: Verification and Validation in CREATE Multi-Physics HPC Software Applications

DOD HPC MODERNIZATION PROGRAM

Lawrence G. Votta Ph.D. with

K.P. Kendall, D.E. Post, E.T. Moyer and S.A. Morton

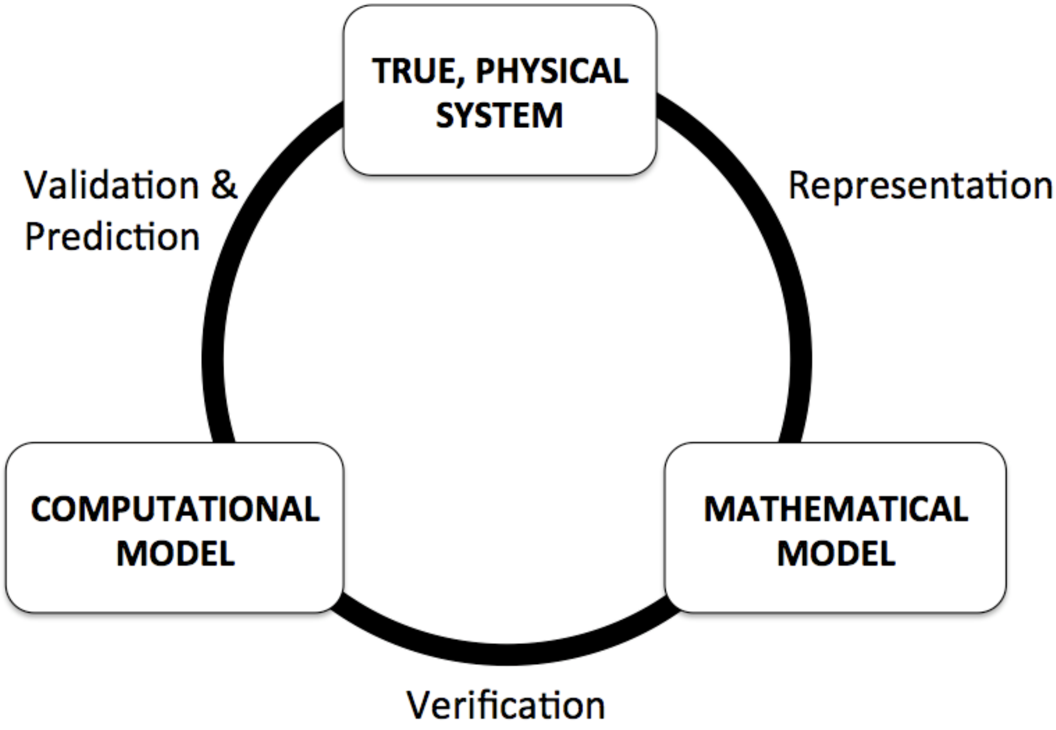
October 2017

Outline

- Introduction
  - VVUQ
  - Design-Analyze-Build
  - Observations
- CREATE Verification and Validation Principles
- Verification Practices
- Validation Practices
- Examples
- Observations and Conclusions

Introduction: Verification & Validation

The Modeling and Simulation Ecosystem



Verification, validation, and prediction as they relate to the true, physical system, the mathematical model, and the computational model. (Adapted from American Institute for Aeronautics and Astronautics. 1998.)

Introduction: Verification & Validation

Important Terms and Concepts - 1

- **Quantity of Interest (QOI) –** are the output(s)/result(s) of computational models, and are used in the engineering and study of modeled systems.
- **Verification –** how accurately a computer program ("code") correctly solves the equations of the mathematical model.
- **Validation –** the degree to which a model is an accurate representation of the real world from the perspective of the intended uses of the model.
- **Uncertainty Quantification (UQ) –** quantifying uncertainties associated with model calculations of true, physical QOIs.

Introduction: Verification & Validation

Important Terms and Concepts - 2

- **Community of Interest –** A community of domain experts, computational users and modelers that maintain detailed domain knowledge, shared validation test suites, and benchmarks for problems of interest.
- **Intended Use –** A computational model cannot "be proven" correct. Usually a community of interest defines problems in a domain and sets an acceptable level of testing to insure that the computational model is validated. An intended use is defined by the set of problems.

Introduction: CREATE Project

Design – Analyze – Build

Concept Development	Engineering Development	Post Development

Design→Build→Test

Virtual Environment

Multi-physics based performance analysis

Build Final Product → Physical Test

Manufacture And Sustainment & Modification

21st Century Goal – Rapid and Agile Systems Development

Potential for Large Productivity Gains	Potential for Large Productivity Gains	Additional Productivity Gains

Introduction:
Observations

- "essentially, all models are wrong, but some are useful" (https://en.wikipedia.org/wiki/George_E._P._Box)
- "Since it isn't possible to prove that the complex multi-physics software in the Computational Research and Engineering Acquisition Tools and Environments (CREATE) program is mathematically "correct", there's a risk that without adequate testing, it won't be trusted to provide accurate predictions of weapon system performance".

Core CREATE Verification and Validation Practices - Principles

Align testing with National Research Council best-practices for scientific software, supplemented and refined by the CREATE staff's collective experience in DoD, DOE, industry, and academia. (ISBN 978-0-309-25634-6)

- Verification Principles:
  - Solution verification is well-defined only in terms of specified QOIs.
  - The efficiency and effectiveness of code and solution verification can often be enhanced by exploiting the hierarchical composition of codes and mathematical models, with verification performed first on the lowest-level building blocks, and then on successively more complex levels.
  - The goal of solution verification is to estimate, and control if possible, the sources of error in the implementation of the models for each QOI for the problem at hand.

Core CREATE Verification and Validation Practices - Principles

- Validation Principles:
  - A validation assessment is well-defined only in terms of specified QOIs and the accuracy needed for the model's intended use.
  - A validation assessment provides information of model accuracy only in the domain of applicability "covered" by the physical observations employed in the assessment.
  - The efficiency and effectiveness of validation and prediction assessments are often improved by exploiting the hierarchical composition of computational and mathematical models.
  - Validation and prediction often involve specifying or calibrating model parameters.
  - The uncertainty in the prediction of a physical QOI must be aggregated from uncertainties and errors introduced by many sources, including discrepancies.
  - Validation assessments should consider the uncertainties and errors in physical observations (measured data).

Core CREATE Verification Practices

"… code and solution both …"

1. *Design code with hierarchical code verification in mind*.
2. *Develop a verification test plan*.
3. *Verify the code prior to validation*.
4. *Verify the code, as much as is practical, and document the coverage*.
5. *Conduct hierarchical testing (that is, unit, integration, system, and regression tests), and document the results. Automate testing to the greatest degree possible*.
6. *Document the domain and range of intended use of the code.*
7. *Use as many types of verification tests as are feasible*.
8. *Test for software integrity*.

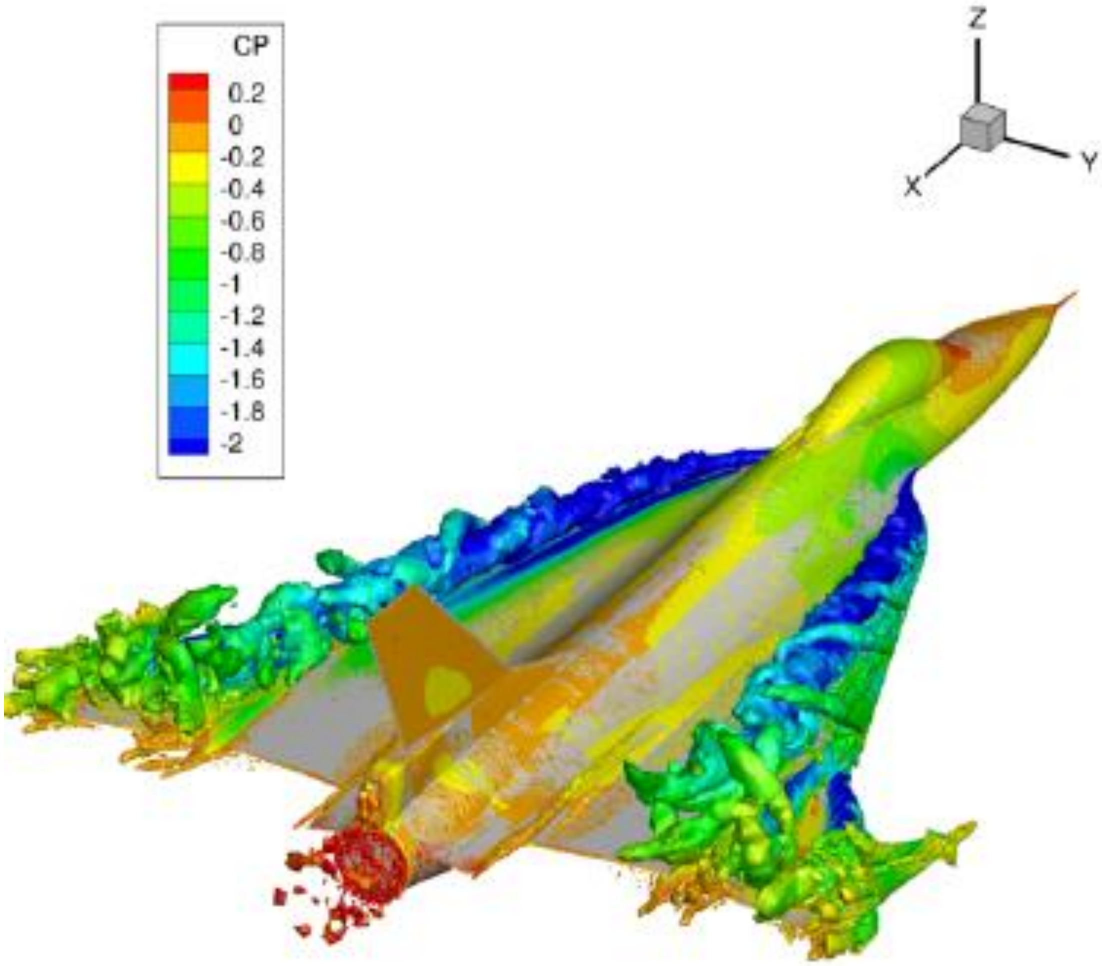
Core CREATE Validation Practices

"… model represents reality …"

9. *Validate for the full range of the code's intended use.*
10. *Develop an archival database for validation.*
11. *Validation should be focused on the behavior and accuracy of QOIs associated with use-cases*.
12. *When metrics are used to assess the difference between model and experiment, they should only measure the mismatch between computational and experimental results*.
13. *Develop validation project plans, review them with independent experts and users, and execute them*.
14. *Formally assess the V&V status and progress.*

Example

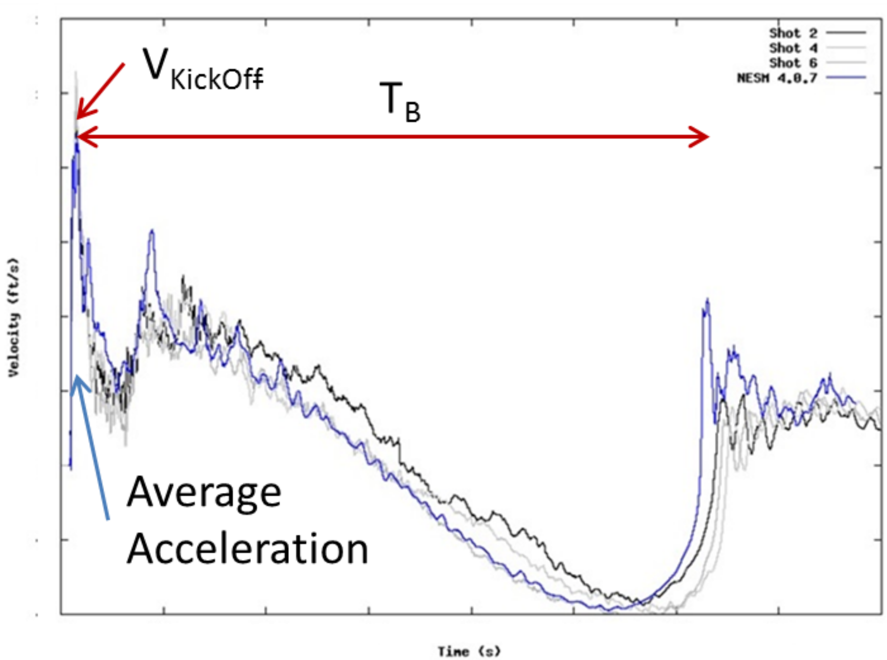
CREATE AV Turbulence Model Tests



Distribution A: Approved for Public release; distribution is unlimited.

Example

Floating Shock Platform (FSP) and typical FSP underwater explosion (UNDEX) test



Observations and Conclusions

- **Automate testing as much as possible.**
- **As intended uses for computational models evolve, so do the V&V test case suites. There is a continual need for maintenance and evolution of test cases and tools that support automated testing.**
- **The principles, as discussed in the NRC, have led to a cost-beneficial set of practices that lead to high-quality supercomputer software applications.**

DoD Risk Management Deficiencies… And How to Fix Them

Richard Sugarman

Steven Glazewski

Air Force Institute of Technology

School of Systems and Logistics

Department of Systems and Software Engineering Management

school of SYSTEMS and LOGISTICS

education research consultation

Our student inputs…

- Issue management is “daily normal”
- RM is centered on checking boxes
- Too much focus on complying with reporting directives
- Measurement of activity, not achievement
- Misplaced incentives

Recommendations

- Know your organization's measureable objectives
- Think about tolerance to the uncertainty that matters
- Measure uncertainty – ranges and confidence… not ordinal values or red/yellow/green
- Consider how to get best return on resource investment to reduce uncertainty

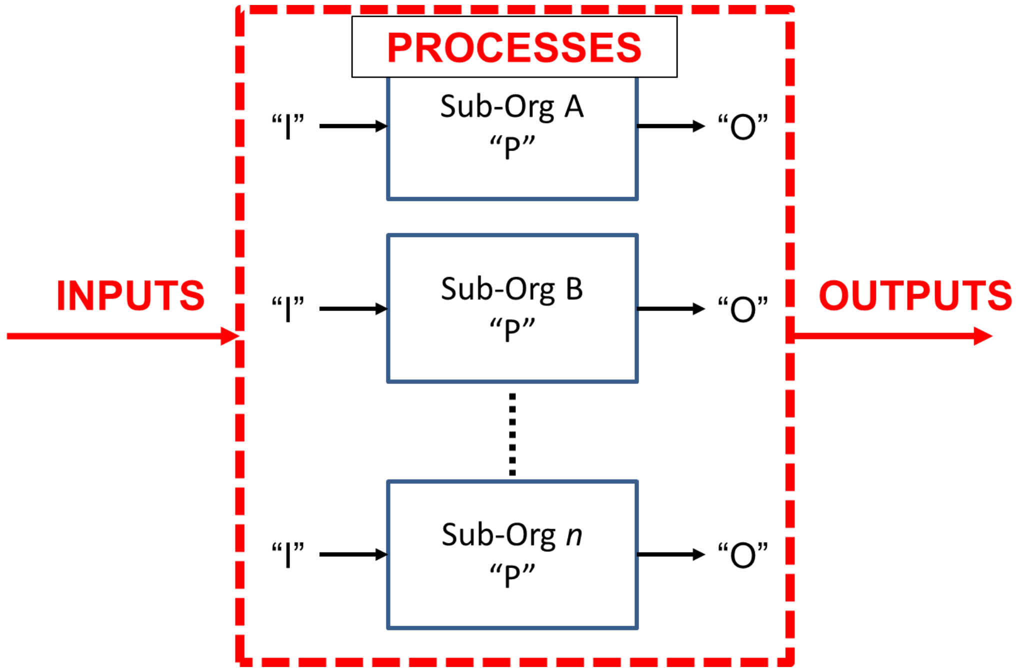
RM is about **Decisions**…

…which starts with knowing organizational objectives!

Note: Outputs = measureable objectives

Recommendation #1

Know your org's measureable objectives



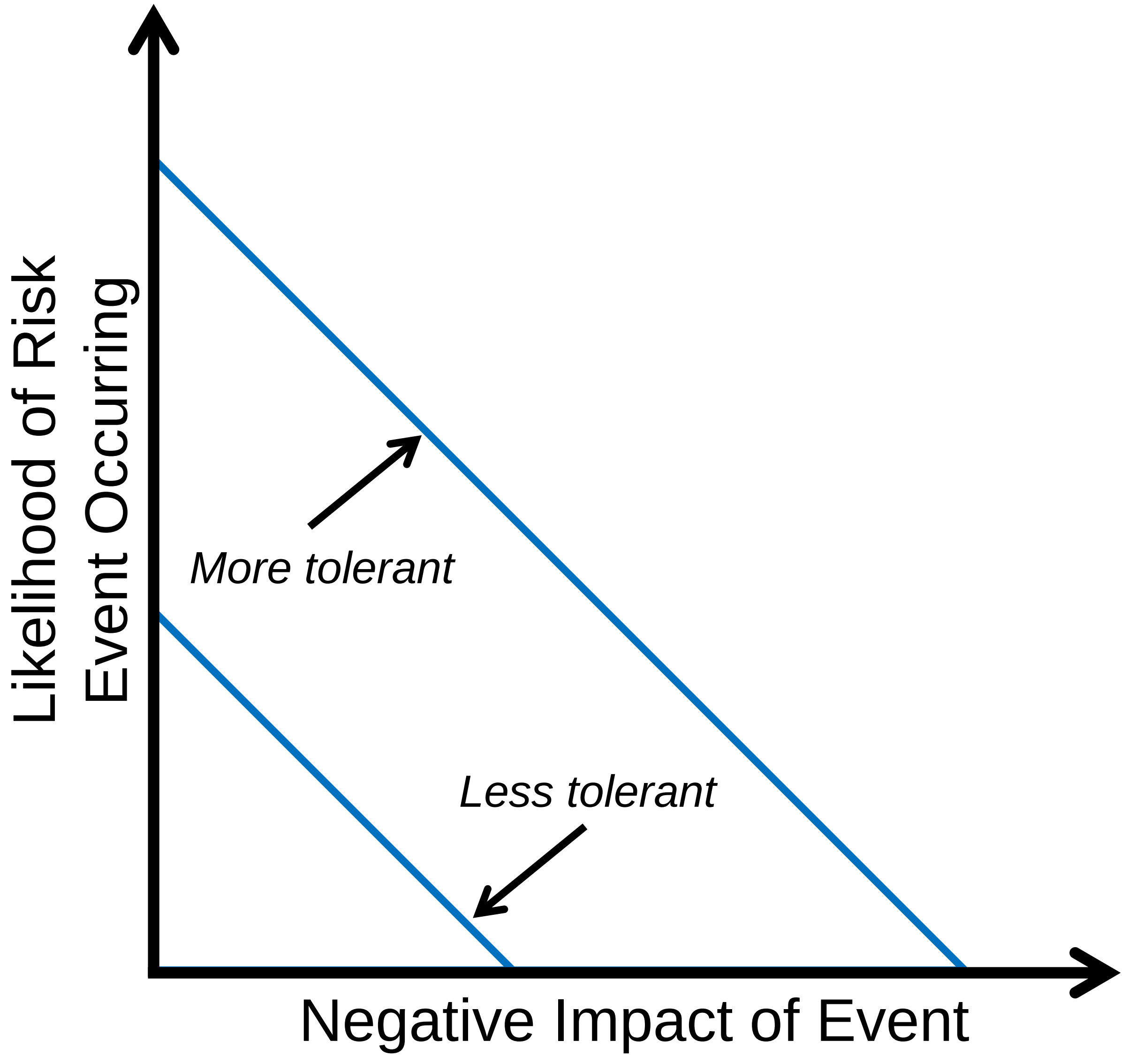
What is Risk?

AIR FORCE INSTITUTE OF TECHNOLOGY

"Uncertainty That Matters"

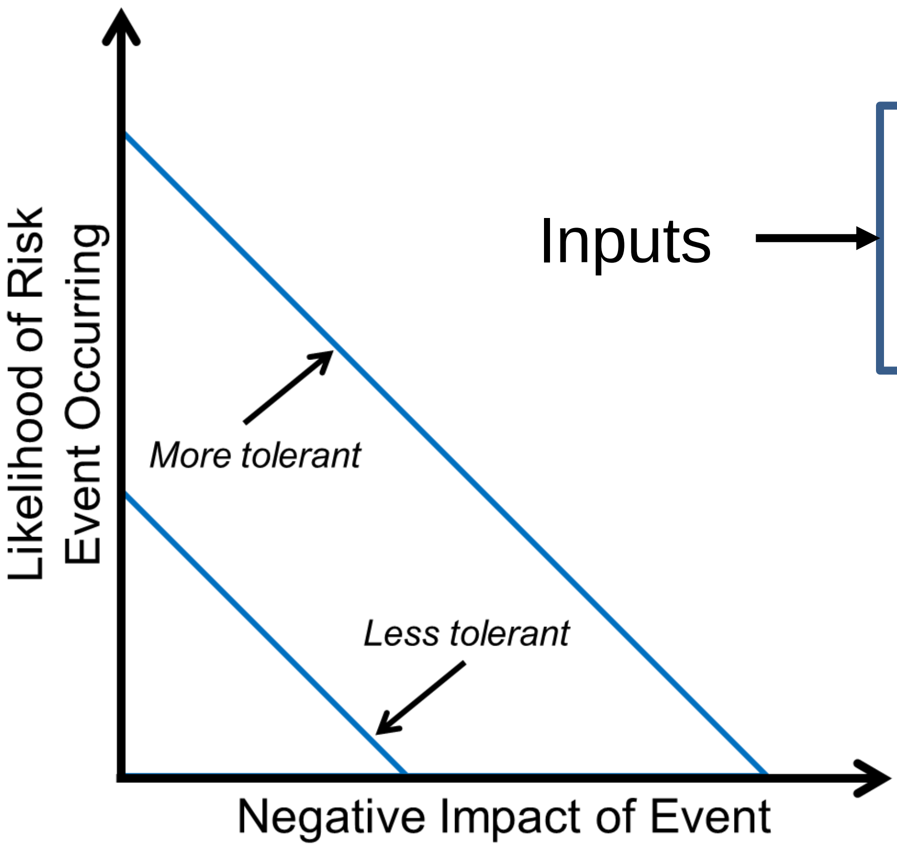
* Definition from Dr. David Hillson, www.risk-doctor.com

How much RM do I need?



Recommendation #2

Think about tolerance to the uncertainty that matters



Which risk is "the worst"?
Which has the greatest uncertainty?

Likelihood					
5	D				A, F
4					
3			C		
2					B
1				E	
	1	2	3	4	5

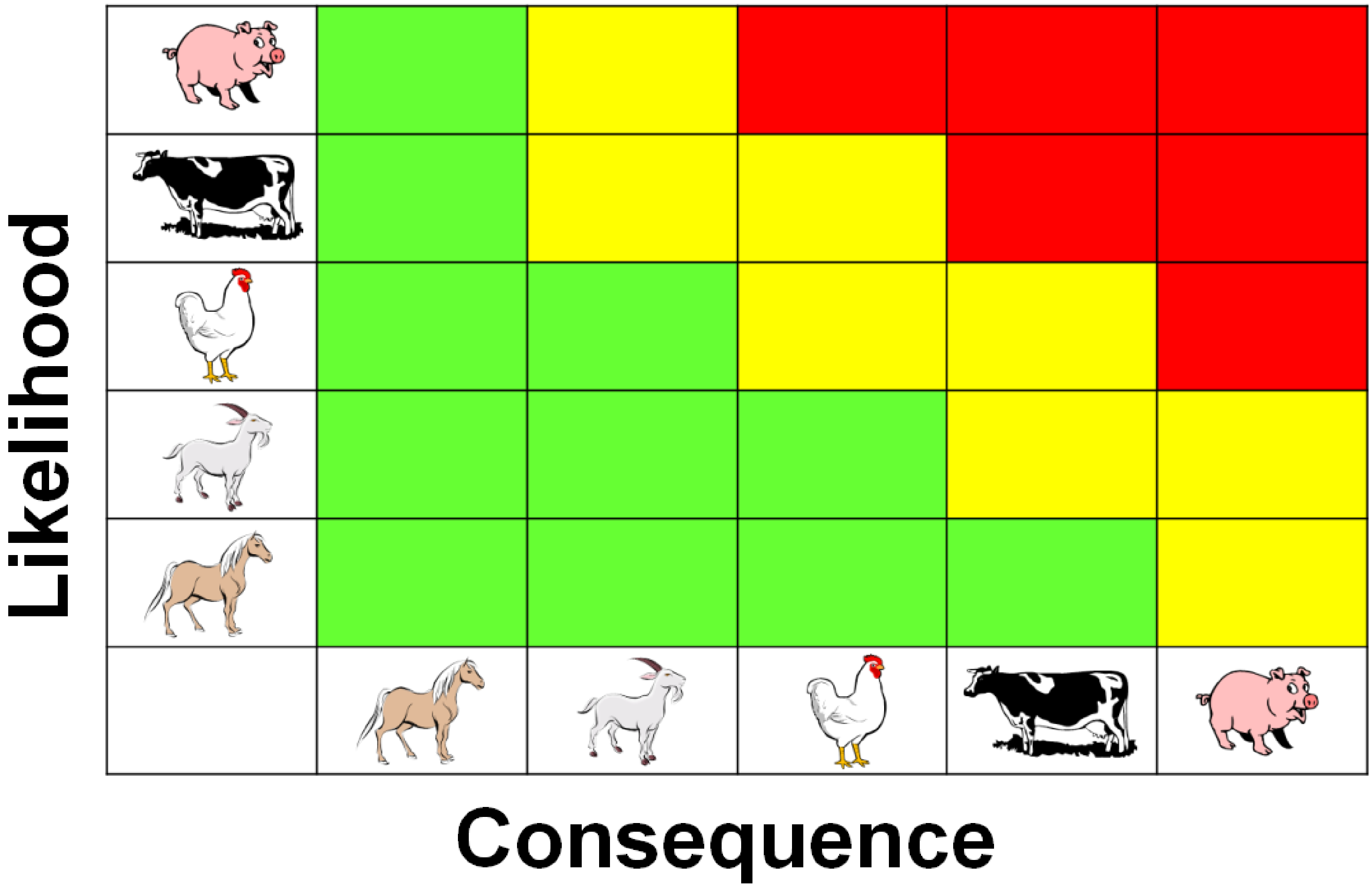
Consequence

Is a risk rated "25" really 2.5 times worse than a risk rated "10"?

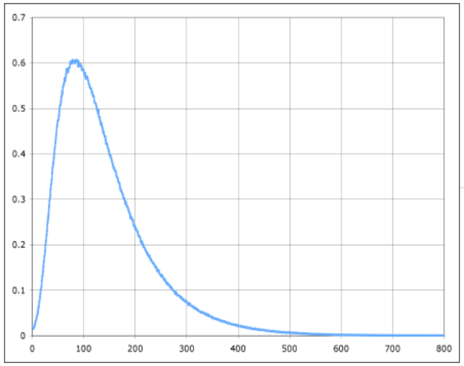
Likelihood					
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5
	1	2	3	4	5

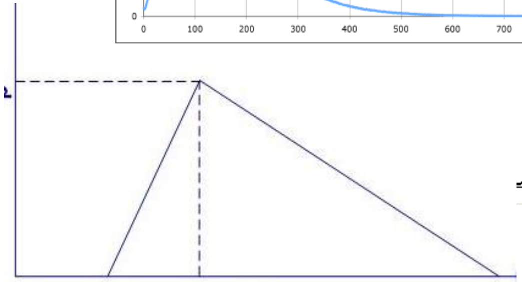
Consequence

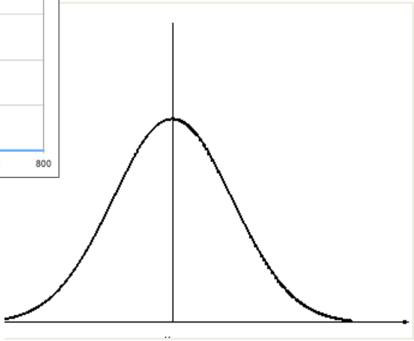
NO! Ordinal values, so…



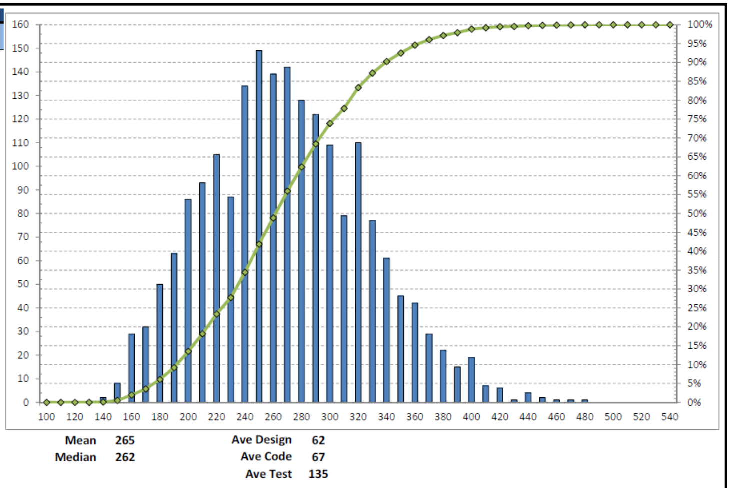
Better ways to think about uncertainty

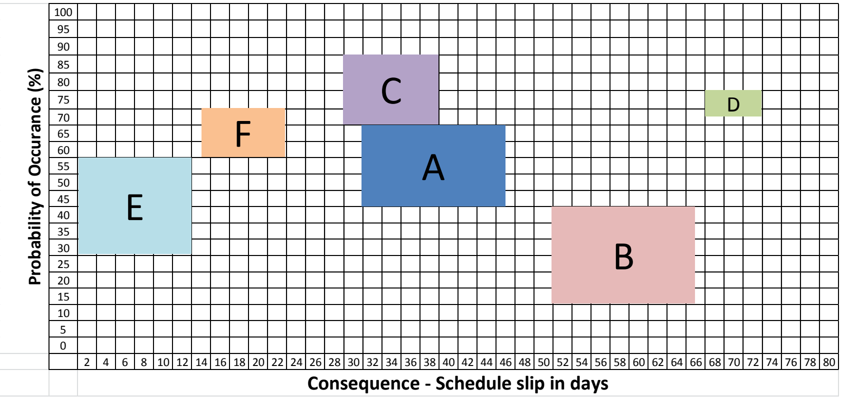






Histogram				
Bin	Cumul Freq	% Cuml Freq	Bin Freq	% Bin Freq
100	0	0.0%	0	0.0%
110	0	0.0%	0	0.0%
120	0	0.0%	0	0.0%
130	0	0.0%	0	0.0%
140	2	0.1%	2	0.1%
150	10	0.5%	8	0.4%
160	39	2.0%	29	1.5%
170	71	3.6%	32	1.6%
180	121	6.1%	50	2.5%
190	184	9.2%	63	3.2%
200	270	13.5%	86	4.3%
210	363	18.2%	93	4.7%
220	468	23.4%	105	5.3%
230	555	27.8%	87	4.4%
240	689	34.5%	134	6.7%
250	838	41.9%	149	7.5%
260	977	48.9%	139	7.0%
270	1119	56.0%	142	7.1%
280	1247	62.4%	128	6.4%
290	1369	68.5%	122	6.1%
300	1478	73.9%	109	5.5%
310	1557	77.9%	79	4.0%
320	1667	83.4%	110	5.5%
330	1744	87.2%	77	3.9%
340	1805	90.3%	61	3.1%
350	1850	92.5%	45	2.3%
360	1892	94.6%	42	2.1%
370	1921	96.1%	29	1.5%
380	1943	97.2%	22	1.1%
390	1958	97.9%	15	0.8%
400	1977	98.9%	19	1.0%
410	1984	99.2%	7	0.4%
420	1990	99.5%	6	0.3%
430	1991	99.6%	1	0.1%
440	1995	99.8%	4	0.2%

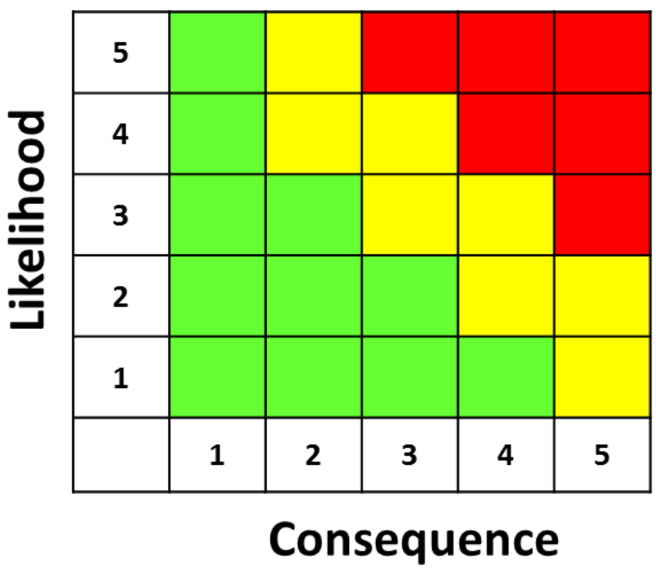




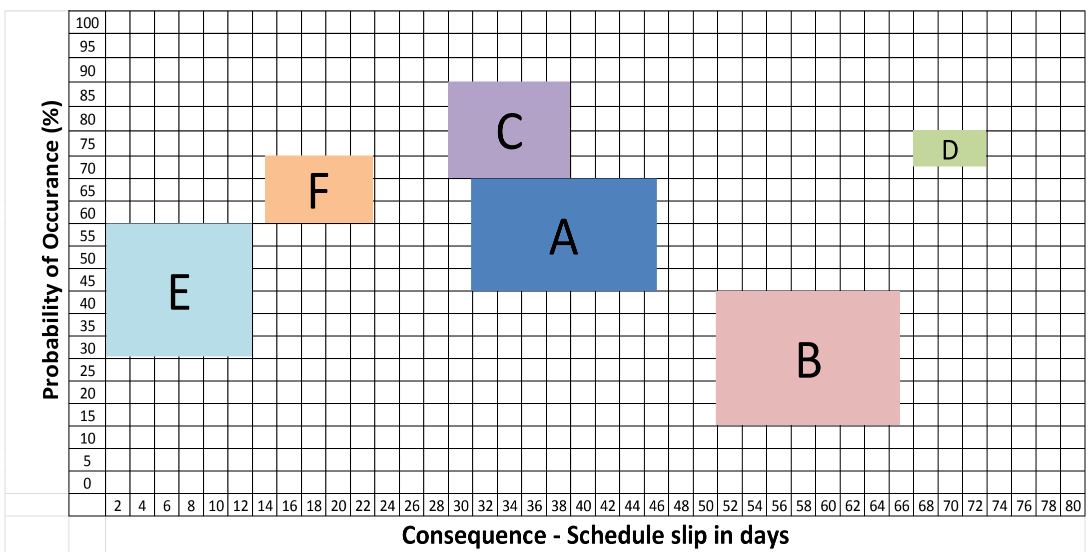
Recommendation #3

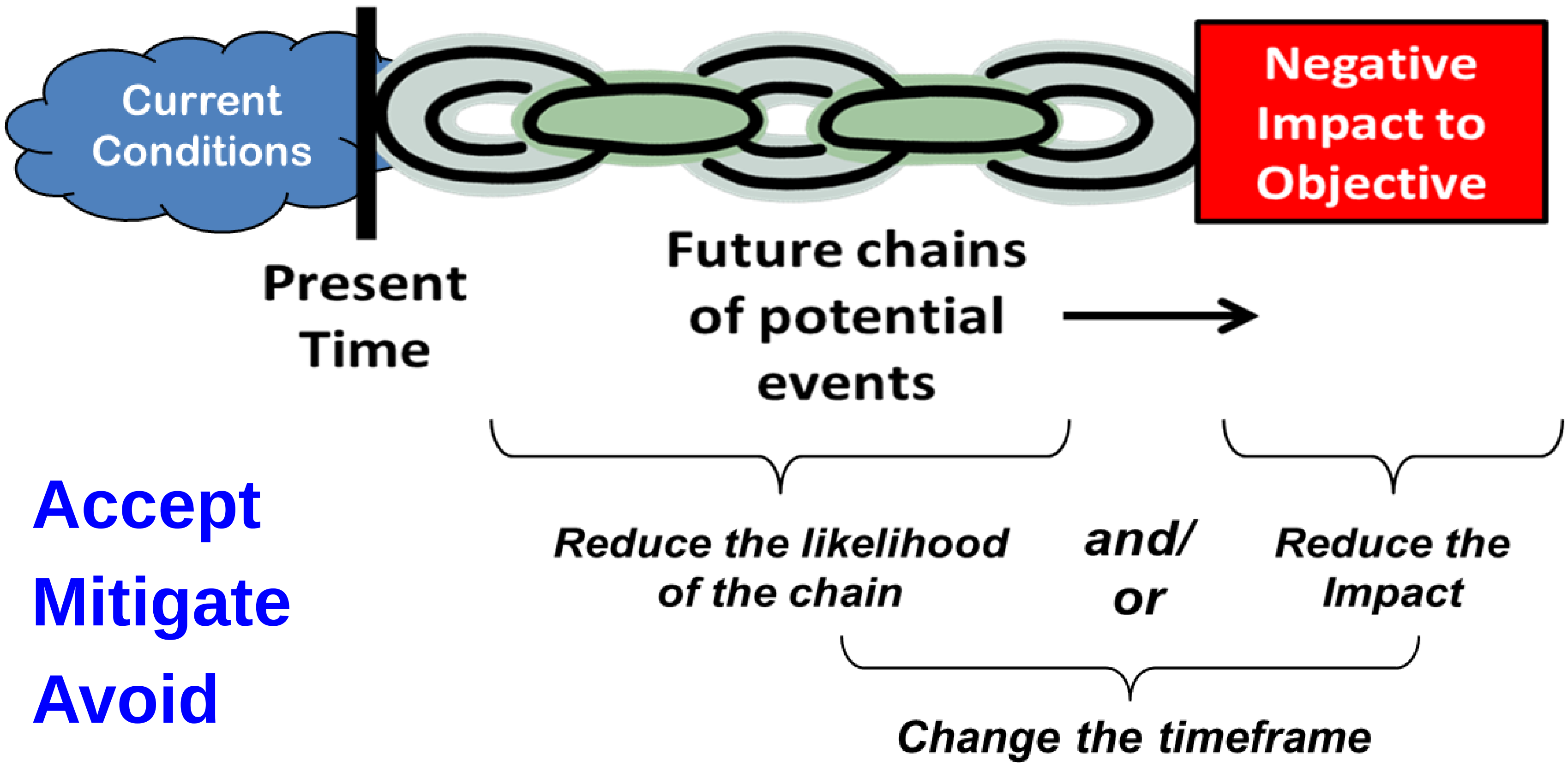
Measure uncertainty = ranges and confidence
…not ordinal levels or red/yellow/green

NO!! ↓ ☹



YES!! ↓ ☺

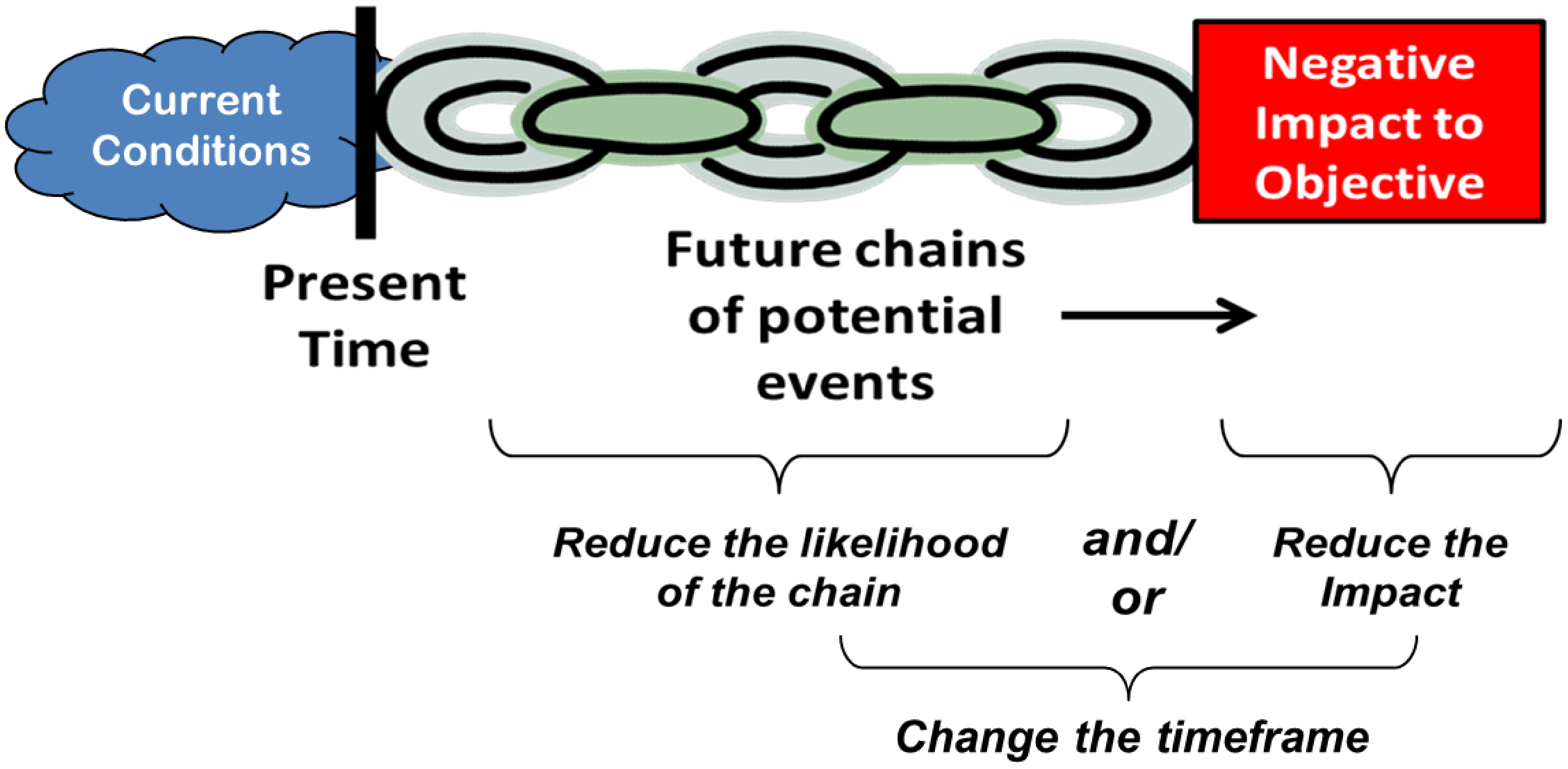




- Accept
- Mitigate
- Avoid
- Transfer
- Monitor
- Research

Recommendation #4

Consider how to get best return on resource investment to reduce uncertainty



“Never attribute to malice or stupidity that which can be explained by moderately rational individuals following incentives in a complex system of incentives.”

— Douglas W. Hubbard

"Never attribute to malice or stupidity that which can be explained by moderately rational individuals following incentives in a complex system of incentives."

— Douglas W. Hubbard

"Earned Autonomy"

Recommendations

- Know your organization's measureable objectives
- Think about tolerance to the uncertainty that matters
- Measure uncertainty – ranges and confidence… not ordinal values or red/yellow/green
- Consider how to get best return on resource investment to reduce uncertainty

Thank you!

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"CREATE-SH IHDE: Workflow Process Improvements for Hydrodynamics Characterization of Ship Designs"

Presented at NDIA Systems Engineering Conference

Wesley Wilson, R. Keawe Van Eseltine, Jun Li, and Joseph Gorski
Naval Surface Warfare Center – Carderock Division

26 October, 2017

Presenter: Wesley Wilson, NSWC Carderock Div.
Computational Design & Analysis Branch (871)

Introduction

- **Hydrodynamics is an important enabler in defining a ship design**
- **For new hull form concepts and non-conventional designs experience and data are lacking**
  - **NEED ROBUST TOOLS!**
  - **NEED EFFICIENT WORK FLOW PROCESSES!**
- **The use of simulation tools earlier in the design cycle to help better characterize the ship performance as early as possible could result in significant cost savings by avoiding costly modifications later in the design**
  - **NEED IMPROVED TIME TO SOLUTION!**
  - **NEED TO LOWER BARRIERS TO USER COMMUNITY!**

COMNAVSEA Memo: 4 Feb 2008 Functionality and Timeliness Objectives – (Reaffirmed Oct 2010 by NAVSEA Chief Engineer for Naval Systems Engineering

- **"This memorandum establishes high-level capability goals for NAVSEA design synthesis and analysis tools in order to guide development efforts within the Navy and for the DoD sponsored CREATE …"**
- **Joint Capabilities Integration & Development (JCIDS)**
  - "… capability to generate and analyze **hundreds** of ship concepts to a rough order of magnitude level within a period of **weeks or months**"
- **Concept Refinement**
  - "…accurately portray cost versus capability trade-offs, including uncertainty analysis, for **dozens** of ship concept options within a **six-month** period of performance"

IHDE addresses Concept Refinement and JCIDS through incorporation in Rapid Ship Design Environment (RSDE)

IHDE Description

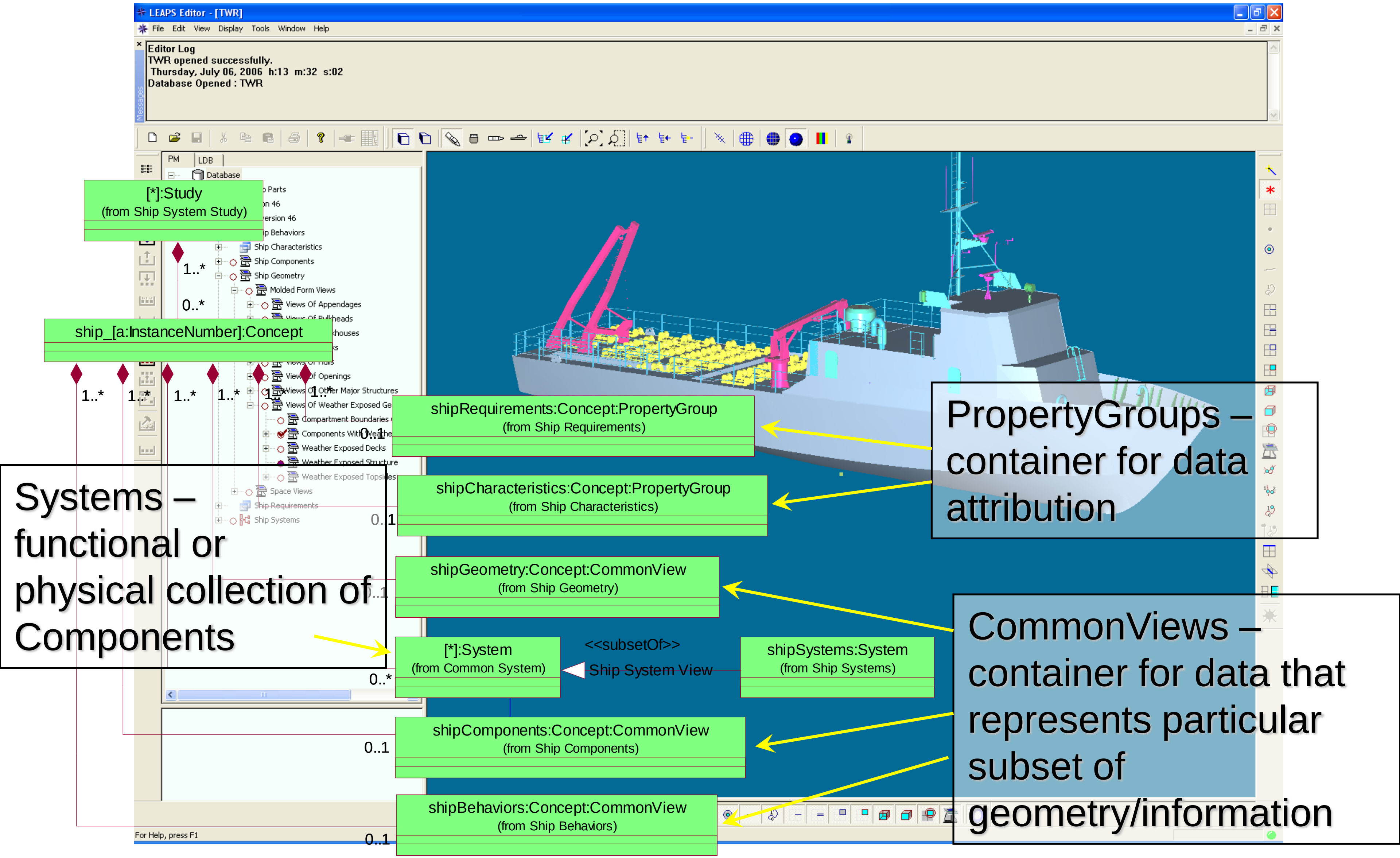
- **Desktop application that integrates a suite of hull form analysis tools including visualization**
  - Range of accuracy vs. computational expense
  - Integrated visualization capabilities
- **IHDE focused on Hydrodynamics**
  - Use by naval architects and design agents in early design stages
  - Enables more complex analyses by Hydro SMEs at all design stages and efficient way for SMEs to engage the design community
  - Supports hydrodynamic analysis needs for design space exploration and other ship performance domains
    - Rapid Ship Design Environment (**RSDE**)
    - Integrated Structural Design Environment (**ISDE**)
- **IHDE is a workflow process environment**
  - Enabler for analysis tools and information exchange across domains
    - Efficiency improvements vs. SME one-offs
  - Provides integration framework with automation
    - Automated meshing, solution preparation and execution

Product Model

- **Leading Edge Architecture for Prototyping Systems (LEAPS)**
  - Geometry and Engineering Math Library (GEML) as mathematical framework for representation of geometry and data
  - Interoperability amongst all of the different activities that rely on LEAPS product model (e.g., ***IHDE***, ***RSDE***, ***ASSET***)
  - Common taxonomy regarding ship geometry and characteristic information (denoted Focus)
  - Synergy in software development amongst all LEAPS related activities
- **Focus is to improve exchange of product model data between design agents and analysis activities within an integrated framework**
  - Maintain integrity of the data
  - Information exchange across different disciplines in a timely manner

Significant investment over many years into developing the capabilities and infrastructure of the LEAPS environment has been a significant enabler for all of the applications that use the LEAPS product model.

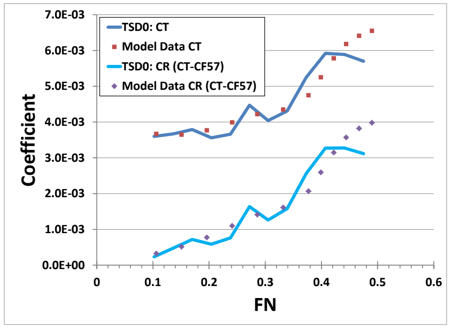
LEAPS Product Model



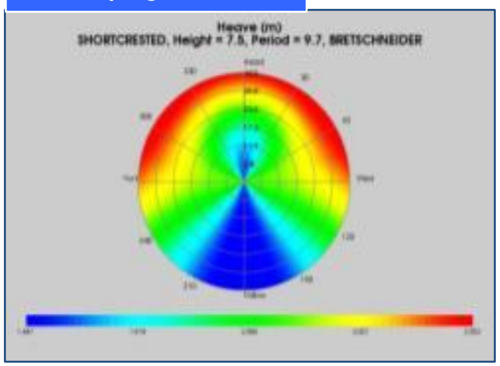
Integrated Hydrodynamics Design Environment (IHDE)

DOD HPC MODERNIZATION PROGRAM

Data Comparisons



Seakeeping Behaviors



RESISTANCE	POWERING	MANEUVERING	LOADS	SEAKEEPING

LOCAL HPC

DESIGN STUDIES

SHAPE OPTIMIZATION

VALIDATION STUDIES

HPCMP

TSD	AEGIR	SMP SEP SWMP	TEMPEST	Osprey NavyFOAM	LAMP

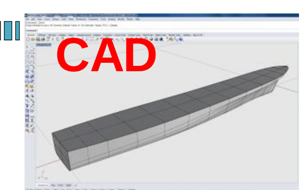
Problem Set Up	Conditions	Geometry	Automated Gridding

DRIVER/GUI

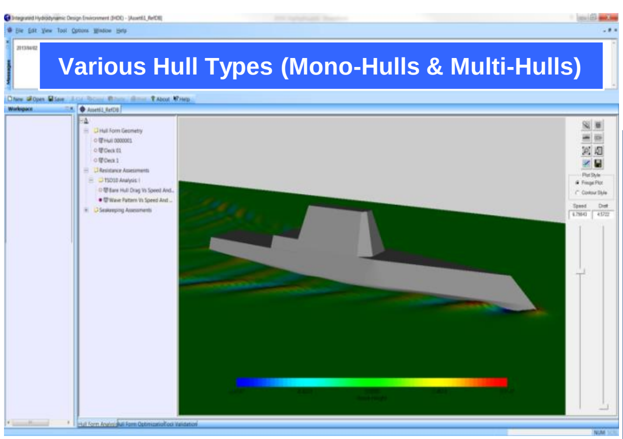
CAPSTONE

LEAPS

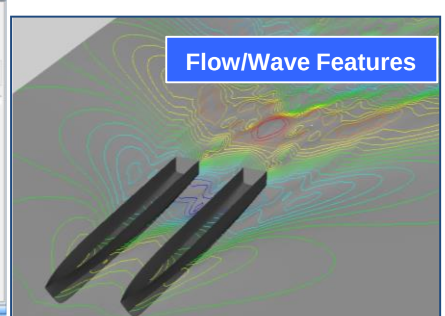
Morpheus



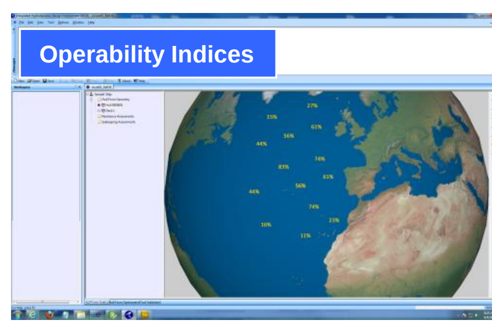
CAD



Various Hull Types (Mono-Hulls & Multi-Hulls)

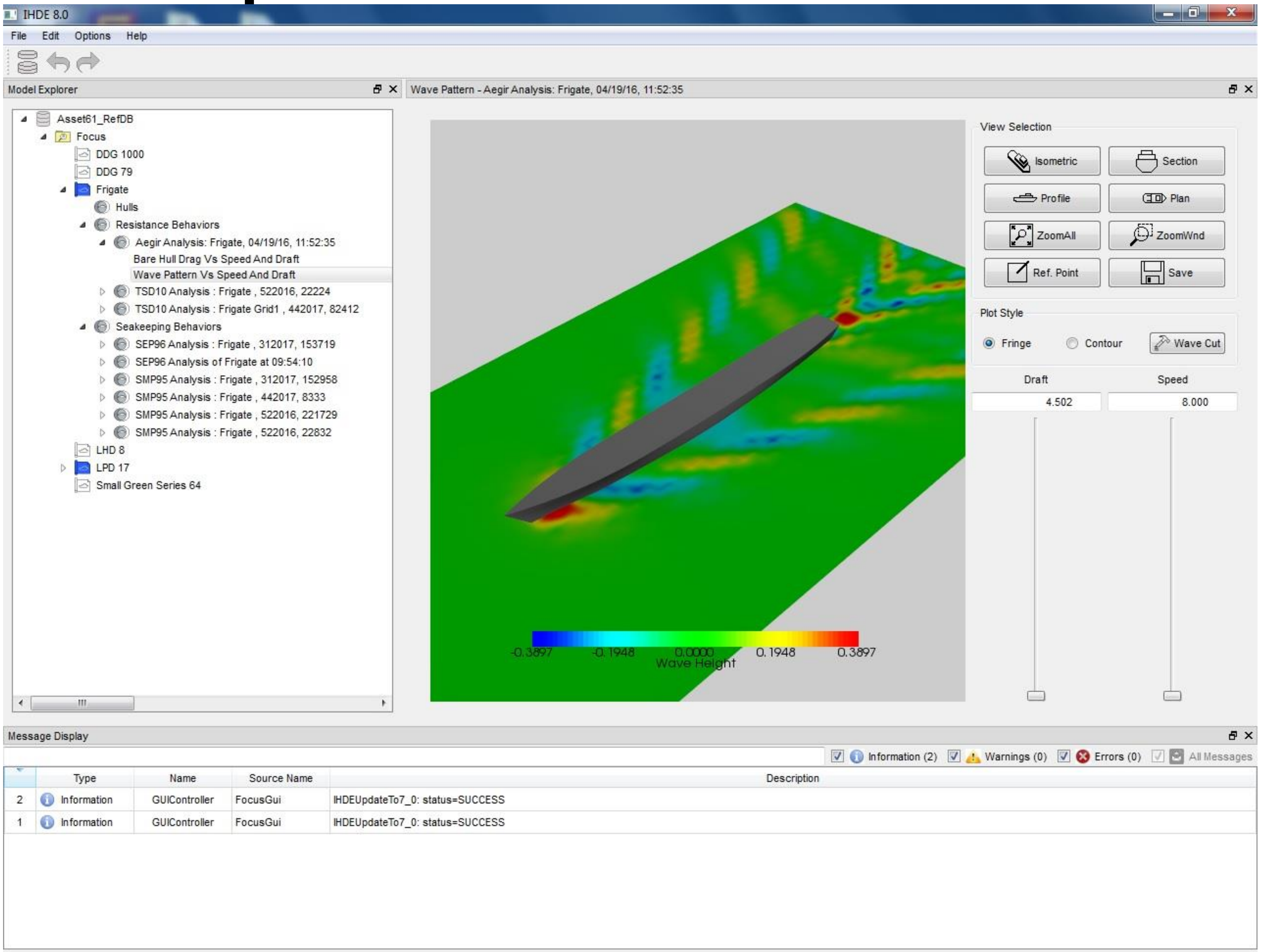


Flow/Wave Features



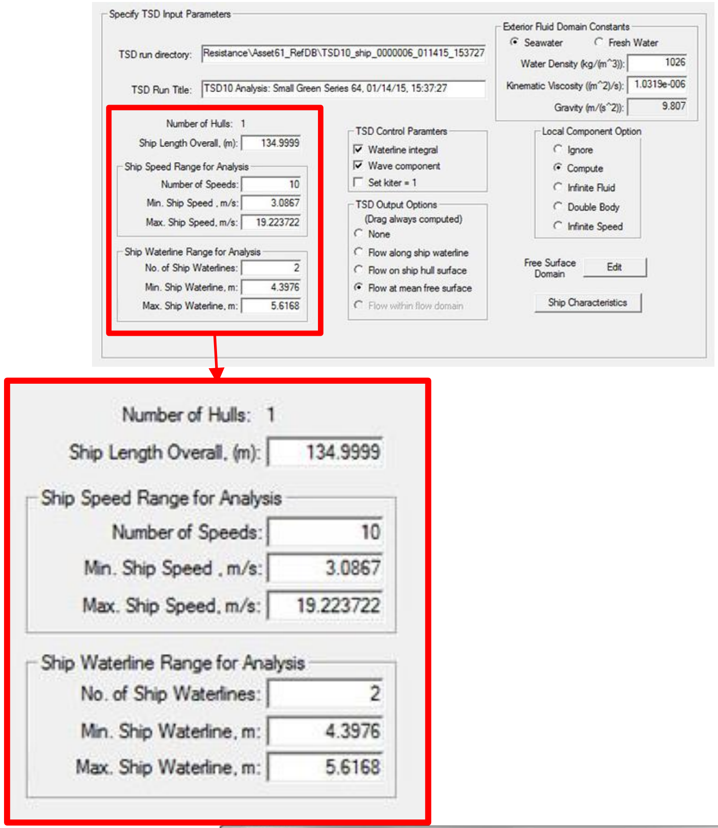
Operability Indices

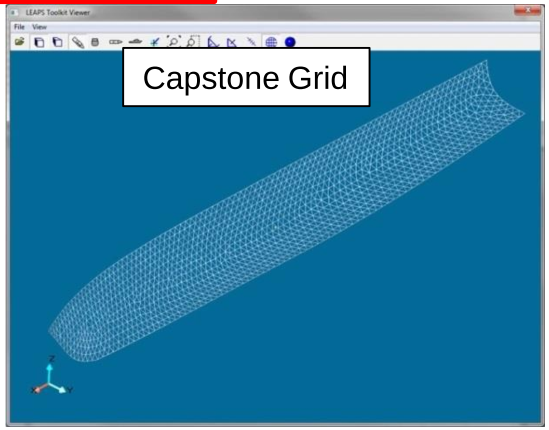
IHDE Graphical User Interface



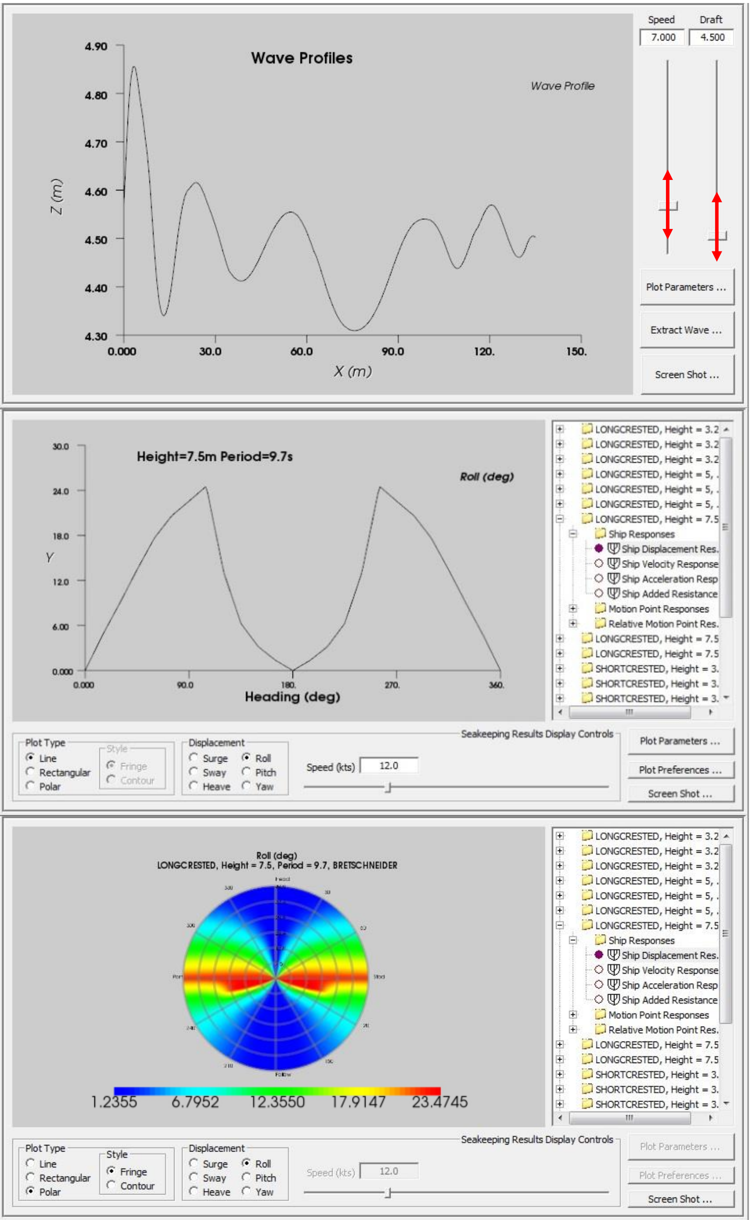
IHDE Description

- **Usability is important!**
  - Impacts in ship design require robust work flow processes to avoid costly delays
- **Automated analysis preparation and parallel execution**
  - Interactive wizard pages used to create solver inputs (reduces input errors)
  - Prepopulated ship characteristics from product model
  - Remote Execution System (RES) processes analysis jobs in background
  - Automation of complex inputs increases productivity
- **Automated mesh generation**
  - Access to CREATE-MG Capstone methods
  - Improved time to solution
- **Integrated visualization capabilities**





User Interactivity

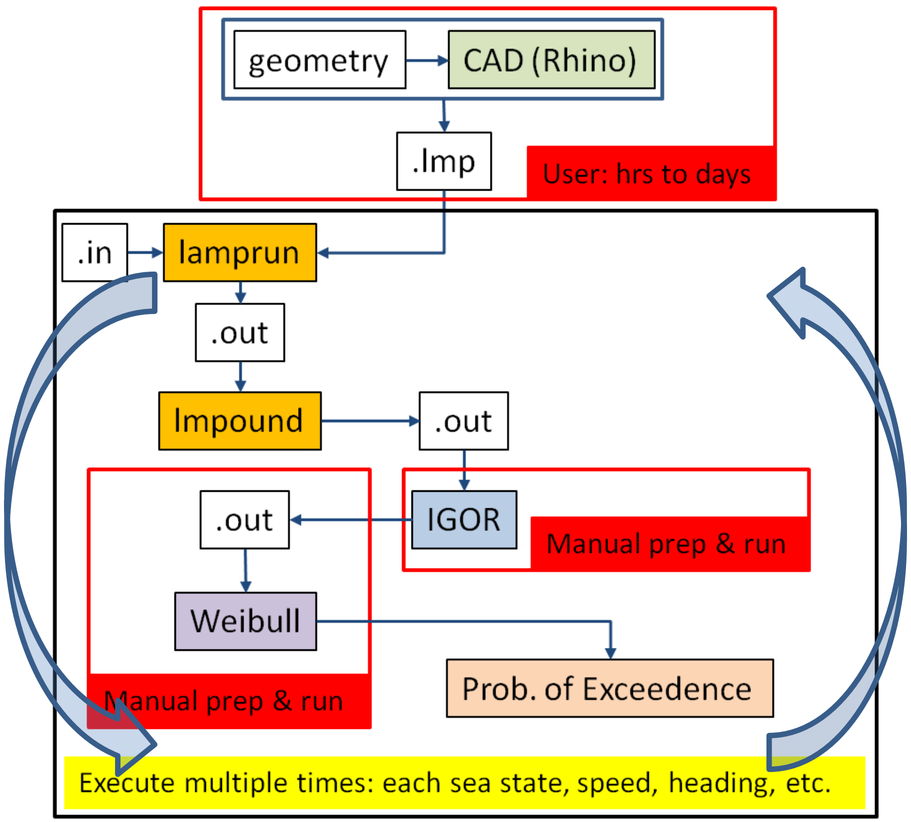


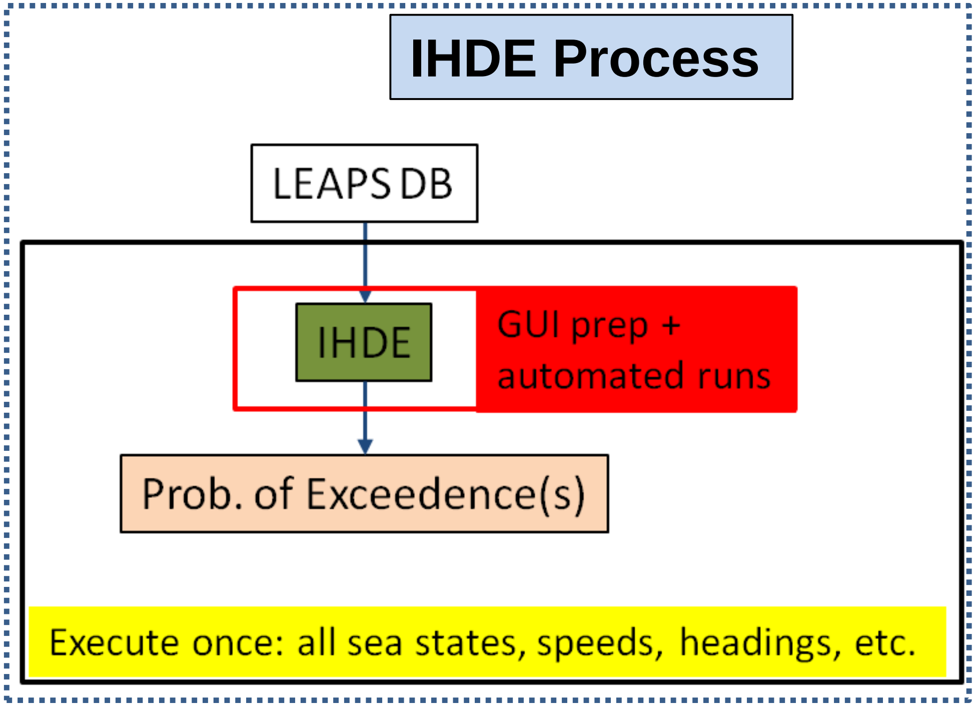
- **Results of analyses are persisted in LEAPS DB as behavior models**
  - Multi-dimensional splines
    - Example: Drag vs Speed vs Draft
- **IHDE provides multiple ways to interact with results**
  - 2D line plots
  - 2D fringe plots
  - 2D speed polar plots
  - 3D wave elevation contours
- **Slider bars effect real-time interrogation of multi-dimensional splines**
  - Dynamic user feedback

Example: Improved Process for Primary Loads using Large Amplitude Motions Program (LAMP)

DOD HPC MODERNIZATION PROGRAM

Previous Process





Significant time savings

- **Manual preparation time reduced**
- **Less chance of input errors**
- **Parallel execution of individual runs**

Time to solution reduced from Hours/Days → minutes!

Other User Community Barriers

- **Validation of Analysis Tools**
  - It is important for users to understand when different tools are applicable
  - Need to verify the pedigree of any geometry or data being used
  - IHDE Validation Engine in V6 and later provides a means for users to assess the accuracy of analysis tool predictions through comparisons with experimental model test data and best-practice pre-computed solutions

- **One of the major challenges is getting geometry into LEAPS Focus-compliant format**
  - Previous process required to import user-defined geometry was very labor intensive and represented a significant barrier to new users
  - **Morpheus** application available in LEAPS V5 provides streamlined process for geometry import
    - Rhino .3dm or .iges formats

IHDE Validation Engine

- **Validation is a key component in understanding and demonstrating the applicability of different tools to different types of problems**
  - IHDE vision is to provide a suite of different analysis tools that balance accuracy with computational expense
- **We are leveraging a wealth of experimental model test data taken over decades at NSWC Carderock**
  - Care must be taken to establish pedigree of geometry and data
- **User workflow process for performing comparisons**
  - Pre-computed ship resistance analysis vs. included model test data
    - Does not require any new predictions on the part of the user
    - **IHDEValidationDB** provided with IHDE installation
  - Wave cuts can be extracted from wave elevation behavior objects for comparison with model test data

IHDEValidationDB Monohulls

Model	Description	Ship Scale		Model Scale	
		Length (ft)	Beam (ft)	Length (ft)	Beam (ft)
5415	Pre-contract DDG 51	465.9	62.5	18.77	2.52
5653	JHSS Baseline Bulb (BB)	950.5	104.9	27.85	3.08
5653	JHSS Gooseneck Bulb (GB)	950.5	104.9	28.71	3.08
5365	*R/V Athena I*	154.0	22.6	18.67	2.74

5415

5653(BB)

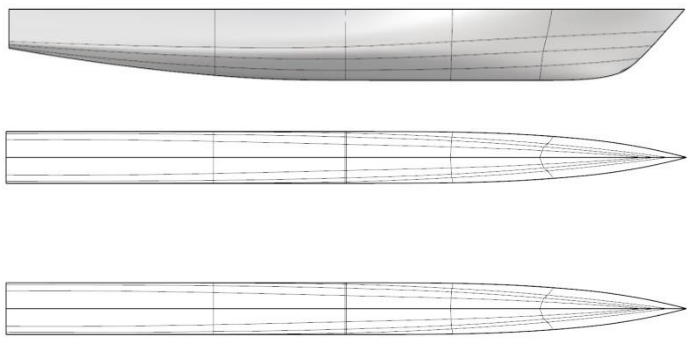
5653(GB)

5365

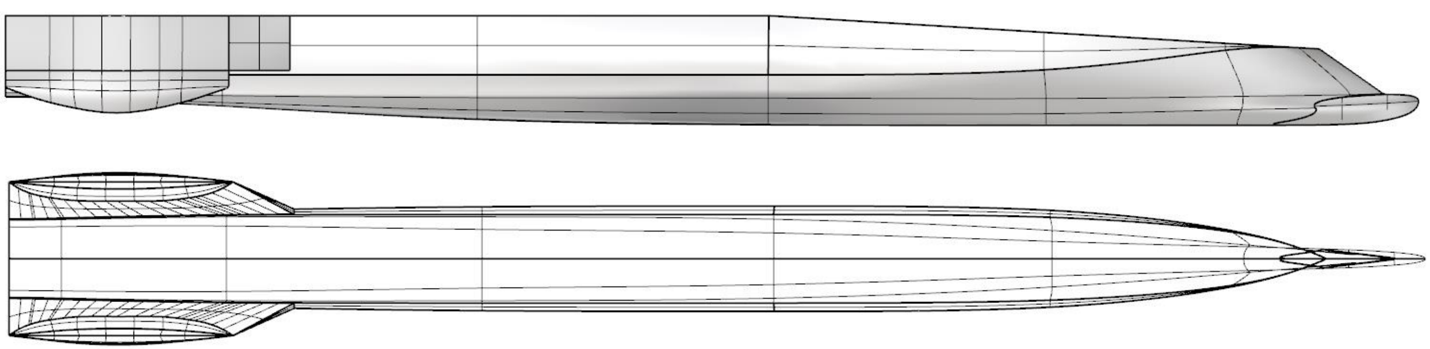
IHDEValidationDB Multi-hulls

Model	Description	Ship Scale		Model Scale	
		Length	Beam	Length	Beam
372	Delft 372 Catamaran	---	---	9.84 ft	3.08 ft
5594	HSS (High Speed Sealift) hull concept	1059 ft	128.6 ft	23.6 ft	2.86 ft

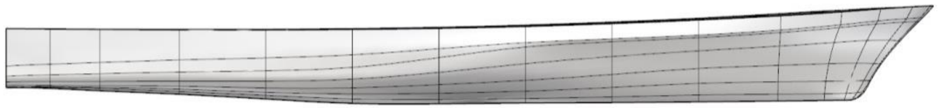
372

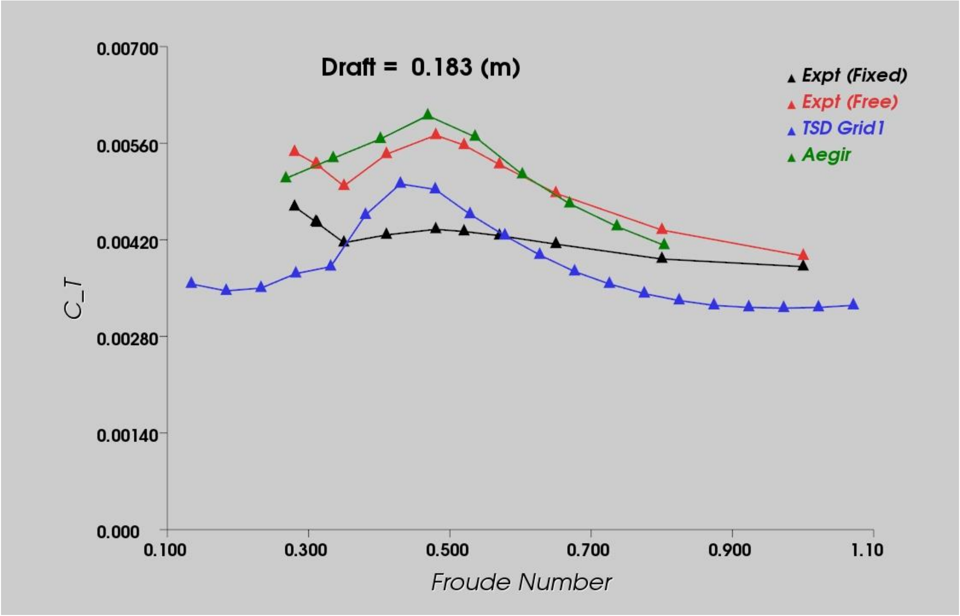


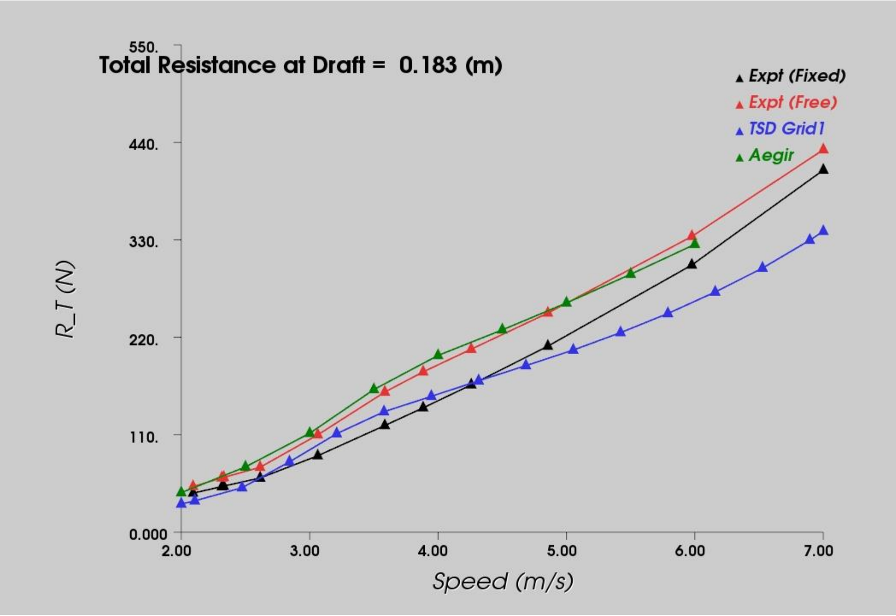
5594



Example: Model 5365 (R/V Athena)







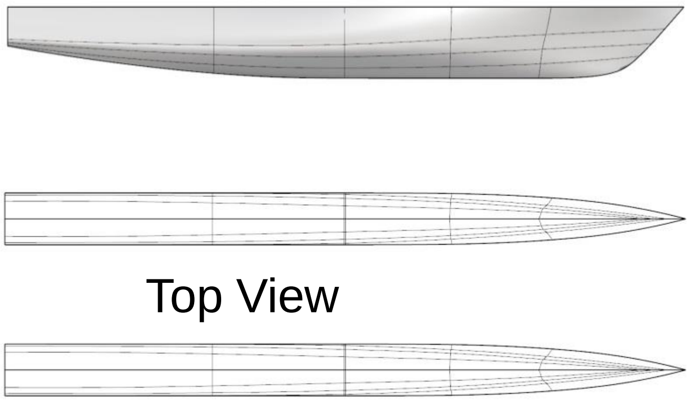
Comparisons with experimental data both fixed and free to sink and trim

-- TSD does not account for ship motion

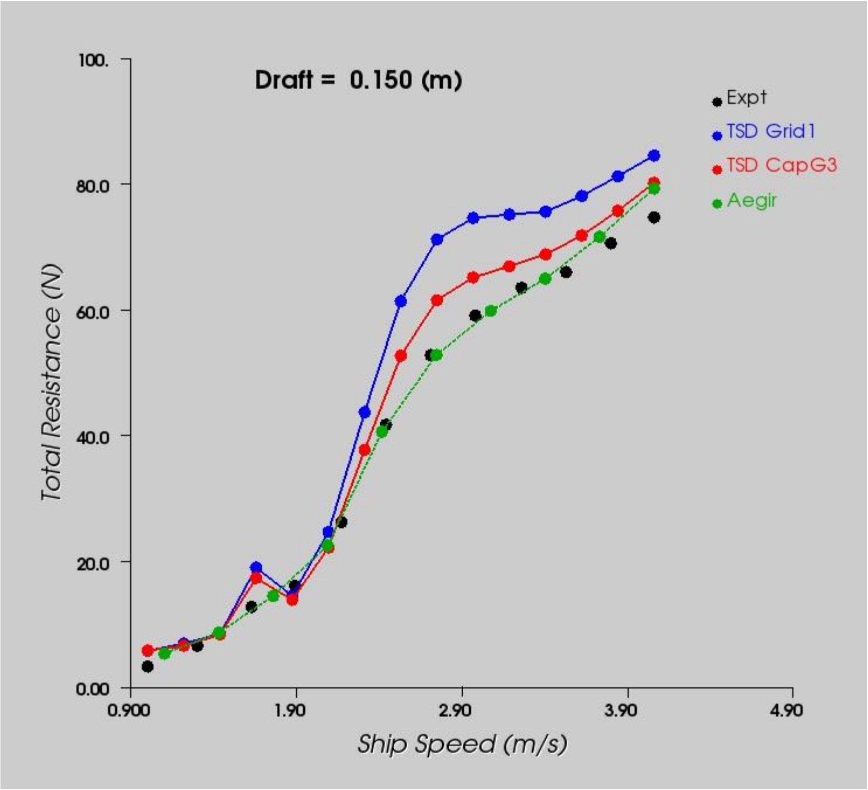
-- TSD under-predicts resistance at higher Fr

-- Aegir accounts for ship motion and shows much improved comparison vs. TSD

Example: Delft 372 Catamaran



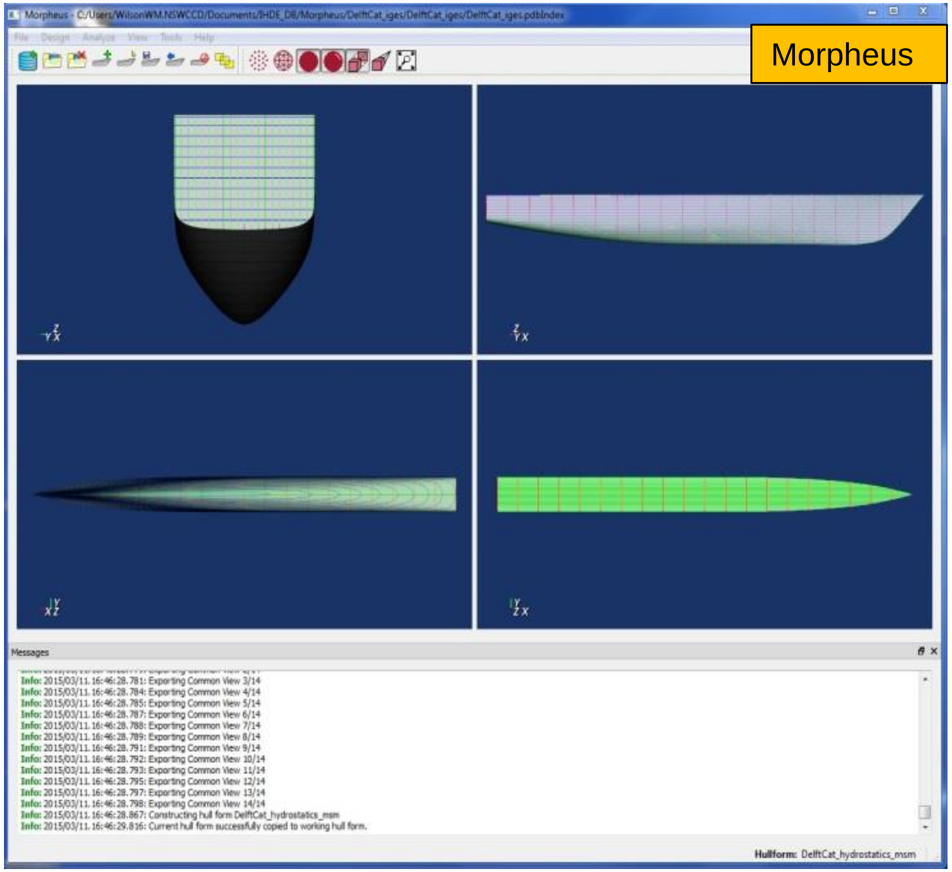
Top View



- **Comparison of different grid methods:**
  - "CapG3" Capstone mesh shows improved accuracy for TSD predicted resistance
- **Comparison of different analysis tools**
  - Aegir shows improved accuracy vs. TSD

LEAPS Geometry Pre-Processor

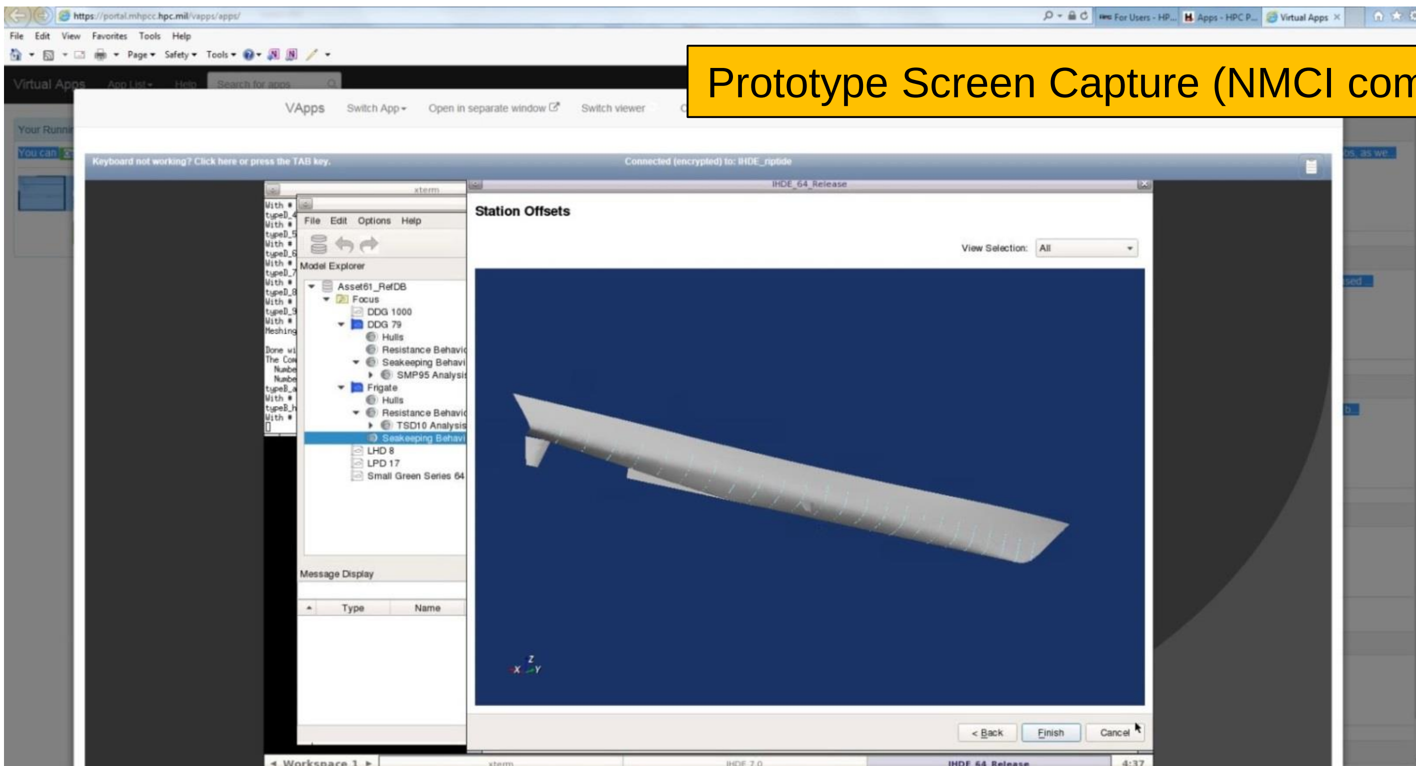
- **Morpheus is a key enabler to lowering the entry point to IHDE!**
  - Supports .iges and Rhino .3dm
  - Drag-and-drop hull view associations
  - Geometry validation compliancy checks for all LEAPS products
  - Automatically creates LEAPS database with correct geometry associations and attributions
- **Morpheus also enables simple hull form modifications from parent hull form**



LEAPS database that is IHDE compliant can be generated in minutes!

Planned IHDE @ HPC Portal

- **Web portal delivery method**
  - No local installs
  - Single sign-on for authentication using CAC
  - Provides easy access to larger HPC resources
  - Future enabler for design engagement of CFD methods



Prototype Screen Capture (NMCI computer)

Summary

- **IHDE is a desktop application that integrates a suite of hull form analysis tools including visualization**
  - Ship performance areas: Resistance, Seakeeping, Hydro Loads, Operability
- **LEAPS product model:**
  - Provides single unified representation of the ship model and maintains the integrity of the data used for analysis
  - Enables Information exchange across different disciplines in a timely manner
- **End-state vision of IHDE is integrated suite of design and analysis tools to fully characterize a ship design with appropriate level of definition**
  - Range of fidelity = accuracy vs. computational expense
  - Automated meshing and analysis preparation & parallel execution
  - Integrated visualization
  - Efficient workflow processes and data exchange at all levels of design
- **IHDE enables direct link between hydrodynamics SMEs and ship design agents for improved ship designs**

Questions?

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