National Defense Industrial Association Systems and Mission Engineering Conference

November 2022

Department-Wide Software Science and Technology Strategy

Mr. Allan Dianic

Director, Software Engineering

Office of the Executive Director, Systems Engineering and Architecture

Office of the Under Secretary of Defense for Research and Engineering

Overview

- History and Background
  - NDAA 2020, Section 255, Department-Wide Software S&T Strategy
  - Drafting and Approval
- Content and Approach
- Strategy Rollout

History and Background: NDAA 2020, Section 255 Department-Wide Software S&T Strategy

- NDAA 2020 Section 255 (enacted December 19, 2019) established two major requirements for DoD:
  - Section 255 (a) Appoint a senior official to guide DoD in software in six areas
  - Section 255 (b) Develop a DoD-wide Software Science and Technology (S&T) Strategy under guidance from the designated senior official

Research Areas

1. Research and development activities on new technologies for the creation of highly secure, scalable, reliable, time-sensitive, and mission-critical software;

2. Research and development activities on new approaches and tools to software development and deployment, testing, integration, and next generation software management tools to support the rapid insertion of such software into defense systems;

3. Foundational scientific research activities to support advances in software;

4. Technical workforce and infrastructure to support defense science and technology and software needs and mission requirements;

5. Providing capabilities, including technologies, systems, and technical expertise to support improved acquisition of software reliant business and warfighting systems; and

6. Providing capabilities, including technologies, systems, and technical expertise to support defense operational missions which are reliant on software.

History and Background: NDAA 2020, Section 255 Department-Wide Software S&T Strategy

Approach

- Establish standing working group for Services, OSD, and industry for ongoing interchange
- Align with research labs and FFRDC to guide
- Conduct software-focused prototyping to advance and mature research in software intensive capabilities and to enhance transition/adoption
- Coordinate across major prototyping efforts to align foundational capabilities for joint use

SSG Composition

- Senior Steering Group
  - OUSD(R&E) Sponsor
  - OUSD(R&E)
  - OUSD(A&S)
  - DoD CIO
  - DOT&E
  - U.S. Army
  - U.S. Air Force
  - U.S. Navy

Software S&T Strategy Document (approved November 2021)

Department of Defense Software Science and Technology Strategy

In response to National Defense Authorization Act for Fiscal Year 2020 (P.L. 116-92) Section 255

November 2021

Department of Defense (DoD) Software Strategy Coordinator

Office of the Under Secretary of Defense for Research and Engineering

Washington, D.C.

The estimated cost of this report or study for the Department of Defense is approximately $159,000 in Fiscal Years 2020 - 2021. This includes $125,000 in expenses and $34,000 in DoD labor.

Generated on 2021May20 RefID: E-2732D97

DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.
DOPSR Case # 22-S-0461.

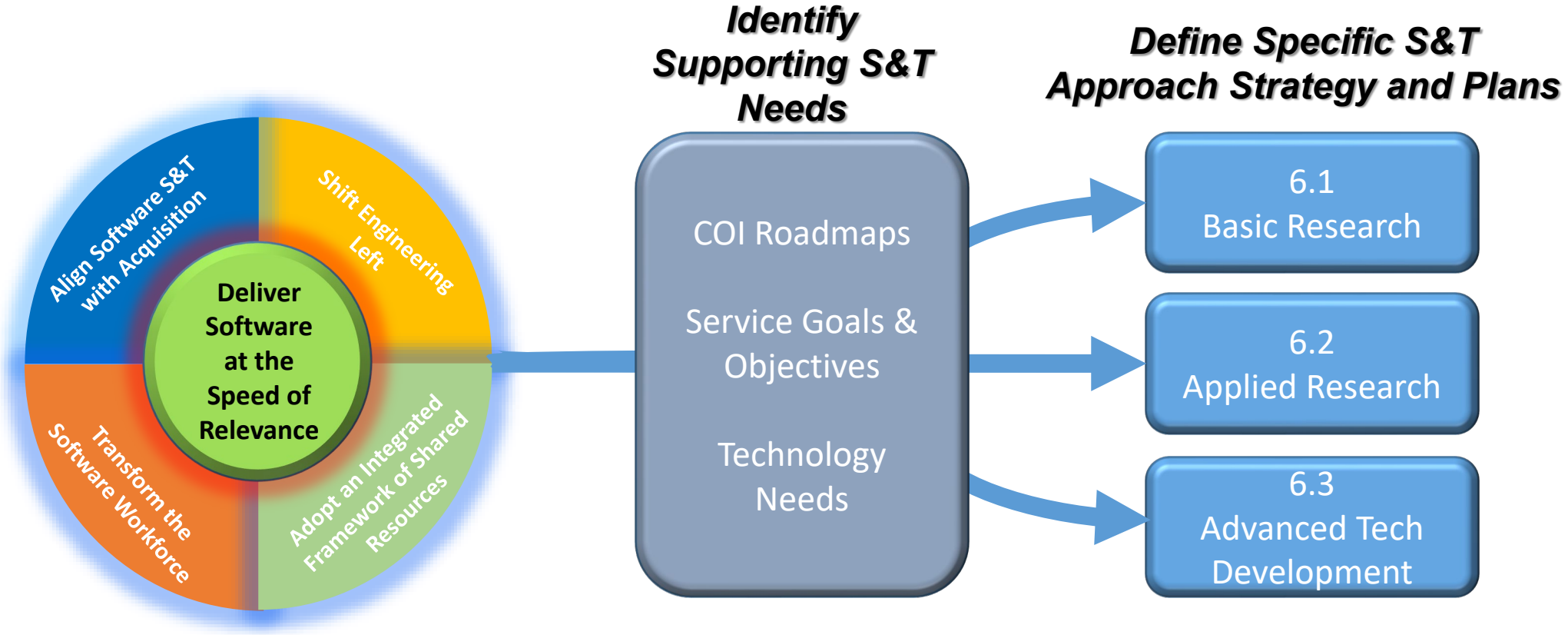
Contents

Content & Approach – Software S&T Strategy Key Points

	STRATEGIC VISION - DELIVER RESILIENT SOFTWARE CAPABILITIES AT THE SPEED OF RELEVANCE			
Goals	**2.1 SHIFT ENGINEERING AND DEVELOPMENT LEFT**	**2.2 ADOPT AN INTEGRATED FRAMEWORK OF SHARED RESOURCES**	**2.3 TRANSFORM THE SOFTWARE WORKFORCE**	**2.4 ALIGN SOFTWARE S&T WITH ACQUISITION**
Focus Areas	• Advance DevSecOps • Enhance resilience through speed • Create and curate high fidelity HWIL/SWIL, and M&S • Enhance engineering rigor and employ pervasive automation and self-service • Ensure a high level of assurance • Mitigate technical debt	• Research highly secure, resilient, cloud-native architectures • Leverage modern ecosystems, technologies, tools and processes • Focus on data acquisition, data science and event streaming • Accelerate delivery and adoption of AI/ML • Create federated repositories of reusable and shared resources • Invest in low-code, no-code and robotic process automation	• Connect the S&T and Engineering workforce • Train and invest in data science, AI/ML, and software engineering • Cultivate a leading S&T and software engineering workforce • Enable continuous learning to keep pace with the commercial sector • Elastically scale the software development workforce	• Bridge the gap between S&T and Acquisition • Embrace the mindset that software is never done • Advocate a strategic outlook toward software S&T investments • Invest in leap forward tech to leverage industry best practices • Streamline the planning, funding, requirements, and contracting process
NDAA Sec(b)	FY2020 NDAA Section 255 (b) 1 to 6. Including Strategies for: 3.1 Types of Software Related Activities within the Science and Technology Portfolio of the Department 3.2 Investment in New Approaches to Software Development, Deployment, and Next Generation Management Tools 3.3 Research to Innovate the Software Development Engineering, and Testing Process for Safety and Mission Critical Systems 3.4 Status of Implementing Recommendations on Software 3.5 Supporting the Acquisition, Technology Development, Testing, Assurance, and Certification 3.6 The Transition of Relevant Capabilities and Technologies to Programs			

Strategy Link to Research Planning

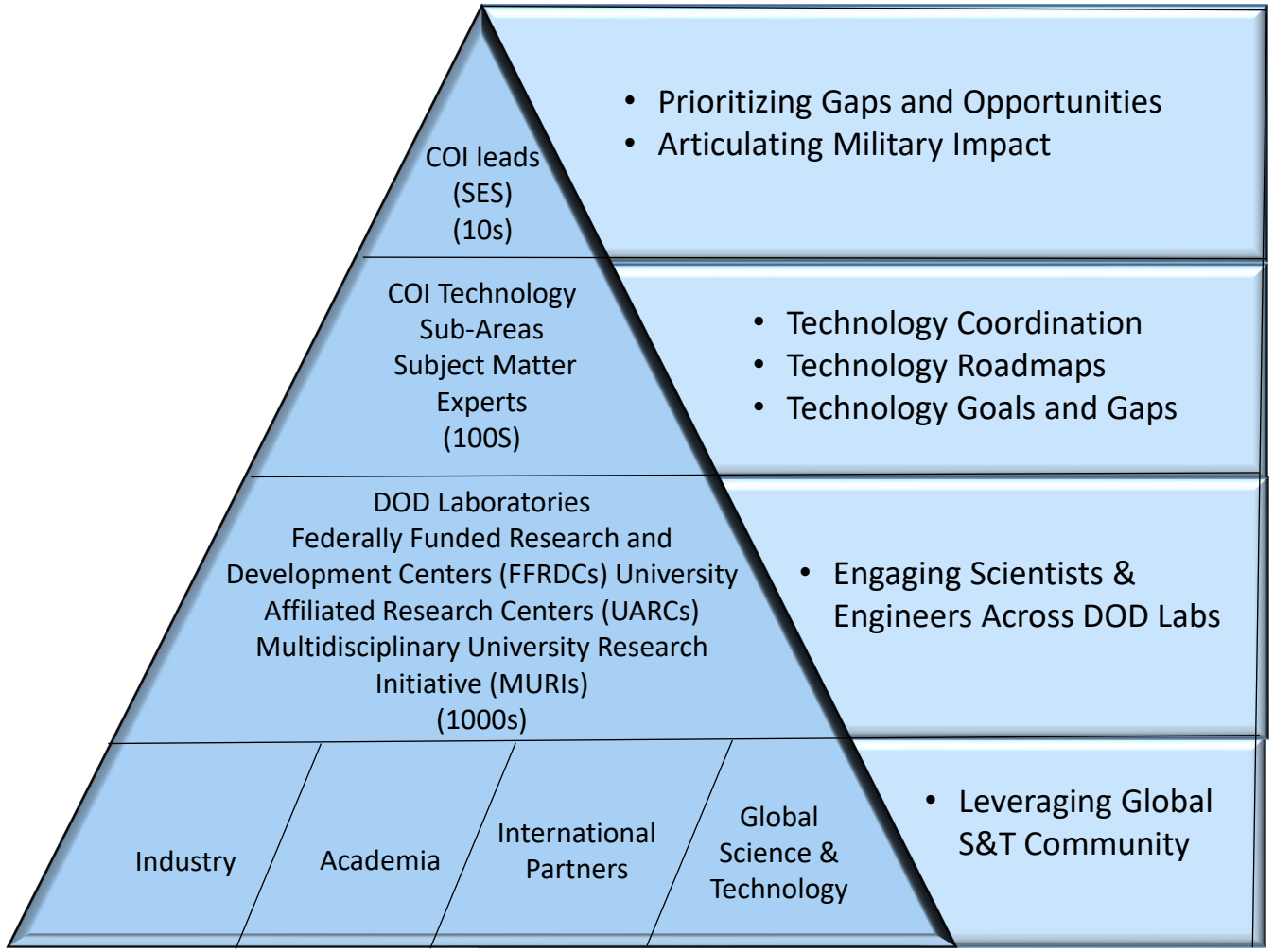
- Coordinate across S&T activities
- Align strategy goals with research threads



Preliminary COI Engagement

- Communities of Interest (COIs) were established as a mechanism to encourage multi-agency coordination and collaboration in cross-cutting technology focus areas with broad multiple Component investment.
- COIs provide a forum for coordinating S&T strategies across the Department, sharing new ideas, technical directions, and technology opportunities.
- Software cuts across many COIs.

Preliminary COI Engagement



Overview of Portfolio
Topic Breakdown, scope, Approximate Investment across sub-topic

Major Goals
What are the Technical Challenges, Opportunities and desired outcome?

How do these align worth operational capability needs?
What is the potential impact?

COI Portfolio Reviews

Investment Plans
Laydown of current and planned project
Transition Opportunities
Key performers. Critical capabilities and facilities

What are the Priority Gaps?

Portfolio Health Assessment
What are the concerns, risks and mitigation?

What are the highlights and strengths?

Addressing Software S&T Needs for DoD Systems

DoD must leverage commercial and academic research to keep pace with industry and adversaries.

DoD must also address its critical software needs with research for its unique system challenges.

DoD infrastructure challenges: secure, legacy, embedded, heterogeneous

NDAA 220 Section 255

20 SEC. 255. DEPARTMENT-WIDE SOFTWARE SCIENCE AND
21 TECHNOLOGY STRATEGY.
22 (a) DESIGNATION OF SENIOR OFFICIAL.—Not later
23 than 180 days after the date of the enactment of this Act,
24 the Secretary of Defense, acting through the Under Sec-
25 retary of Defense for Research and Engineering and in

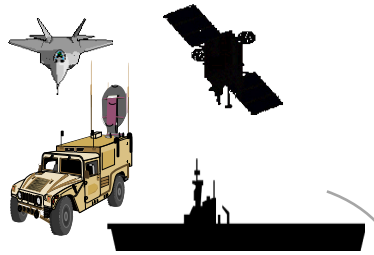
Software S&T Research

DoD Labs
FFRDCS/UARCS

Commercial Industry/Academia

- DevOps
- Artificial Intelligence
- Homogeneous Cloud
- Open Source

Secure
Legacy
Embedded
Heterogeneous



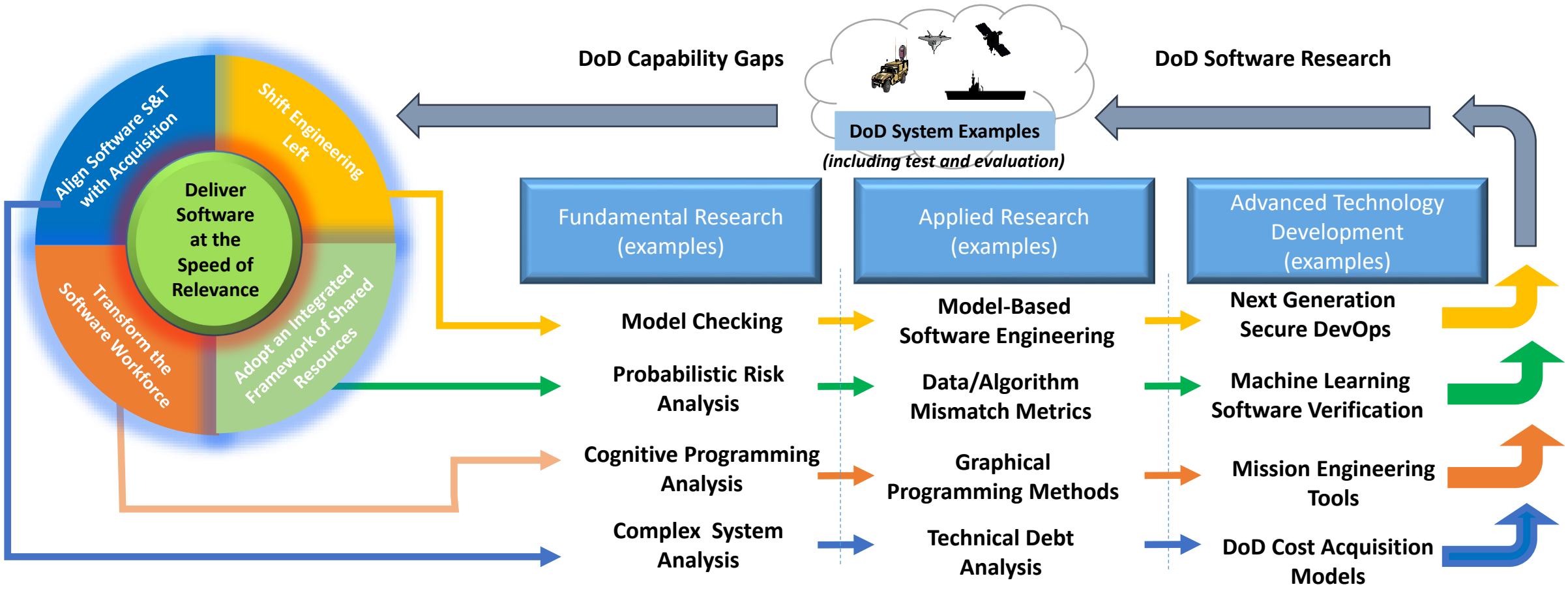
DoD System Examples

DoD Research Software Challenges (Examples)

- **Security:** DoD software systems have life-critical dependencies to mission operators and are subject to advanced threats from nation-state actors intended to impact weapons and strategic systems
- **Legacy:** The DoD has a very large and costly legacy software and hardware platform inventory to maintain and upgrade with substantial costs to changes in infrastructure across most DoD mission areas
- **Embedded:** Many DoD software platforms are legacy embedded weapons, air, space, ground, and sea infrastructure that need new approaches for adopting modern continuous integration practices and advanced methods of test and evaluation
- **Heterogeneous:** Unlike many homogeneous cloud software/hardware platforms, the DoD must integrate across highly heterogeneous systems, particularly in the context of command, control, and communications infrastructures

Research Strategy

Software S&T Strategy addresses technology needs for DoD systems by leveraging and incorporating commercial, academic, and DoD research in system development and test and evaluation



Research Strategy (Examples)

- Shift Engineering Left: Develop software and system models to plan for complex system integration issues
  - Fundamental Research: Develop methods to improve the accuracy and scale of model checking for software to model system security and performance
  - Applied Research: Develop advanced models of embedded, cloud, and information services to enable integration of large-scale defense software
  - Advanced Technology Development: Develop advanced tool frameworks to constitute missions on top of resilient and reusable information services

Research Strategy (Examples)

- Adopt a Common Automated Foundation: Automate the software lifecycle to reduce cost and complexity as well as manage automated methods for machine learning
  - Fundamental Research: Improve methods of probabilistic risk analysis to establish performance standards for matching data and machine learning algorithms
  - Applied Research: Characterize how mismatch occurs between data and algorithms in machine learning to enhance data and algorithm security
  - Advanced Technology Development: Enable a routine method of characterizing the performance and security of automated software, data, and machine learning software

Research Strategy (Examples)

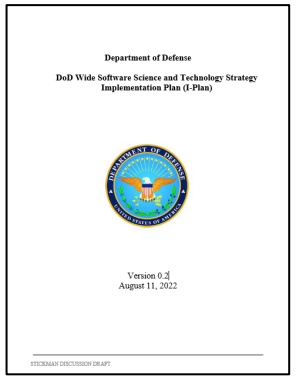
- Transform the Software Workforce: Develop tools to automate and simplify software integration and analysis for mission operators
  - Fundamental Research: Develop automated methods to analyze the cognitive performance of software and mission developers in system planning and use
  - Applied Research: Develop methods of graphical programming so software mission developers can quickly analyze and correct security flaws in software and infrastructure
  - Advanced Technology Development: Develop and train a workforce to leverage emerging mission engineering tools for cloud and information services

Research Strategy (Examples)

- Align Software S&T With Acquisition: Develop methods and tools to assess cost and complexity of large-scale DoD software integration with rigorous data analysis
  - Fundamental Research: Develop analytics to characterize key complex software system integration flaws from program and empirical system data
  - Applied Research: Develop methods to translate software system flaws into technical debt and cost metrics for system design trade-offs in the acquisition process
  - Advanced Technology Development: Develop acquisition models that can be used to characterize the procurement and sustainment cost of DoD software systems

Implementation

Implementation Plan


Department of Defense

DoD Wide Software Science and Technology Strategy Implementation Plan (I-Plan)

Version 0.2
August 11, 2022

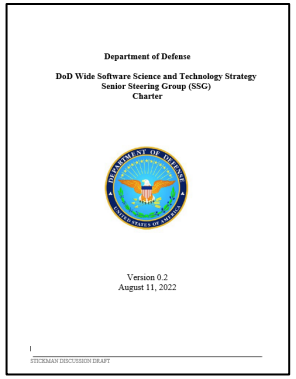
STICKMAN DISCUSSION DRAFT

- Initial activities
- Link to strategies

- ❑ Ensure SSG membership has correct representation
- ❑ Define action teams
- ❑ Define internal and external relationships

- ❑ SG 1: Shift Left
- ❑ SG 2: Integrated Framework of Shared Resources
- ❑ SG 3: Transform the S&T Workforce
- ❑ SG 4: Align Acquisition with SW S&T

SSG Charter


Department of Defense

DoD Wide Software Science and Technology Strategy Senior Steering Group (SSG) Charter

Version 0.2
August 11, 2022

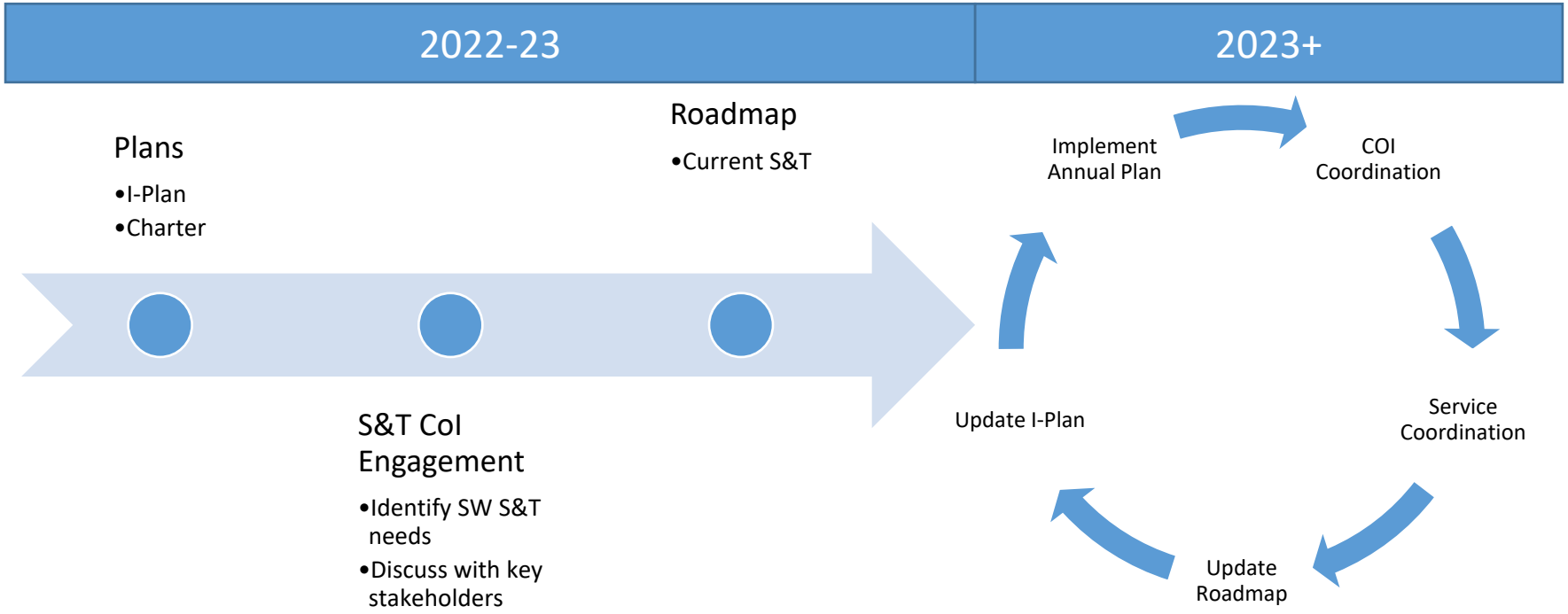
STICKMAN DISCUSSION DRAFT

- Alignment
- Scope

- ❑ Threads linking SW S&T Strategic Goals to SW Mod goals/objectives
- ❑ S&T Communities of Interest (CoI)

- ❑ Align 6.1-6.3 planning with SW Mod SSG
- ❑ Link between related working groups
- ❑ Functions and responsibilities
- ❑ Membership

Strategy Rollout Timeline



- Complete initiation of strategy planning/integration cycle
- Establish process relationships
- Enter annual execution cycle

Conclusion

- Questions and discussion

Contact

Office of the Under Secretary of Defense for Research and Engineering
osd.r-e.comm@mail.mil | Attn: SE&A SWE
https://www.cto.mil
https://ac.cto.mil/engineering