Modernizing DoD Software Production

Jeff Boleng, OUSD(A&S), Special Assistant for Software Acquisition

Guidance and Advice

HON Ellen Lord, USD(A&S)

“We have to get a lot better, faster, more agile”

“We want to develop contracts to support Agile DevOps software development. Our systems need to be hardware-enabled and software-defined. Software development processes are different than traditional production, development and sustainment processes for weapons systems. We need a software color of money.”

“Implementation of some of the study's recommendations, such as the creation of new acquisition pathways for software and a new mechanism for authorization to operate reciprocity, are already under way.”

“I am committed to creating a culture of creative compliance, scaling innovation from pockets of excellence, and mainstreaming authorities provided by Congress.”

“Security is a first order consideration. We need to create a secure environment that supports DevSecOps for big defense contractors and small innovative companies.”

“Software development requires different skill sets. We need to change how we train and maintain talent. We need to develop centers of excellence with broad reach across the acquisition and operational communities.”

“Defense technological advantage today is enabled by hardware, but its capability is defined by software. There is an undeniable urgency to develop and deploy software faster, faster than our adversaries, in order to maintain strategic and tactical advantage.”

Guidance and Advice

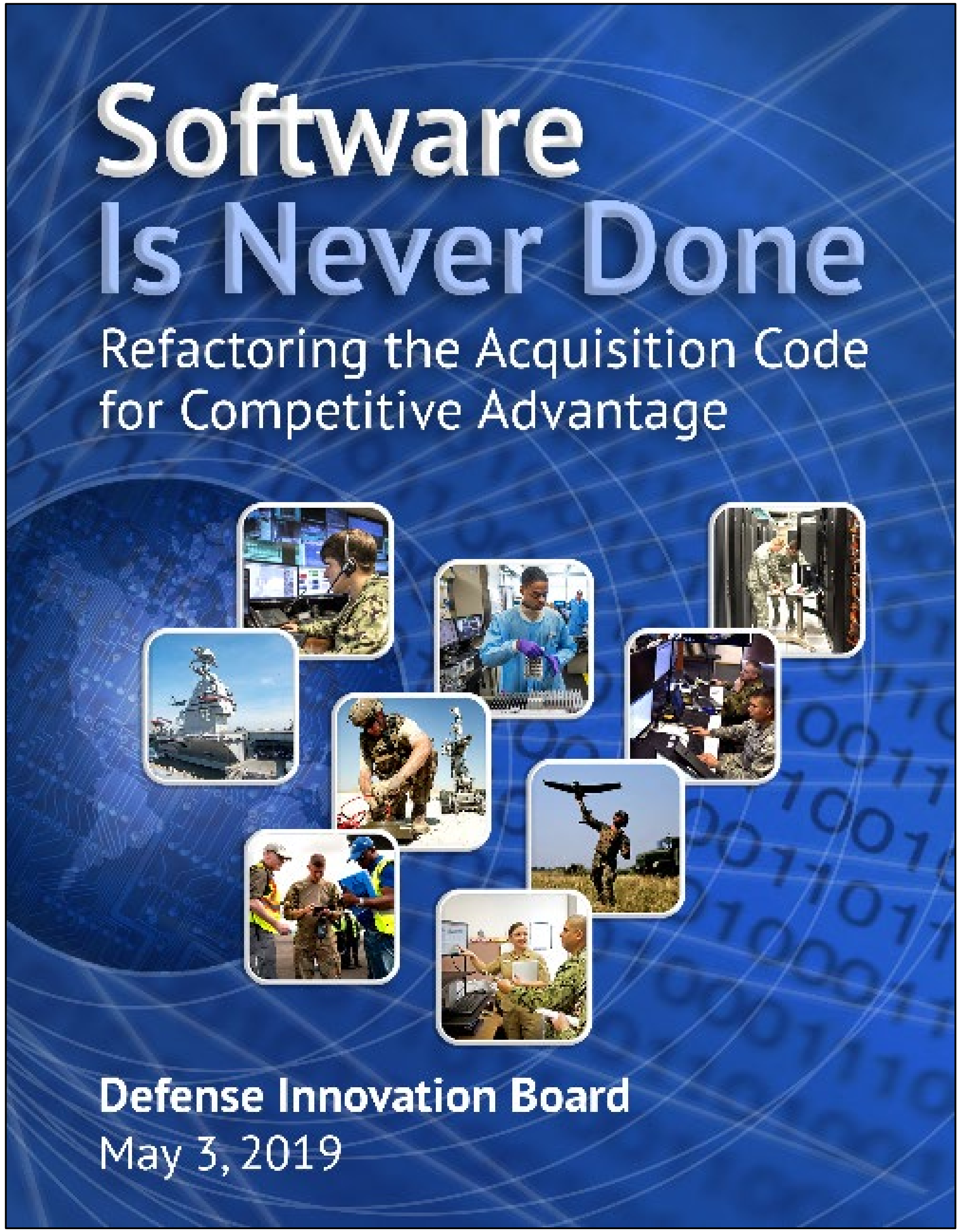
DEPARTMENT OF DEFENSE
DEFENSE SCIENCE BOARD

DESIGN AND ACQUISITION OF SOFTWARE FOR DEFENSE SYSTEMS

February 2018

CLEARED FOR OPEN PUBLICATION
February 14, 2018
DEPARTMENT OF DEFENSE
OFFICE OF PREPUBLICATION AND SECURITY REVIEW

OFFICE OF THE UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING
WASHINGTON, D.C. 20301-3140

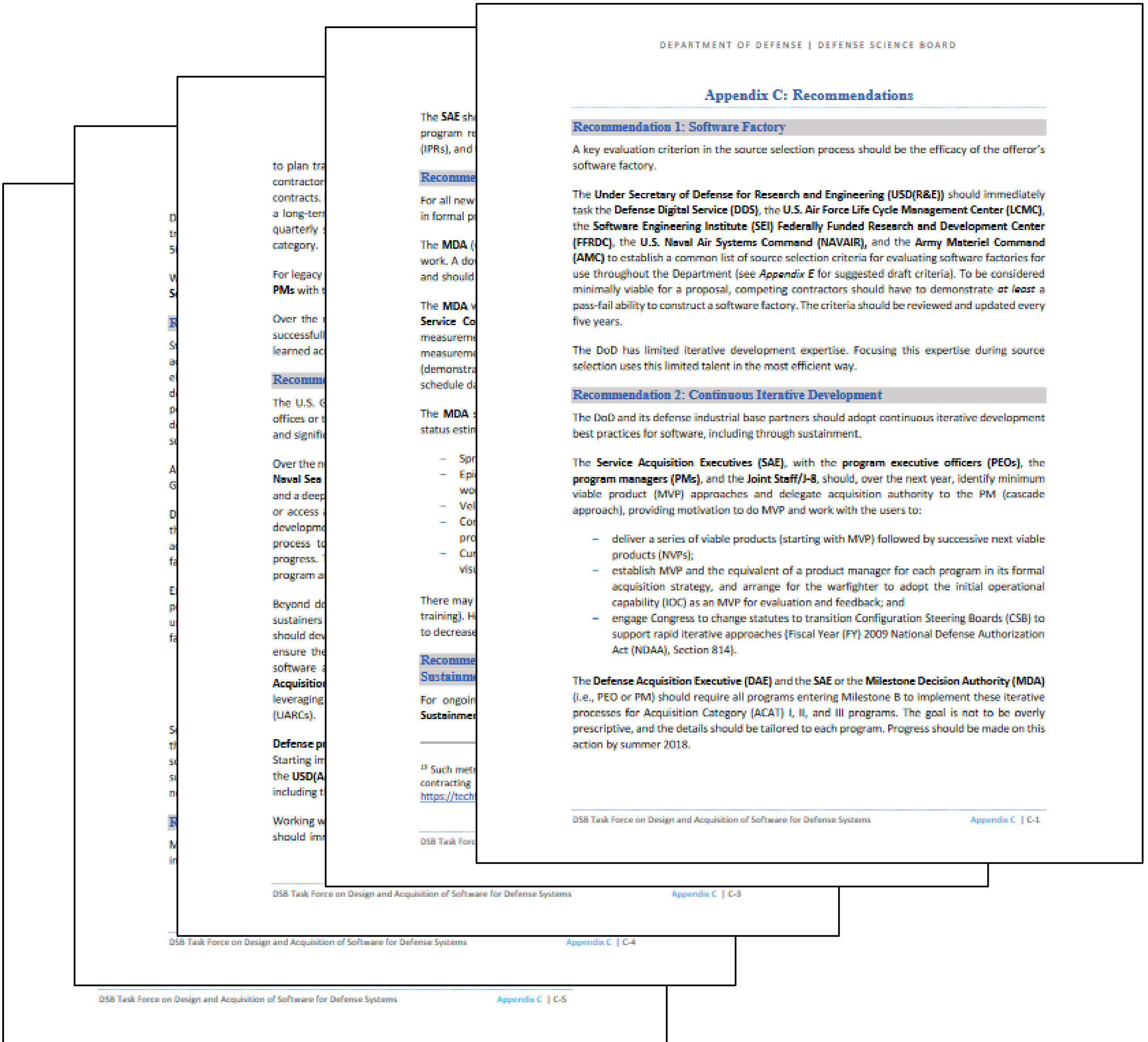


Software Is Never Done

Refactoring the Acquisition Code for Competitive Advantage

Defense Innovation Board
May 3, 2019

Advice and Guidance



DEPARTMENT OF DEFENSE | DEFENSE SCIENCE BOARD

Appendix C: Recommendations

Recommendation 1: Software Factory

A key evaluation criterion in the source selection process should be the efficacy of the offeror's software factory.

The **Under Secretary of Defense for Research and Engineering (USD(R&E))** should immediately task the **Defense Digital Service (DDS)**, the **U.S. Air Force Life Cycle Management Center (LCMC)**, the **Software Engineering Institute (SEI) Federally Funded Research and Development Center (FFRDC)**, the **U.S. Naval Air Systems Command (NAVAIR)**, and the **Army Materiel Command (AMC)** to establish a common list of source selection criteria for evaluating software factories for use throughout the Department (see *Appendix E* for suggested draft criteria). To be considered minimally viable for a proposal, competing contractors should have to demonstrate *at least* a pass-fail ability to construct a software factory. The criteria should be reviewed and updated every five years.

The DoD has limited iterative development expertise. Focusing this expertise during source selection uses this limited talent in the most efficient way.

Recommendation 2: Continuous Iterative Development

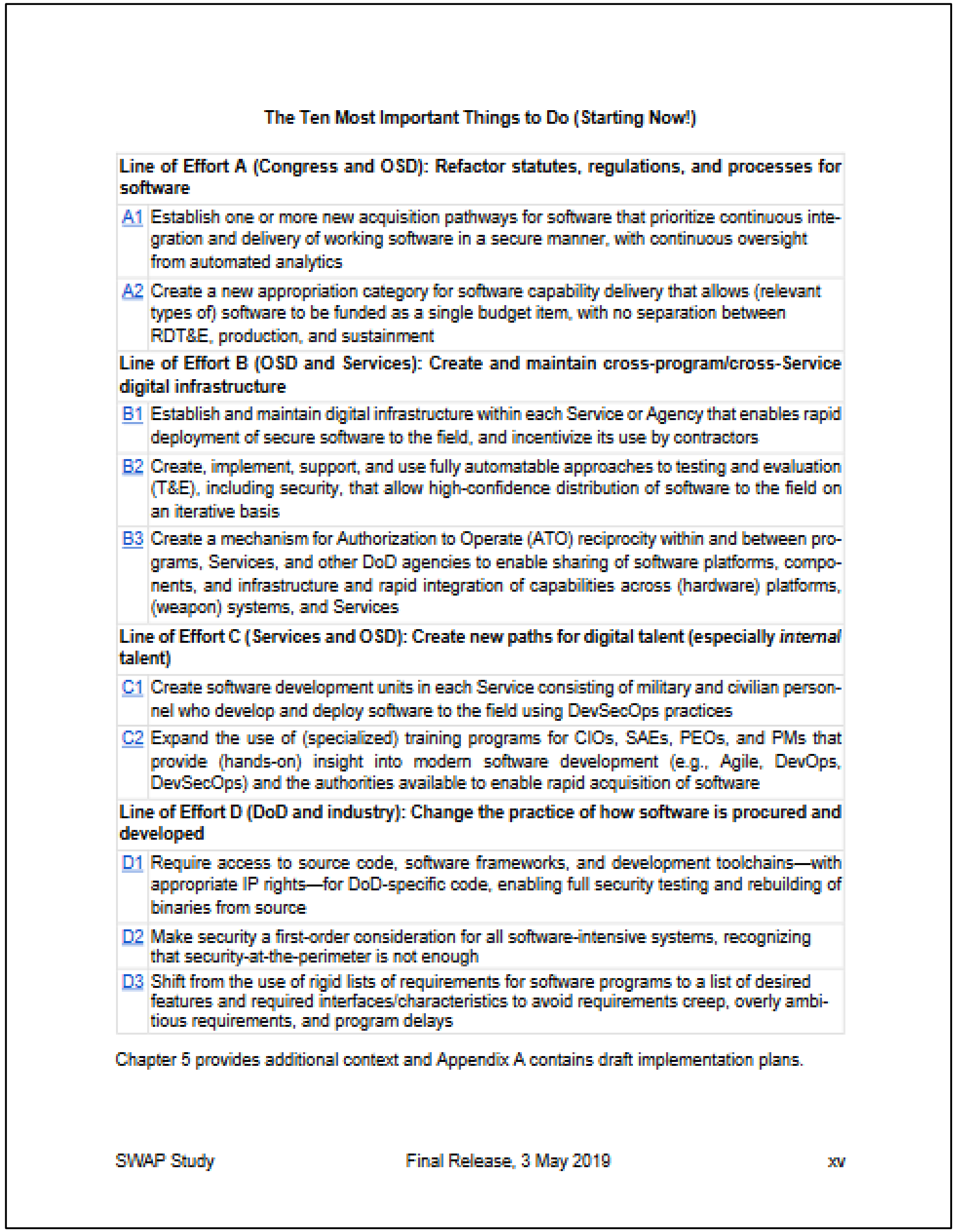
The DoD and its defense industrial base partners should adopt continuous iterative development best practices for software, including through sustainment.

The **Service Acquisition Executives (SAE)**, with the **program executive officers (PEOs)**, the **program managers (PMs)**, and the **Joint Staff/J-8**, should, over the next year, identify minimum viable product (MVP) approaches and delegate acquisition authority to the PM (cascade approach), providing motivation to do MVP and work with the users to:

- deliver a series of viable products (starting with MVP) followed by successive next viable products (NVPs);
- establish MVP and the equivalent of a product manager for each program in its formal acquisition strategy, and arrange for the warfighter to adopt the initial operational capability (IOC) as an MVP for evaluation and feedback; and
- engage Congress to change statutes to transition Configuration Steering Boards (CSB) to support rapid iterative approaches (Fiscal Year (FY) 2009 National Defense Authorization Act (NDAA), Section 814).

The **Defense Acquisition Executive (DAE)** and the **SAE** or the **Milestone Decision Authority (MDA)** (i.e., PEO or PM) should require all programs entering Milestone B to implement these iterative processes for Acquisition Category (ACAT) I, II, and III programs. The goal is not to be overly prescriptive, and the details should be tailored to each program. Progress should be made on this action by summer 2018.

DSB Task Force on Design and Acquisition of Software for Defense Systems Appendix C | C-1



The Ten Most Important Things to Do (Starting Now!)

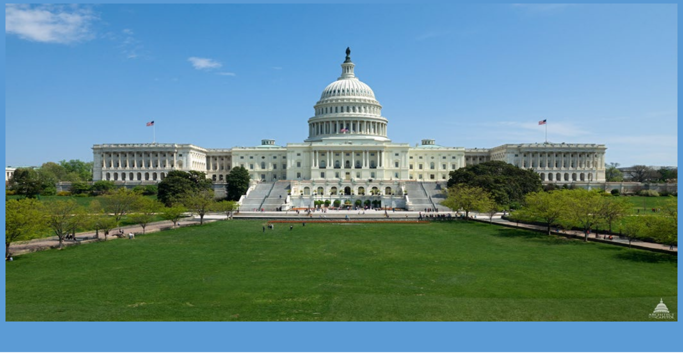
Line of Effort A (Congress and OSD): Refactor statutes, regulations, and processes for software	
A1	Establish one or more new acquisition pathways for software that prioritize continuous integration and delivery of working software in a secure manner, with continuous oversight from automated analytics
A2	Create a new appropriation category for software capability delivery that allows (relevant types of) software to be funded as a single budget item, with no separation between RDT&E, production, and sustainment
Line of Effort B (OSD and Services): Create and maintain cross-program/cross-Service digital infrastructure	
B1	Establish and maintain digital infrastructure within each Service or Agency that enables rapid deployment of secure software to the field, and incentivize its use by contractors
B2	Create, implement, support, and use fully automatable approaches to testing and evaluation (T&E), including security, that allow high-confidence distribution of software to the field on an iterative basis
B3	Create a mechanism for Authorization to Operate (ATO) reciprocity within and between programs, Services, and other DoD agencies to enable sharing of software platforms, components, and infrastructure and rapid integration of capabilities across (hardware) platforms, (weapon) systems, and Services
Line of Effort C (Services and OSD): Create new paths for digital talent (especially *internal* talent)	
C1	Create software development units in each Service consisting of military and civilian personnel who develop and deploy software to the field using DevSecOps practices
C2	Expand the use of (specialized) training programs for CIOs, SAEs, PEOs, and PMs that provide (hands-on) insight into modern software development (e.g., Agile, DevOps, DevSecOps) and the authorities available to enable rapid acquisition of software
Line of Effort D (DoD and industry): Change the practice of how software is procured and developed	
D1	Require access to source code, software frameworks, and development toolchains—with appropriate IP rights—for DoD-specific code, enabling full security testing and rebuilding of binaries from source
D2	Make security a first-order consideration for all software-intensive systems, recognizing that security-at-the-perimeter is not enough
D3	Shift from the use of rigid lists of requirements for software programs to a list of desired features and required interfaces/characteristics to avoid requirements creep, overly ambitious requirements, and program delays

Chapter 5 provides additional context and Appendix A contains draft implementation plans.

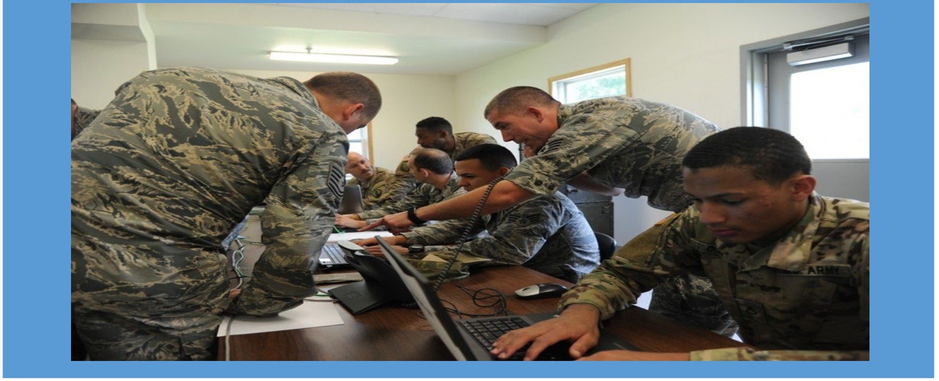
SWAP Study Final Release, 3 May 2019 xv

DIB SWAP FOUR LINES OF EFFORT

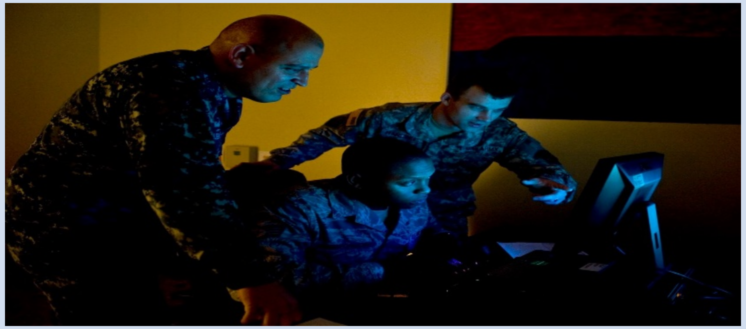
A. Refactor statutes, regulations, and processes for software



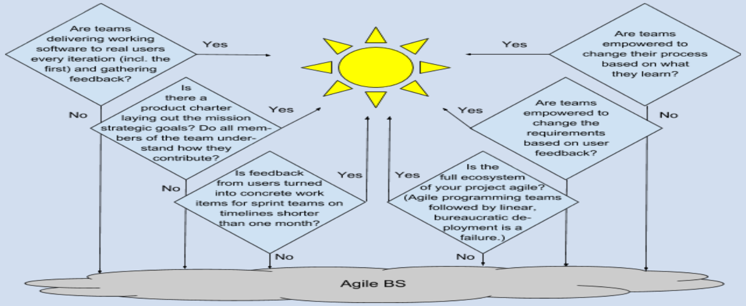
B. Create and maintain cross-program/ cross-service digital infrastructure



C. Create new paths for digital talent (especially internal talent)



D. Change the practice of how software is procured and developed



Are teams delivering working software to real users every iteration (incl. the first) and gathering feedback?

Is there a product charter laying out the mission strategic goals? Do all members of the team understand how they contribute?

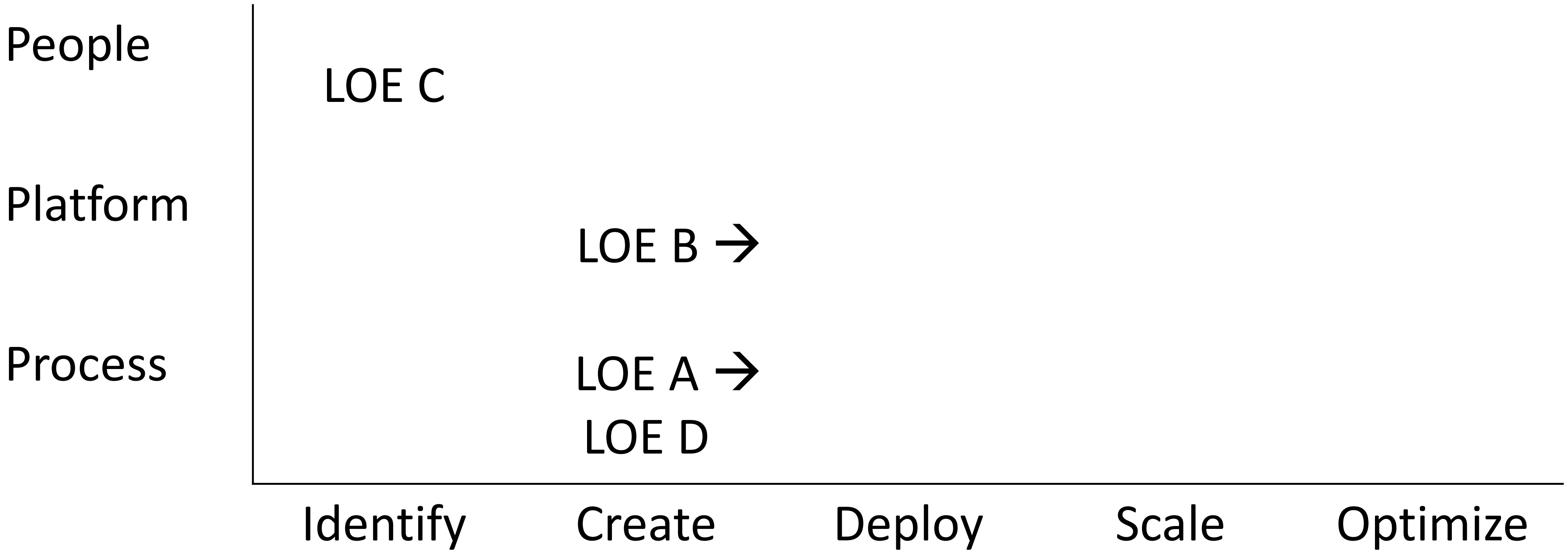
Is feedback from users turned into concrete work items for sprint teams on timelines shorter than one month?

Is the full ecosystem of your project agile? (Agile programming teams followed by linear, bureaucratic deployment is a failure.)

Are teams empowered to change the requirements based on user feedback?

Are teams empowered to change their process based on what they learn?

People, Platform, Process



People

LOE C

Platform

LOE B →

Process

LOE A →

LOE D

Identify Create Deploy Scale Optimize

LOE Executive Champions

People

JOSE M. GONZALEZ
Executive Director,
Human Capital Initiatives

Platform

Peter T. Ranks
Deputy Chief Information Officer for
Information Enterprise (DCIO(IE))

Process

Stacy Cummings
Principal Deputy Assistant Secretary of
Defense, Acquisition Enablers at United
States Department of Defense

People

LEVELUP CYBER WORKS

AIR FORCE BES

Kessel Run in Massachusetts
Space Camp in Colorado
BESPIN in Alabama
Rogue Blue in Nebraska
Kobyashi Maru and
Section 31 in California
LevelUP in Texas

DEVELOP
DEPLOY
TEST

F22 RAPTOR

- Identify high performing SW development activities across Services and 4th estate
- Create a forum for sharing of best practices
  - Contracting
  - Recruiting, hiring, retaining
  - Training and education
  - Estimating
  - Project management
- NDAA-18 873/874 Agile Pilots

JOINT IMPROVISED-THREAT DEFEAT ORGANIZATION

Railgun
Catapult

DEFENSE LOGISTICS AGENCY

AEGIS

NAVWAR

C2C24
A-RCI

Naval Information Warfare Center
PACIFIC

Naval Information Warfare Center
ATLANTIC

ICON Industry Connections

FENCES

DI2E
Defense Intelligence Information Enterprise

People

DAU

- Education and Training
  - Surveying available courses
  - Modernizing content
  - In search of vignettes, lessons learned and best practices

NPS

PRAESTANTIA PER SCIENTIAM

1909

icpc.foundation

advancing the art and sport
of competitive programming

NATIONAL DEFENSE UNIVERSITY

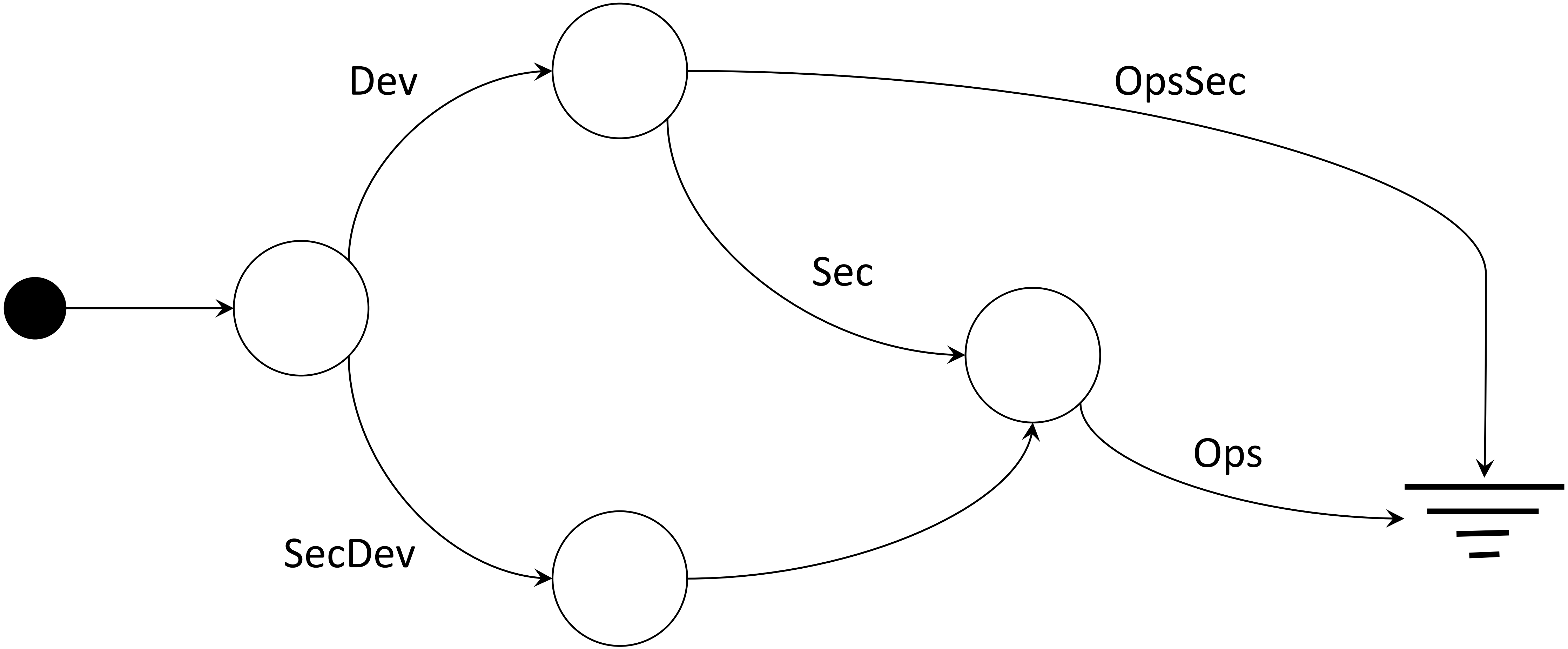
DoD Software Alliance
Total and Complete
Victory

AFIT

AIR FORCE INSTITUTE OF TECHNOLOGY

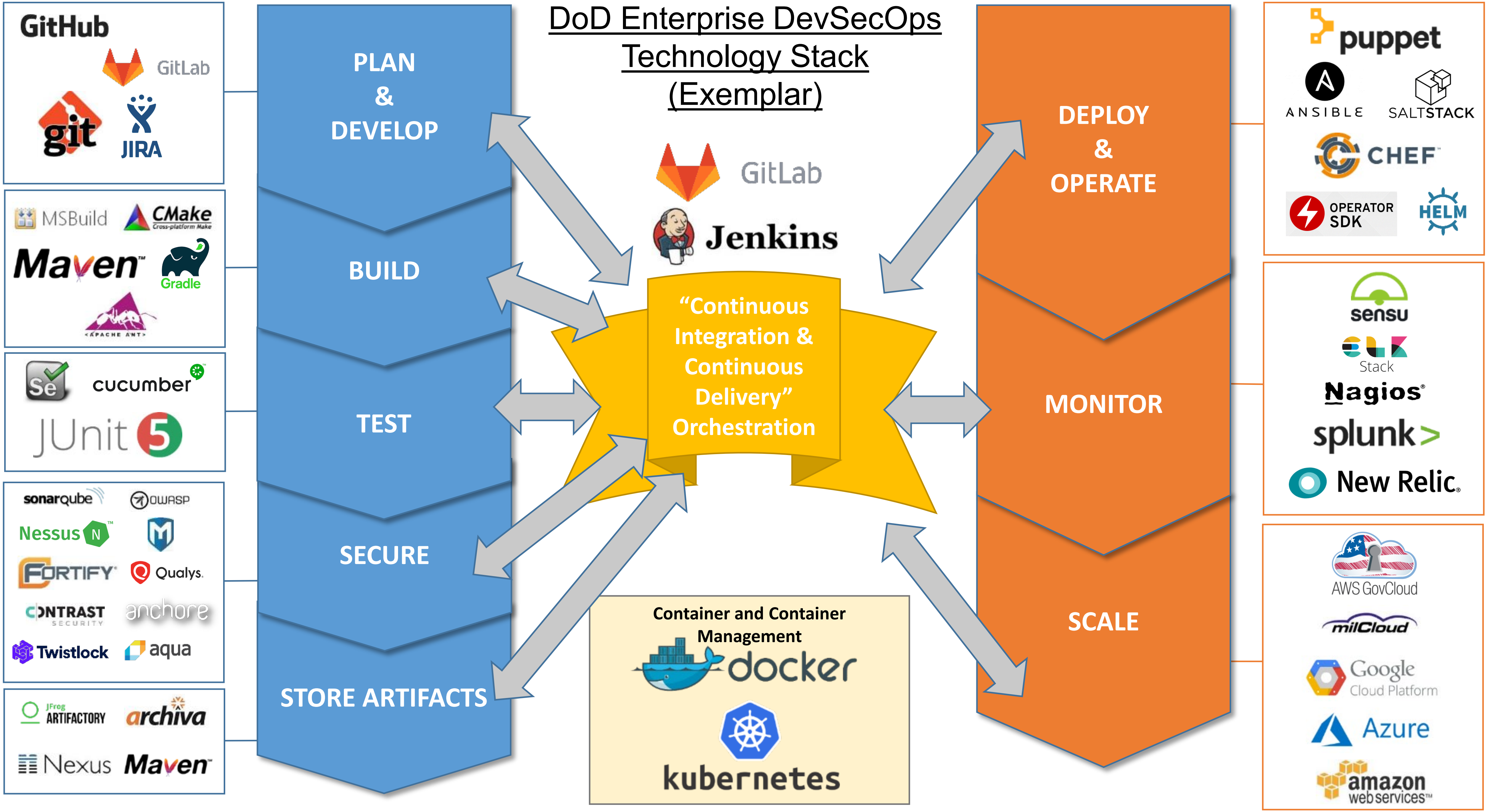
Platform

Enterprise DevSecOps



? [SecDevOps | DevSecOps | DevOpsSec] ?

DoD Enterprise DevSecOps Technology Stack (Exemplar)



PLAN & DEVELOP

BUILD

TEST

SECURE

STORE ARTIFACTS

"Continuous Integration & Continuous Delivery" Orchestration

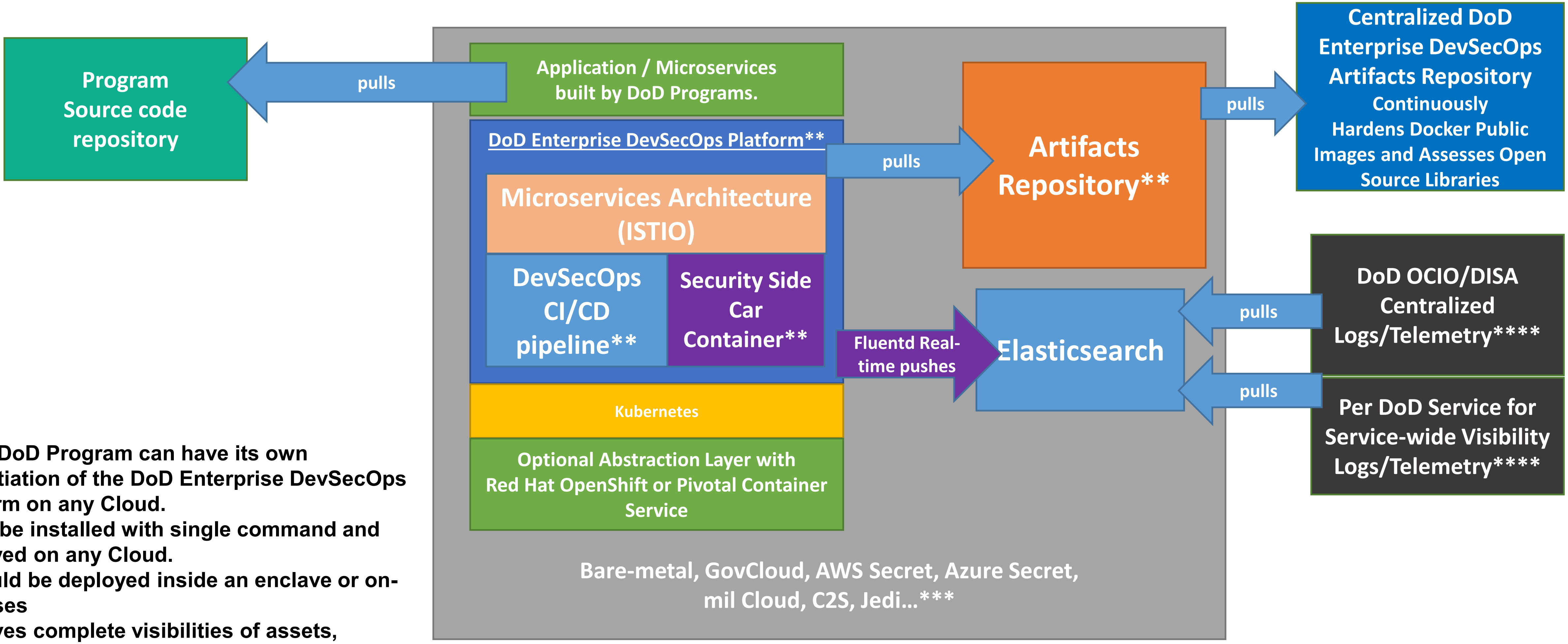
Container and Container Management

DEPLOY & OPERATE

MONITOR

SCALE

DoD Enterprise DevSecOps Architecture*



Program Source code repository

pulls

Application / Microservices built by DoD Programs.

DoD Enterprise DevSecOps Platform**

Microservices Architecture (ISTIO)

DevSecOps CI/CD pipeline**

Security Side Car Container**

Kubernetes

Optional Abstraction Layer with Red Hat OpenShift or Pivotal Container Service

Bare-metal, GovCloud, AWS Secret, Azure Secret, mil Cloud, C2S, Jedi…***

pulls

Artifacts Repository**

pulls

Centralized DoD Enterprise DevSecOps Artifacts Repository Continuously Hardens Docker Public Images and Assesses Open Source Libraries

Fluentd Real-time pushes

Elasticsearch

pulls

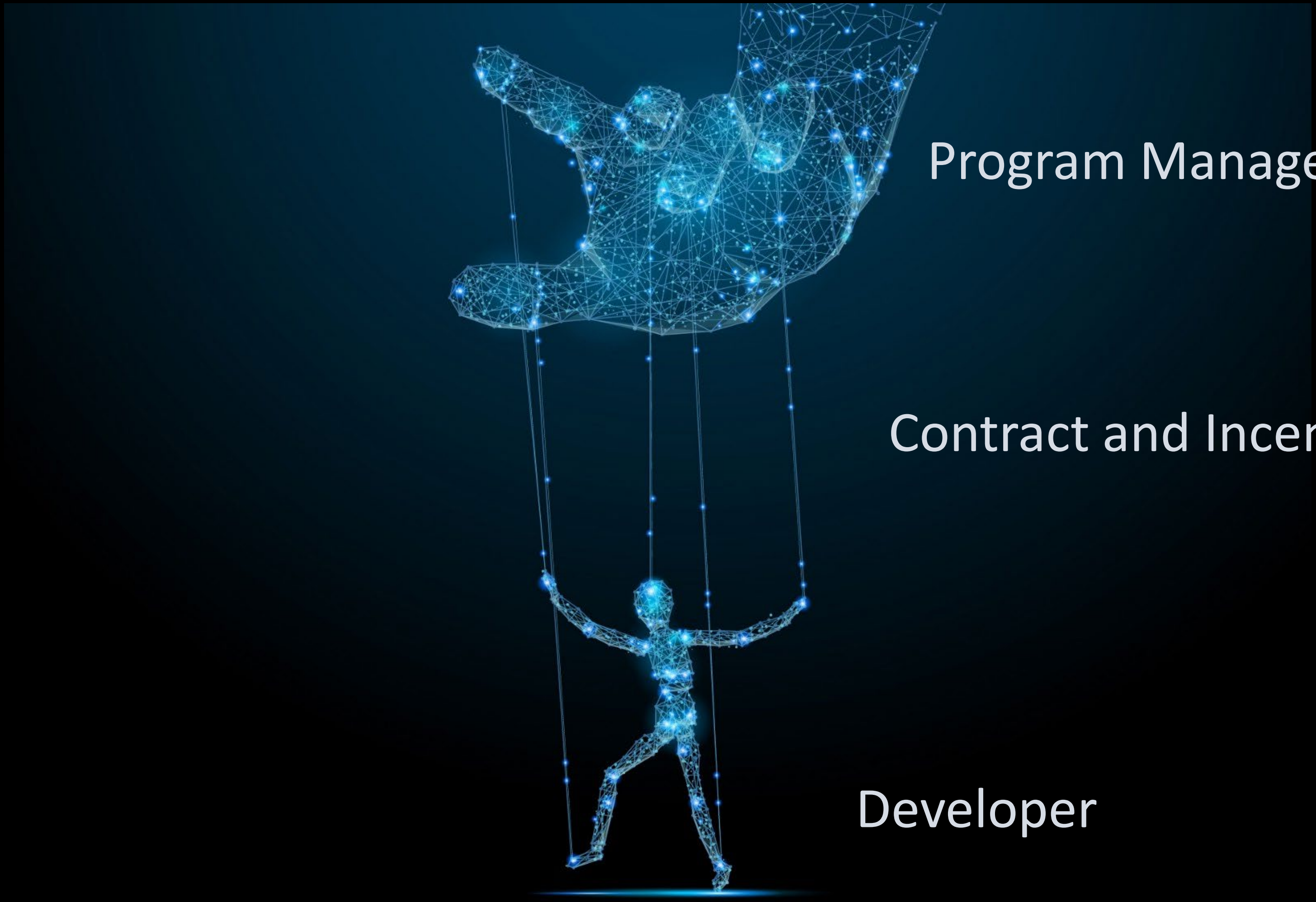
DoD OCIO/DISA Centralized Logs/Telemetry****

pulls

Per DoD Service for Service-wide Visibility Logs/Telemetry****

*each DoD Program can have its own instantiation of the DoD Enterprise DevSecOps Platform on any Cloud.
** can be installed with single command and deployed on any Cloud.
*** could be deployed inside an enclave or on-premises
**** gives complete visibilities of assets, security/vulnerability state etc. can be integrated to existing cybersecurity shared services.

Why is this so hard?



Program Manager

Contract and Incentives

Developer

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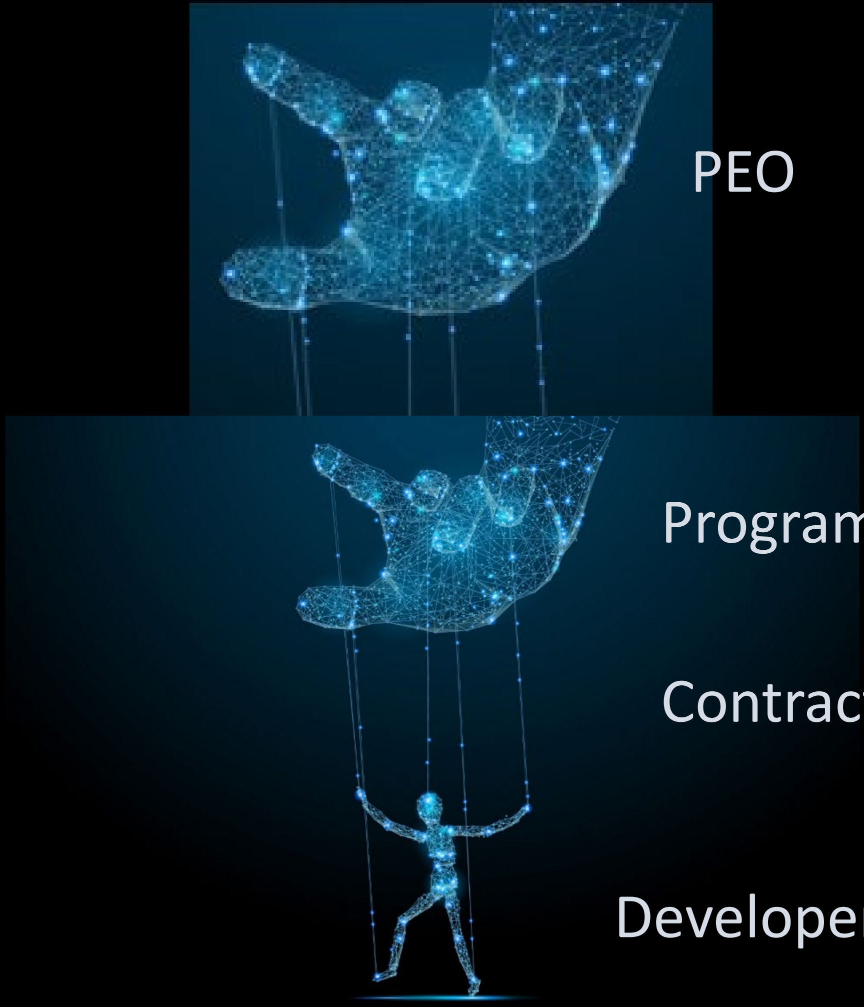

PEO

Program Manager

Contract and Incentives

Developer

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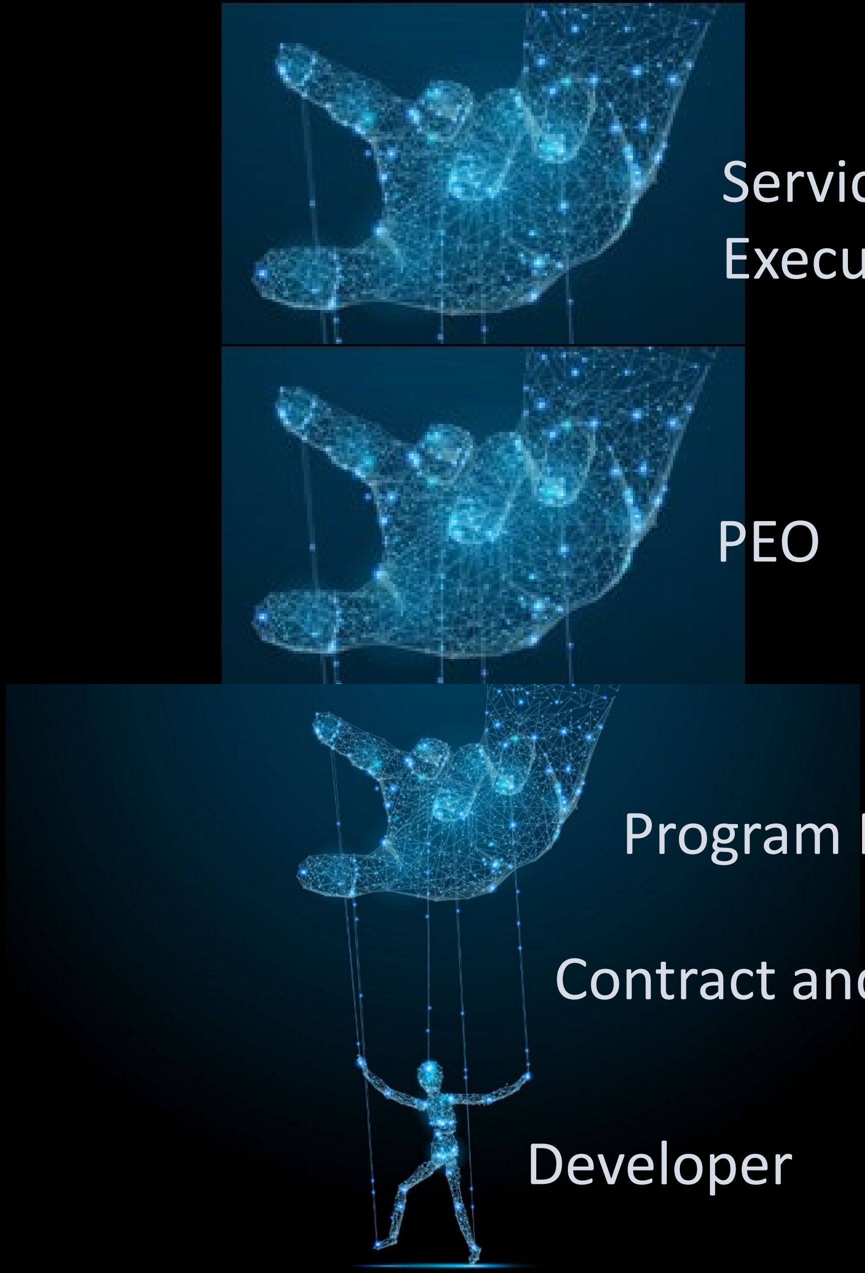

Service Acquisition Executive

PEO

Program Manager

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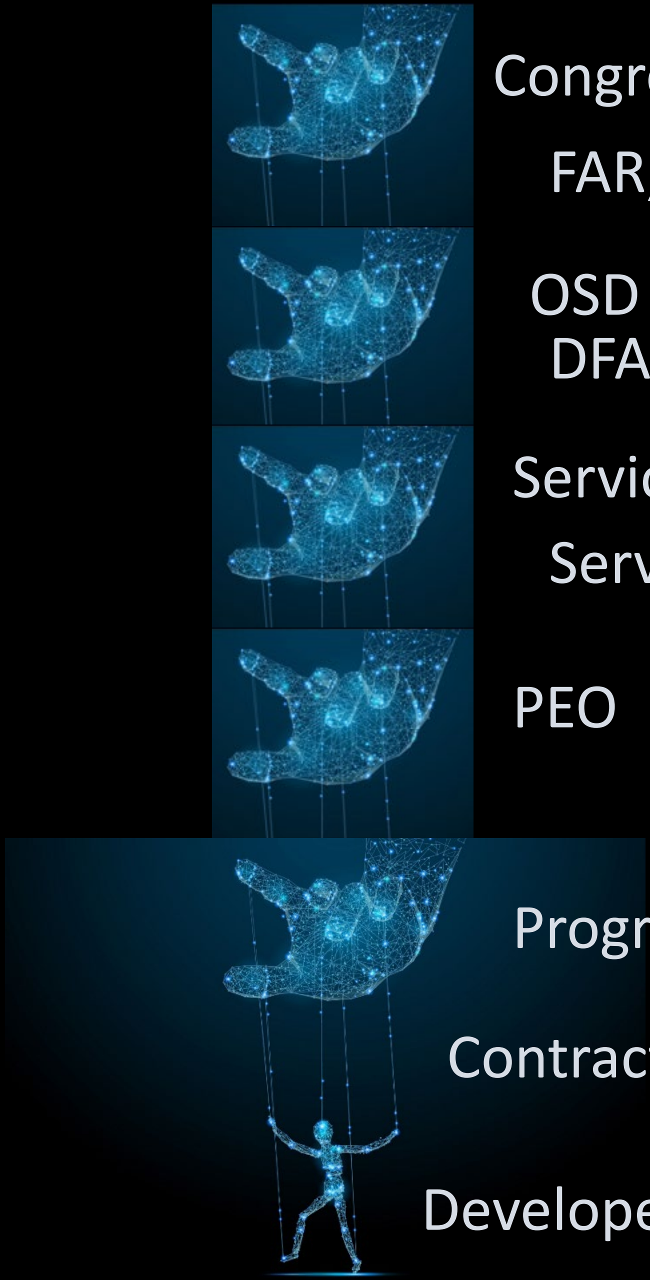

Congress

FAR, NDAA, Appropriations Bill, Statute

OSD

DFAR, 5000 series

Service Acquisition Executive

Service Acquisition Regulations

PEO

Program Manager

Contract and Incentives

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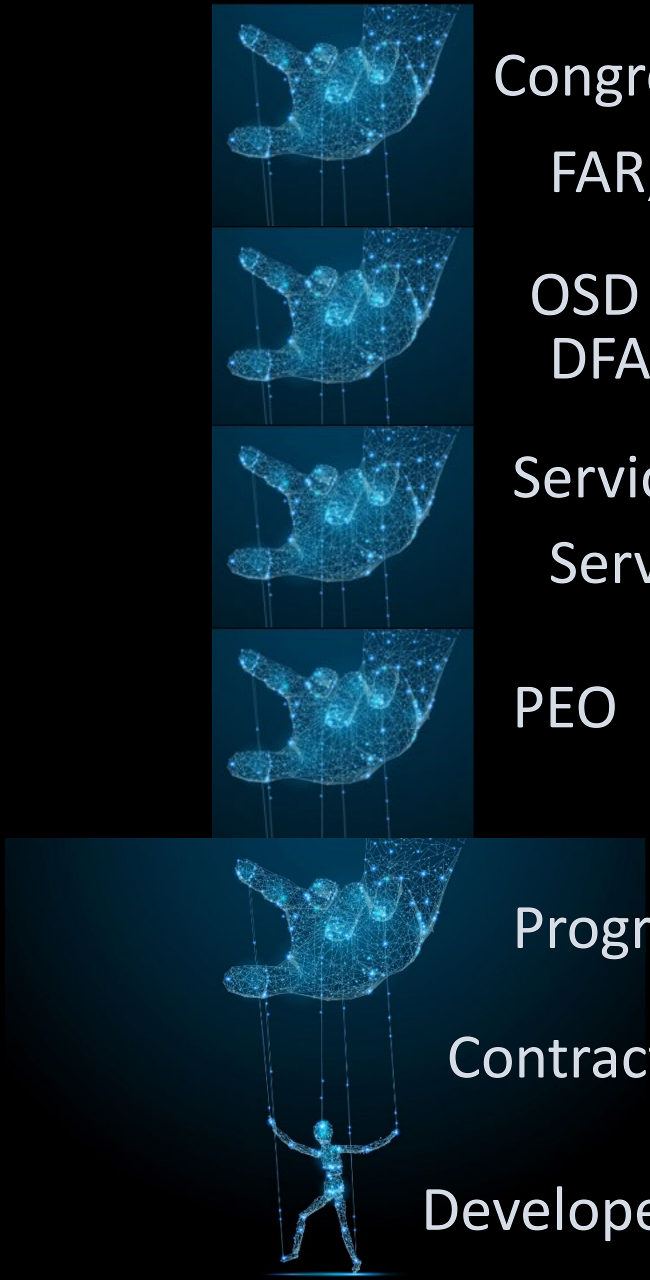
Where is the Operational User?



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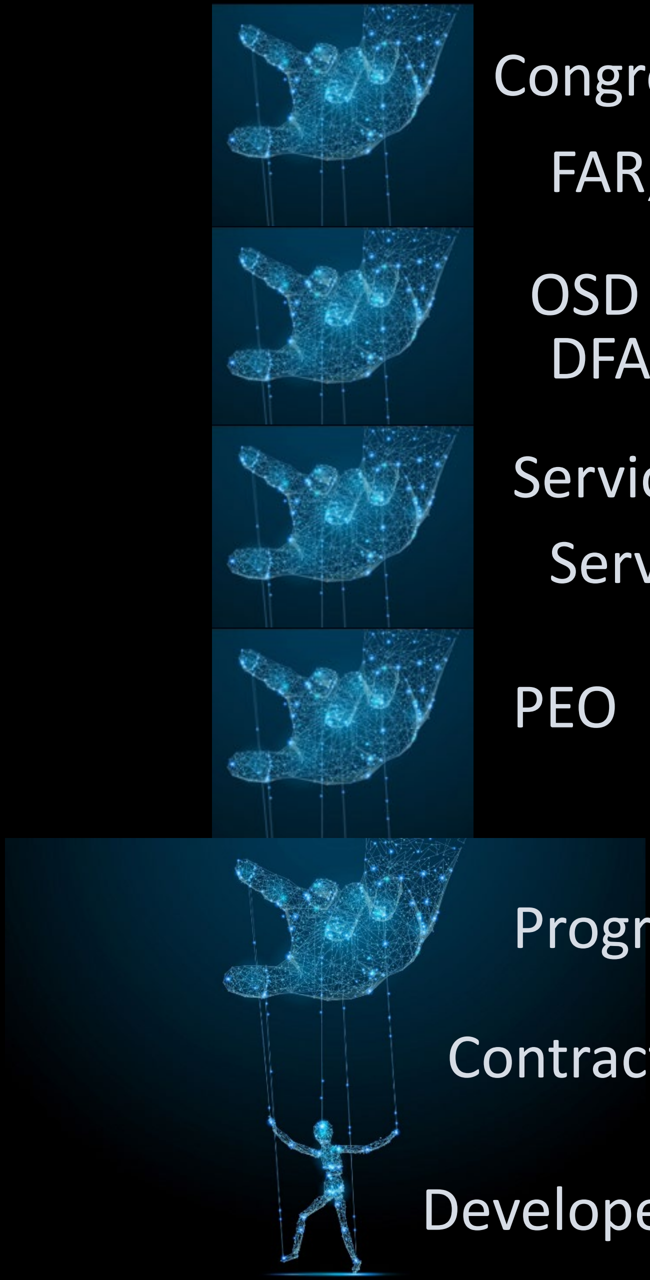
And the Feedback Loops?



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Process

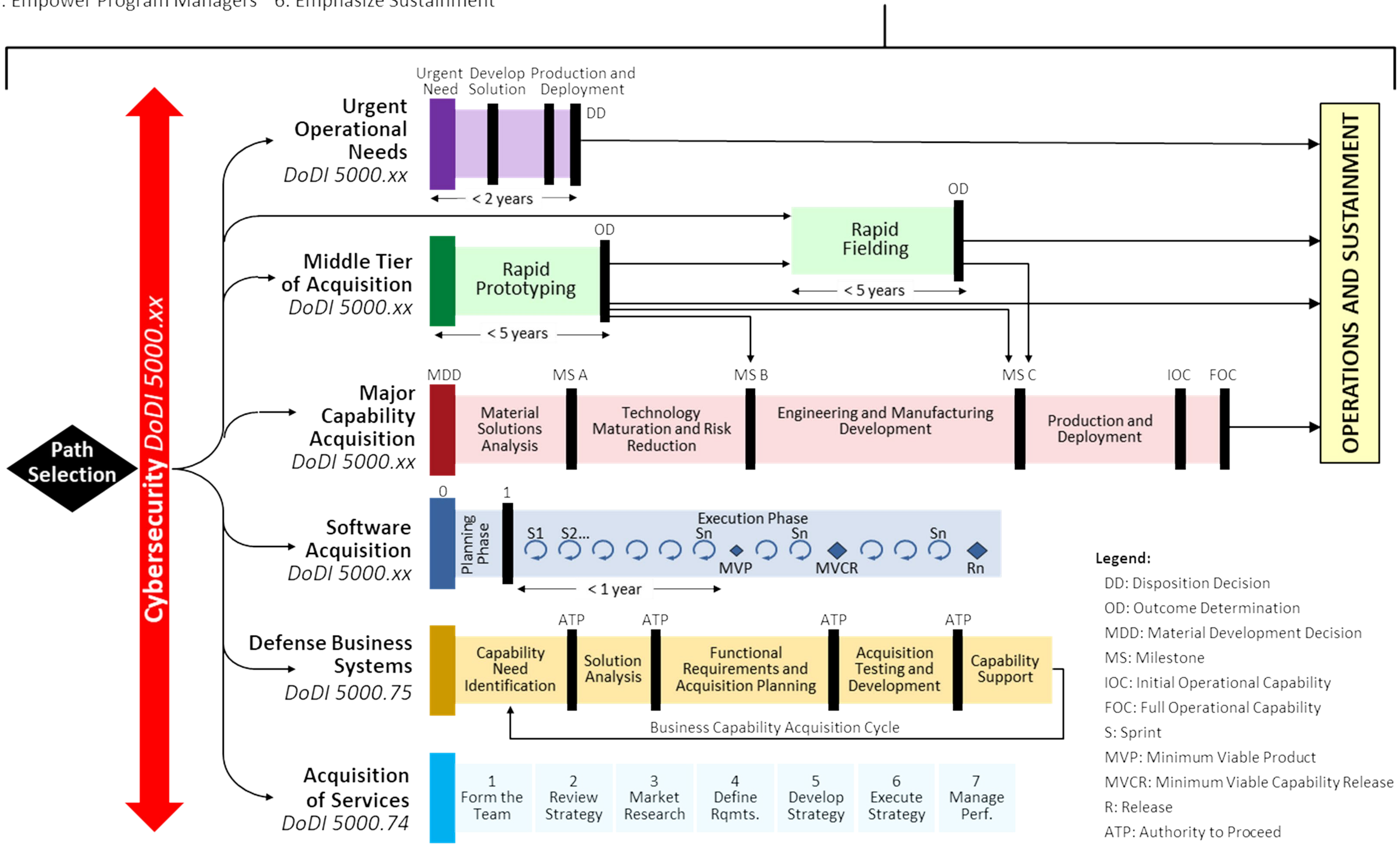
Adaptive Acquisition Framework

Tenets of the Defense Acquisition System

1. Simplify Acquisition Policy
2. Tailor Acquisition Approaches
3. Empower Program Managers
4. Data Driven Analysis
5. Active Risk Management
6. Emphasize Sustainment

DoDD 5000.01: *The Defense Acquisition System*

DoDI 5000.02: *Operation of the Adaptive Acquisition Framework*



Path Selection

Cybersecurity *DoDI 5000.xx*

Urgent Operational Needs *DoDI 5000.xx*

Urgent Need | Develop Solution | Production and Deployment | DD

< 2 years

Middle Tier of Acquisition *DoDI 5000.xx*

Rapid Prototyping | OD

< 5 years

Rapid Fielding | OD

< 5 years

Major Capability Acquisition *DoDI 5000.xx*

MDD | Material Solutions Analysis | MS A | Technology Maturation and Risk Reduction | MS B | Engineering and Manufacturing Development | MS C | Production and Deployment | IOC | FOC

Software Acquisition *DoDI 5000.xx*

0 | Planning Phase | 1 | Execution Phase

S1 S2... Sn MVP Sn MVCR Sn Rn

< 1 year

Defense Business Systems *DoDI 5000.75*

Capability Need Identification | ATP | Solution Analysis | ATP | Functional Requirements and Acquisition Planning | ATP | Acquisition Testing and Development | ATP | Capability Support

Business Capability Acquisition Cycle

Acquisition of Services *DoDI 5000.74*

1 Form the Team | 2 Review Strategy | 3 Market Research | 4 Define Rqmts. | 5 Develop Strategy | 6 Execute Strategy | 7 Manage Perf.

OPERATIONS AND SUSTAINMENT

Legend:

DD: Disposition Decision

OD: Outcome Determination

MDD: Material Development Decision

MS: Milestone

IOC: Initial Operational Capability

FOC: Full Operational Capability

S: Sprint

MVP: Minimum Viable Product

MVCR: Minimum Viable Capability Release

R: Release

ATP: Authority to Proceed

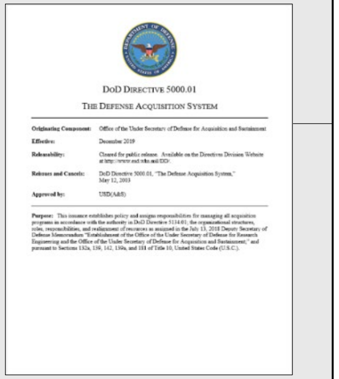
19/1540 Jul 19

DoD 5000 Series Policy Development Process

Current DoDI 5000.02

❖ **CORE A&S ACQUISITION POLICY**	**A&S**
- Policy	
- Responsibilities	
- Procedures	
- Decision Points and Phases	
❖ **FUNCTIONAL ENCLOSURES**	
Acquisition Categories and Compliance Requirements	A&S
Program Management	A&S
Systems Engineering	R&E
Developmental T&E	R&E
Operational & Live Fire T&E	DOT&E
Life-Cycle Sustainment	A&S
Human Systems Integration	P&R
Affordability Analysis and Investment Constraints	A&S
Analysis of Alternatives	CAPE
Cost Estimating and Reporting	CAPE
Information Technology	CIO
Urgent Capability Acquisition	JRAC
Cybersecurity	R&E

Revised DoD Directive 5000.01



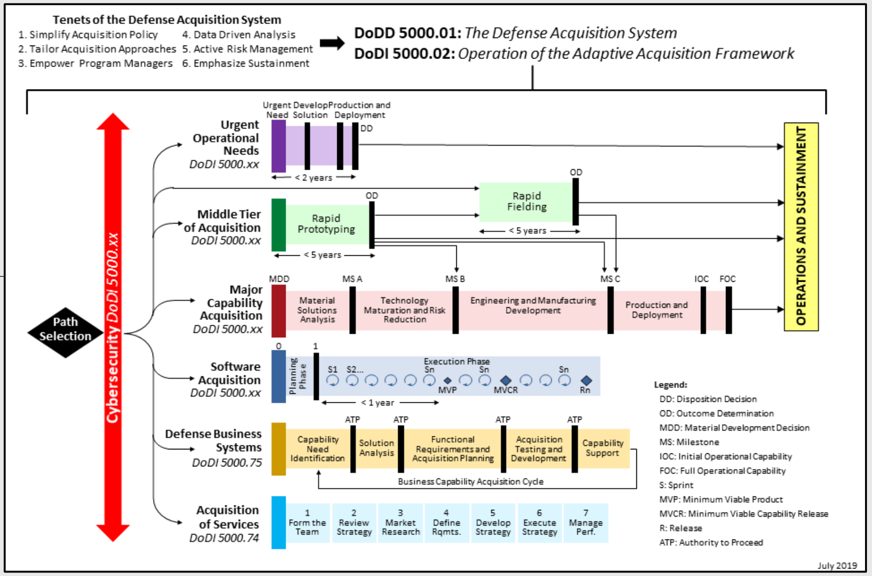
DoD Directive 5000.01

The Defense Acquisition System

Originating Component:	Office of the Under Secretary of Defense for Acquisition and Sustainment
Effective:	December 2019
Releasability:	Cleared for public release. Available on the Directives Division Website at http://www.esd.whs.mil/DD/.
Reissues and Cancels:	DoD Directive 5000.01, "The Defense Acquisition System," May 12, 2003
Approved by:	USD(A&S)

Purpose: This issuance establishes policy and assigns responsibilities for managing all acquisition programs in accordance with the authority in DoD Directive 5134.01; the organizational structures, roles, responsibilities, and realignment of resources as assigned in the July 13, 2018 Deputy Secretary of Defense Memorandum "Establishment of the Office of the Under Secretary of Defense for Research Engineering and the Office of the Under Secretary of Defense for Acquisition and Sustainment;" and pursuant to Sections 132a, 139, 142, 139a, and 181 of Title 10, United States Code (U.S.C.).

Revised DoD Instruction 5000.02, Operation of the Adaptive Acquisition Framework



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DoDI 5000.02: *Operation of the Adaptive Acquisition Framework*

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MDD
MS A
MS B
MS C
IOC
FOC
Material Solutions Analysis
Technology Maturation and Risk Reduction
Engineering and Manufacturing Development
Production and Deployment
Software Acquisition DoDI 5000.xx
0
1
Planning Phase
Execution Phase
S1
S2...
Sn
MVP
Sn
MVCR
Sn
Rn
< 1 year
Defense Business Systems DoDI 5000.75
ATP
Capability Need Identification
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Acquisition Testing and Development
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- R: Release
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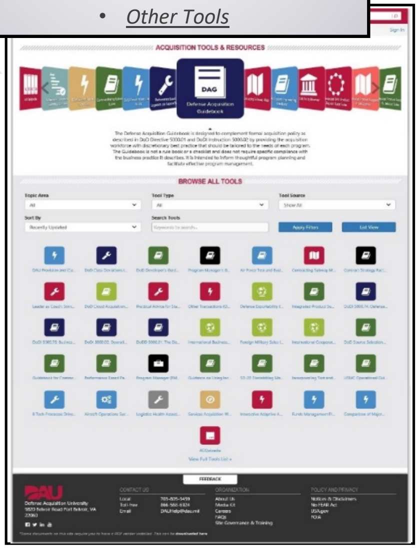
July 2019

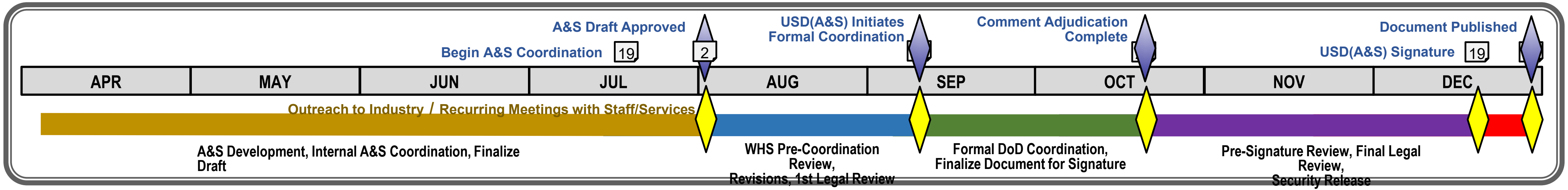
DAU Website

- DoD Directive 5000.01
- DoD Instruction 5000.02
- DoD Instructions 5000.xx, (ea. Pathway)
- Functional Policy Documents
- Tables (Milestone Documentation Identification Tool)
- Defense Acquisition Guidebook
- Other Tools



Separately Published Functional Policies

Policy	Office
OT&E	DOT&E
DT&E	USD(R&E)
Systems Engineering	USD(R&E)
Human Systems Integration	USD(P&R)
AoAs	DCAPE
Cost Estimating	DCAPE
Information Technology	DoD CIO
Intelligence	USD(A&S)
Intellectual Property	USD(A&S)
Cybersecurity	USD(A&S) et.al.
Urgent	USD(A&S)



A&S Draft Approved

Begin A&S Coordination 19

2

USD(A&S) Initiates Formal Coordination

Comment Adjudication Complete

Document Published

USD(A&S) Signature 19

APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

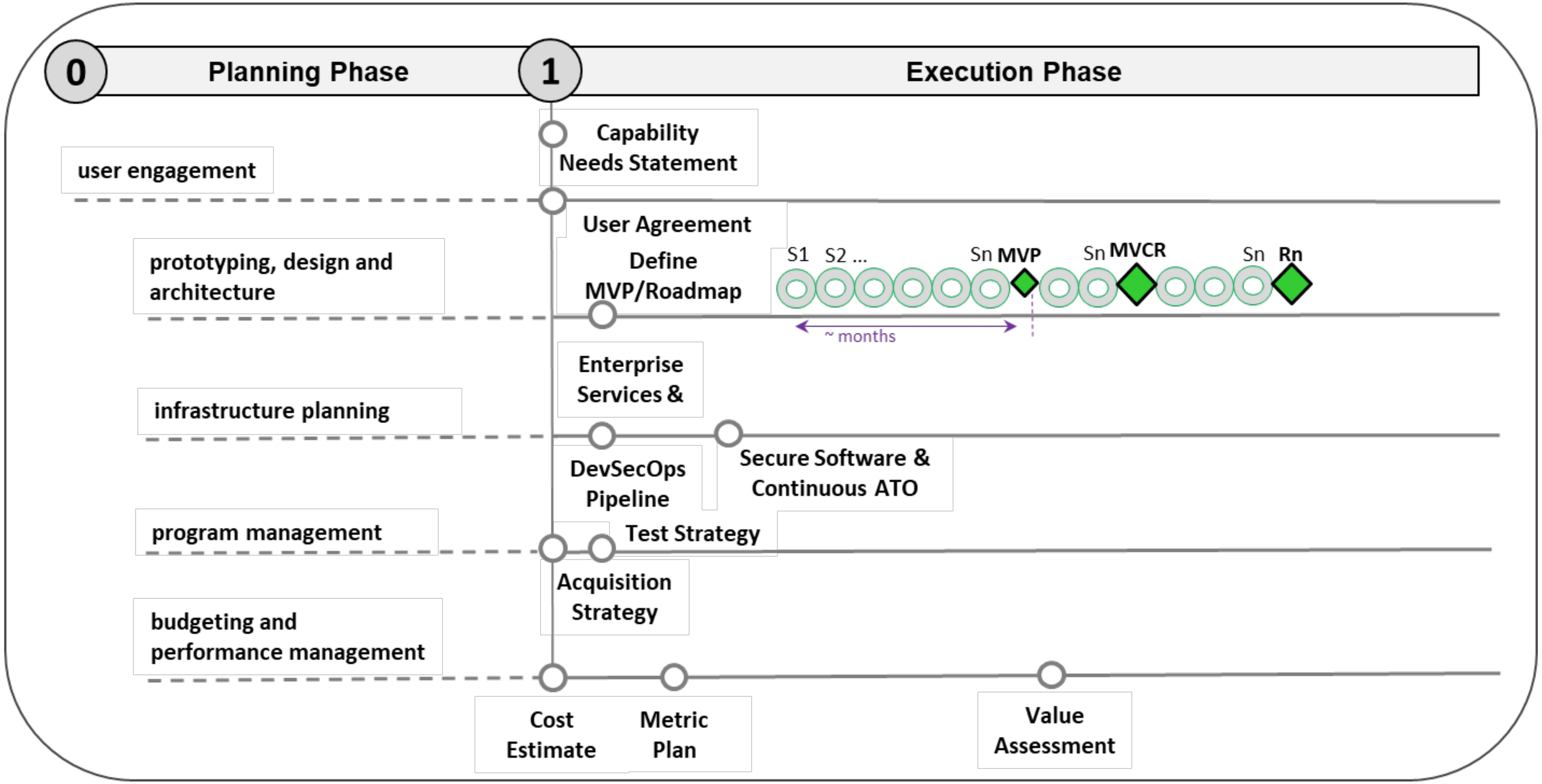
Outreach to Industry / Recurring Meetings with Staff/Services

A&S Development, Internal A&S Coordination, Finalize Draft

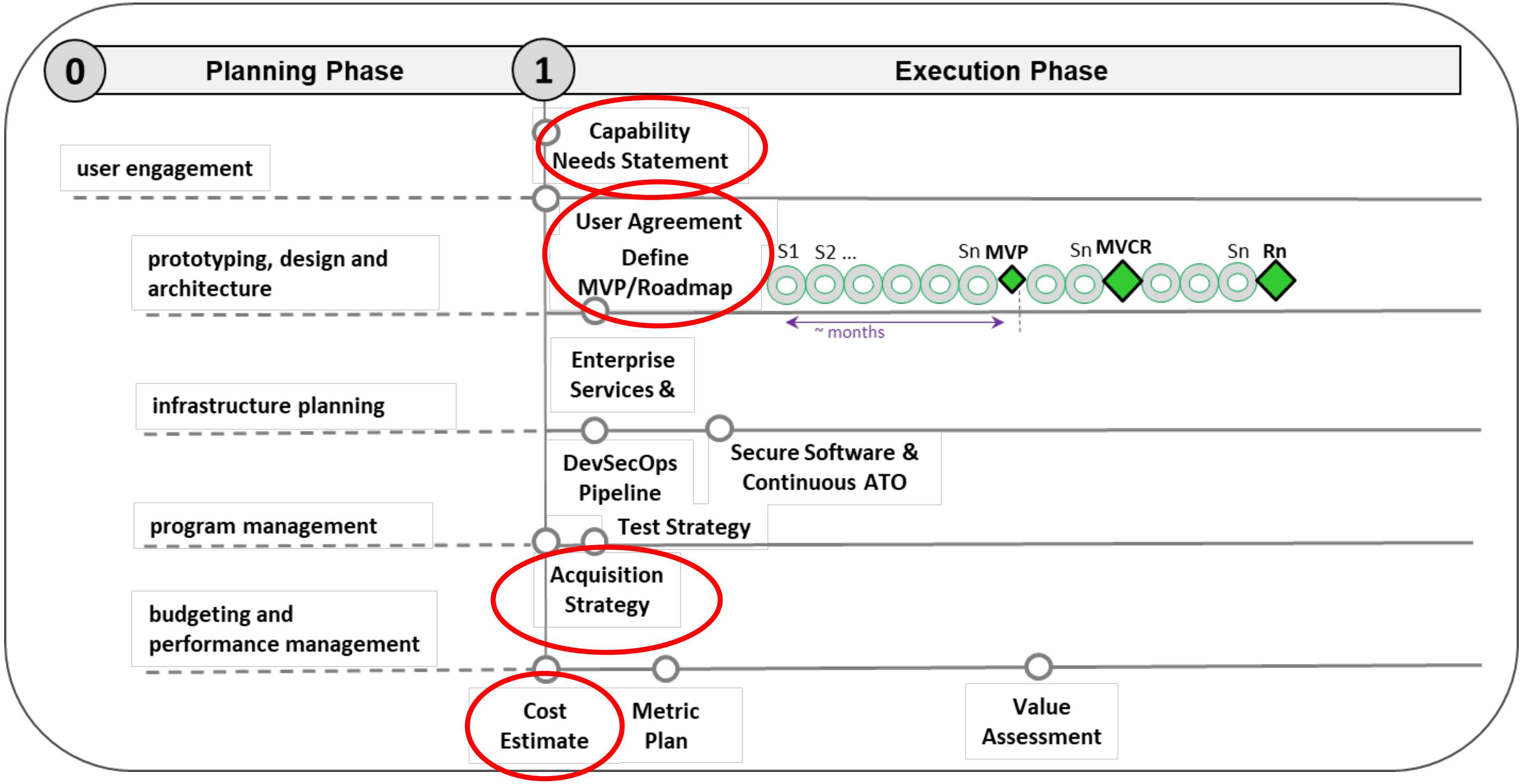
WHS Pre-Coordination Review, Revisions, 1st Legal Review

Formal DoD Coordination, Finalize Document for Signature

Pre-Signature Review, Final Legal Review, Security Release



Software Acquisition Pathway – draft/pre-decisional



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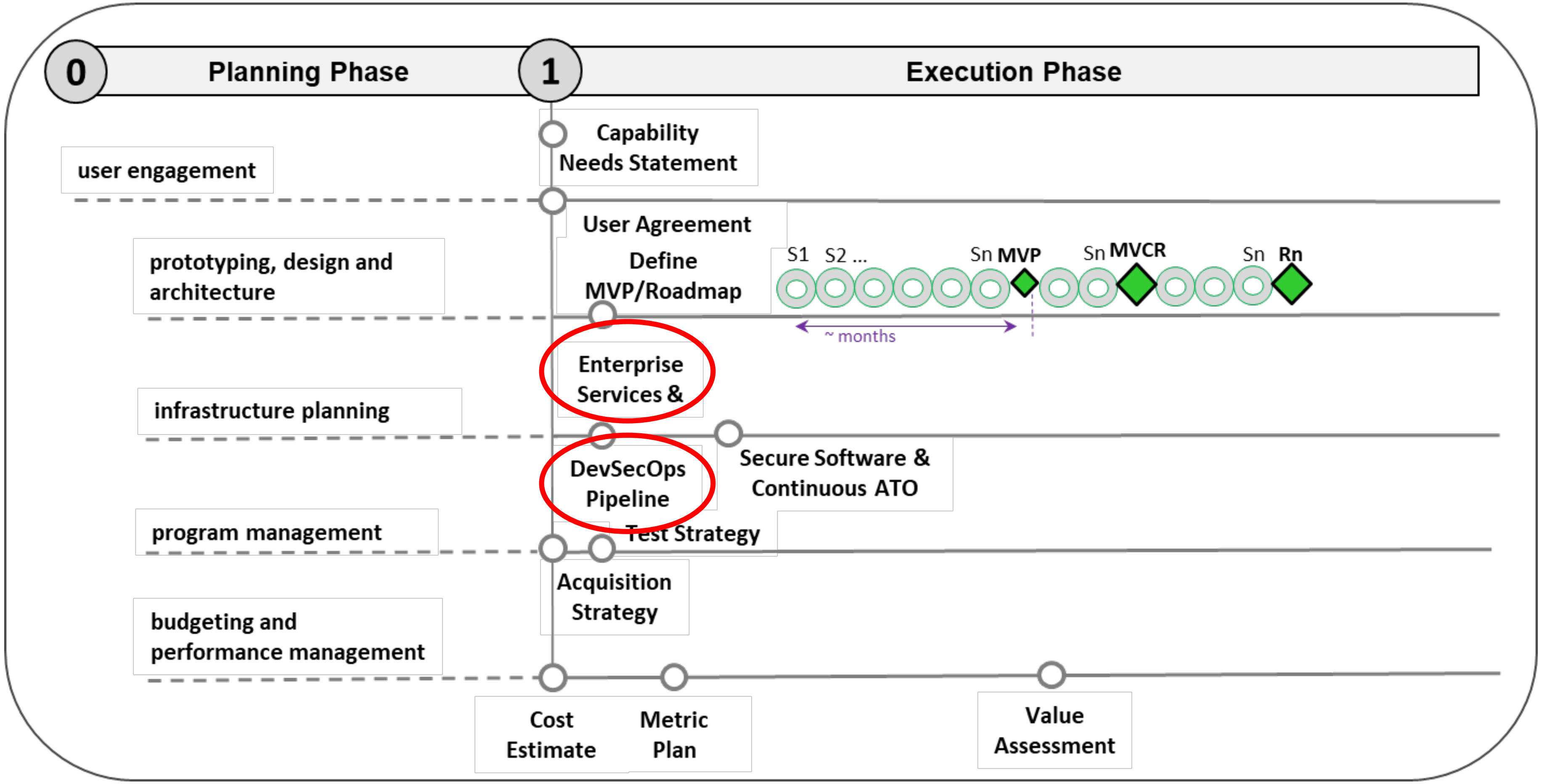
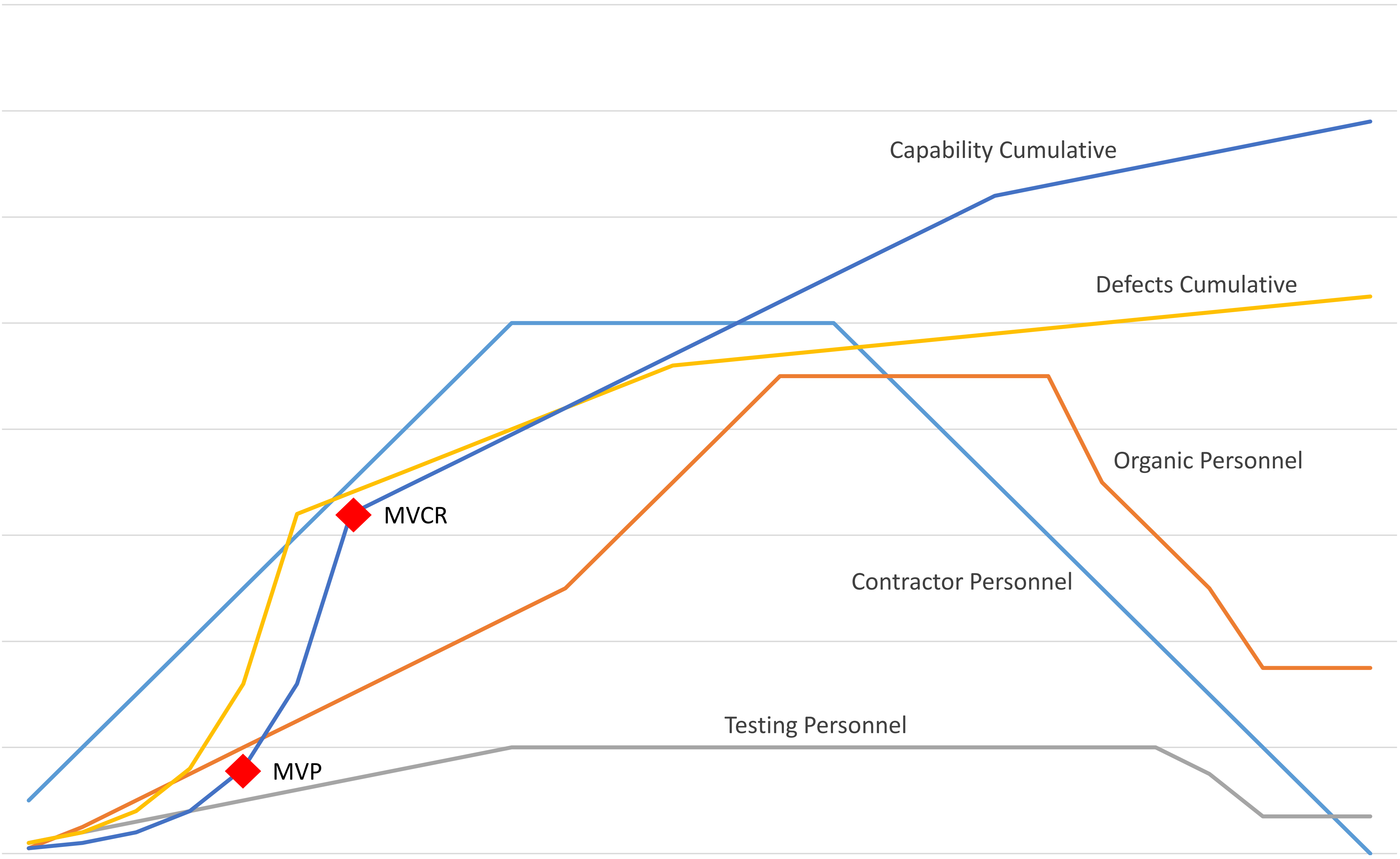


Software Acquisition Pathway – draft/pre-decisional

Notional Software Development Effort (contractor and organic), Defects, and Capabilities



Engagement and feedback

- Engagement
  - May – US Chamber of Commerce
  - May - 16th Annual Acquisition Research Symposium
  - July - feedback session hosted by NDIA, AIA event, quarterly industry association round table
  - August – PEO forum, SW Acq Pathway wargame
- Feedback
  - Need to better describe linkage to system's engineering process
  - How does this map to embedded software?
  - Where does developmental and operational testing fit in?
  - This will be hard to estimate cost

Software Appropriation

- Comptroller and A&S legislative proposal
- New Budget Activity (BA 8) Software & Digital Technology Pilot Programs
    - Within existing RDT&E appropriation
    - Established for each service and defense wide
    - 2 year funding
    - Available for select pilot programs in FY-21 if approved
- Pilot programs will use BA 8 as one source of funding for full lifecycle
    - Development,
    - Procurement,
    - Deployment,
    - Assurance,
    - Modifications, and
    - Continuous improvement
- A&S evaluating 12 nominated pilot programs now

Requirements

Fix schedule and cost

Allow/encourage Scope (aka Requirements) to evolve and change

Require frequent deliveries

Evaluate delivered scope/capability and quality via metrics

Start small with minimal risk

Attack highest ROI MVP first

Determine if value delivered justifies continuing

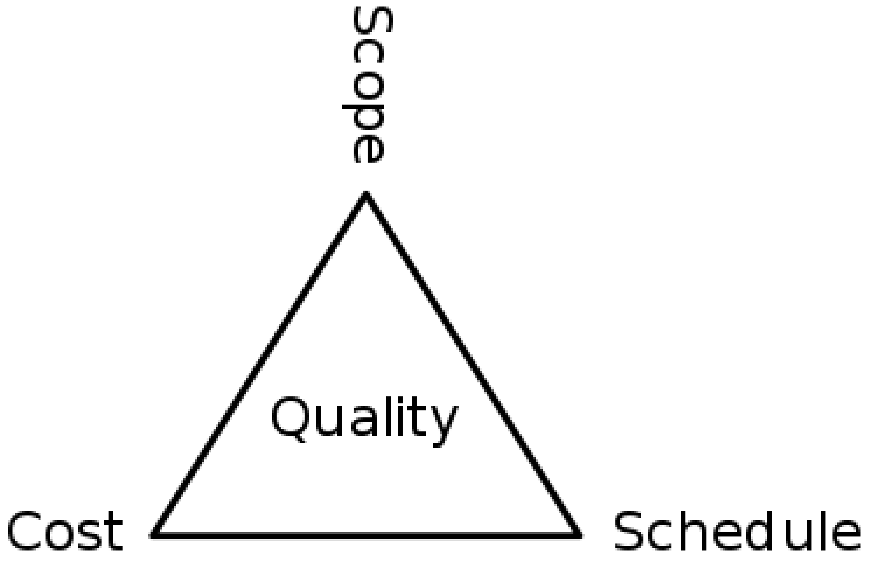


Image source: https://en.wikipedia.org/wiki/File:The-triad-constraints.svg

Questions and Feedback

Reference Material

milSuite CoP: https://www.milsuite.mil/book/groups/dod-enterprise-devsecops

AF version of the above: https://www.milsuite.mil/book/groups/af-devsecops

Currently available hardened containers: https://dccscr.dsop.io/dsop

DAU Community Hub: https://www.dau.edu/community-hub

Specifically these three:
https://www.dau.edu/cop/cybersecurity/Pages/Default.aspx
https://www.dau.edu/cop/it/Pages/Default.aspx
https://www.dau.edu/cop/it/Pages/Topics/DevSecOps.aspx