National Defense Industrial Association Systems and Mission Engineering Conference

November 2022

Data Centricity: Multi-Directional Flow of Specialty Engineering Data Throughout the Life Cycle

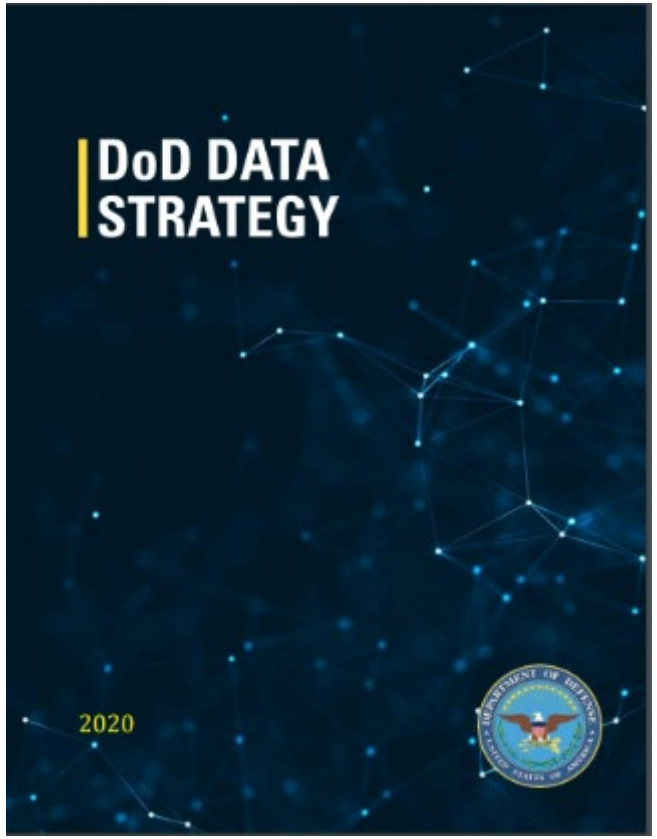
Mr. R. Chris DeLuca

Director Specialty Engineering

Office of the Executive Director, Systems Engineering and Architecture

Office of the Under Secretary of Defense for Research and Engineering

DoD Is a Data-Centric Organization



David L. Norquist, Deputy Secretary of Defense
2020

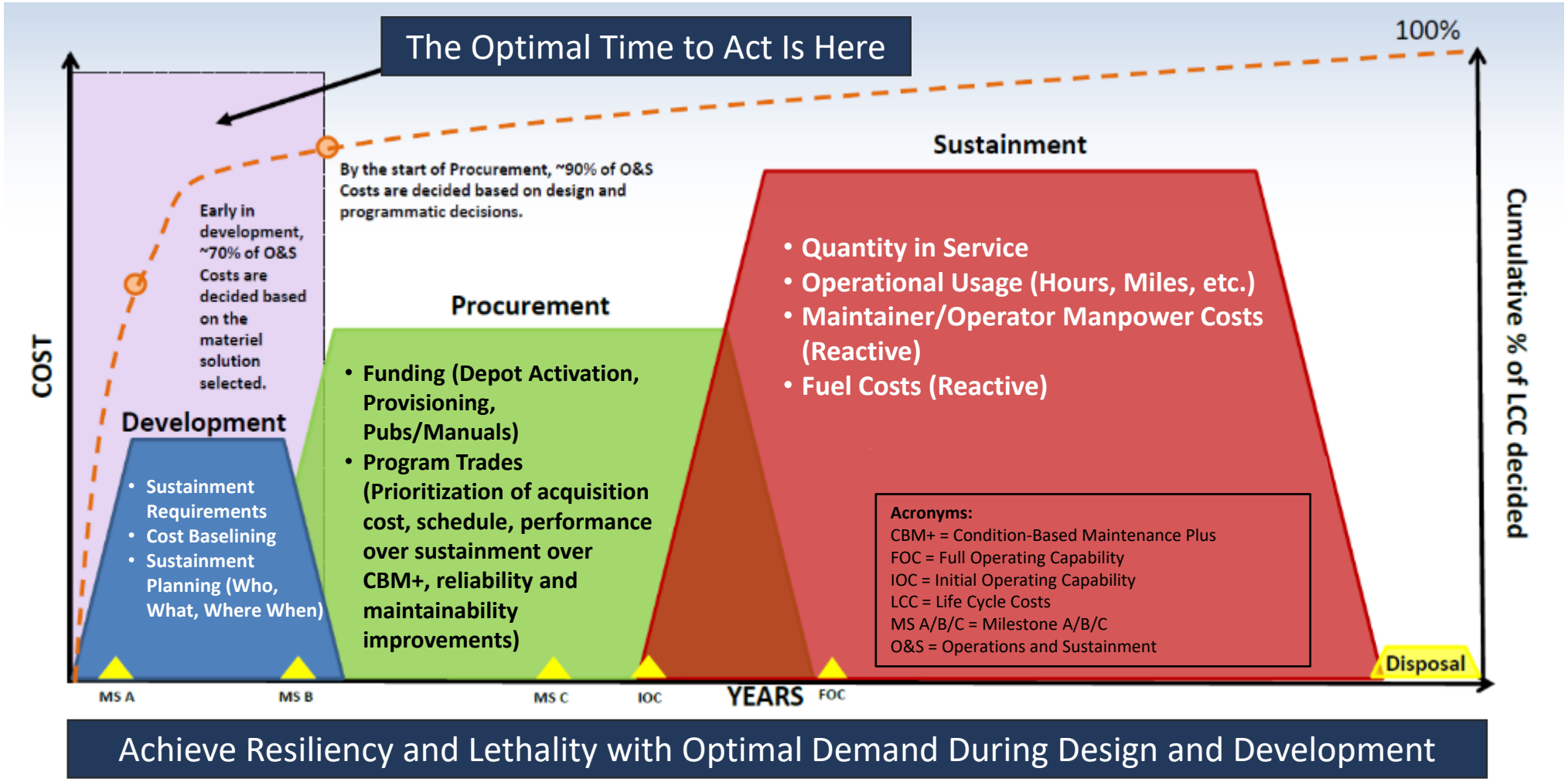
- **"Unleashing data to advance the National Defense Strategy"**
- **Guiding Principle #6 – "Data for Artificial Intelligence Training – Data sets for A.I. training and algorithmic models will increasingly become the DoD's most valuable digital assets"**
- **"As DoD modernizes and integrates AI technologies into joint warfighting, generating DoD-wide visibility of and access to these digital assets will be vital in an era of algorithmic warfare"**

"We have a very large AI challenge ahead of us but in order to do this, we have to get the data right"
Craig Martell, Pentagon CDAO, 2022 Intelligence & National Security Summit (C4ISRNET September 15)

Increasing Complexity and Challenges

Source: 2022 PSM Workshop, RDML Dion English, SC, USN

“Bake In” Data During System Design

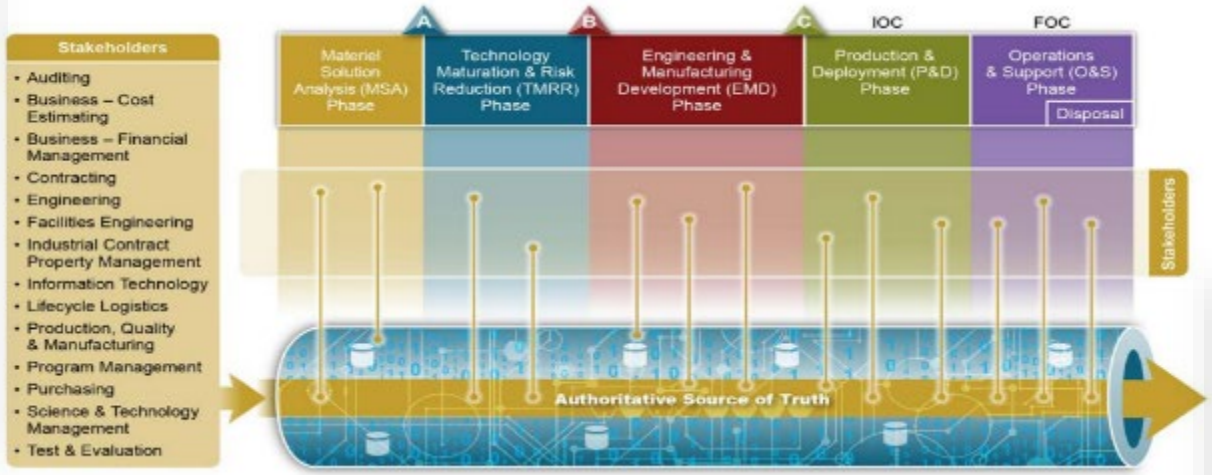


Achieve Resiliency and Lethality with Optimal Demand During Design and Development

Source: 2022 PSM Workshop, Principal Deputy Assistant Secretary of Defense (Sustainment)

Lesson Learned: Ecosystem Needed

U.S. Air Force photo by Jill Pickett
HIGH MACH, Vol 67, No 12

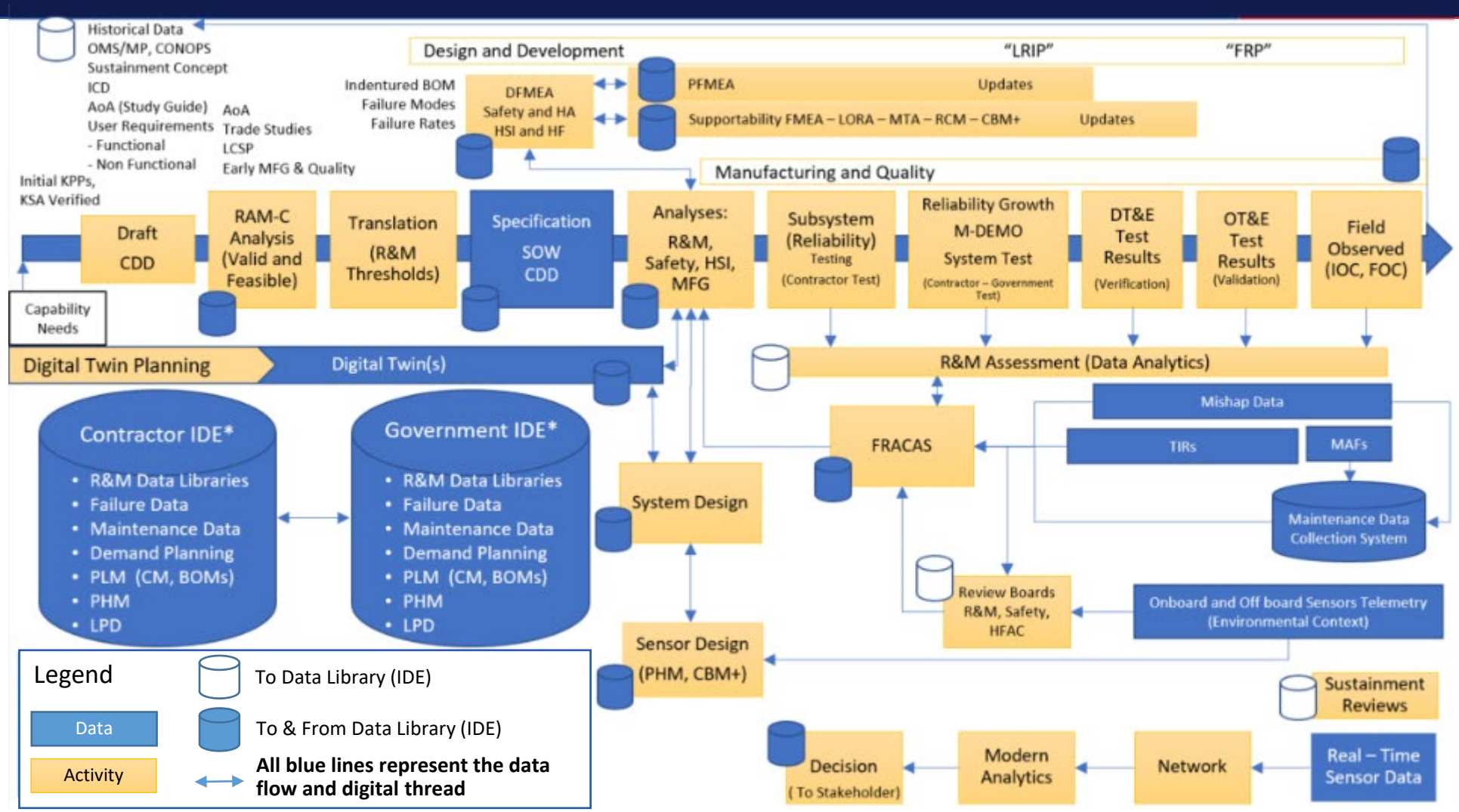


Authoritative Source of Truth, Digital Engineering Strategy

Photo By: Army Spc. Kayla Anstey, "Digital Transformation, AI Important in Keeping Battlefield Edge" June 9, 2022
960cyber.afrc.af.mil/News

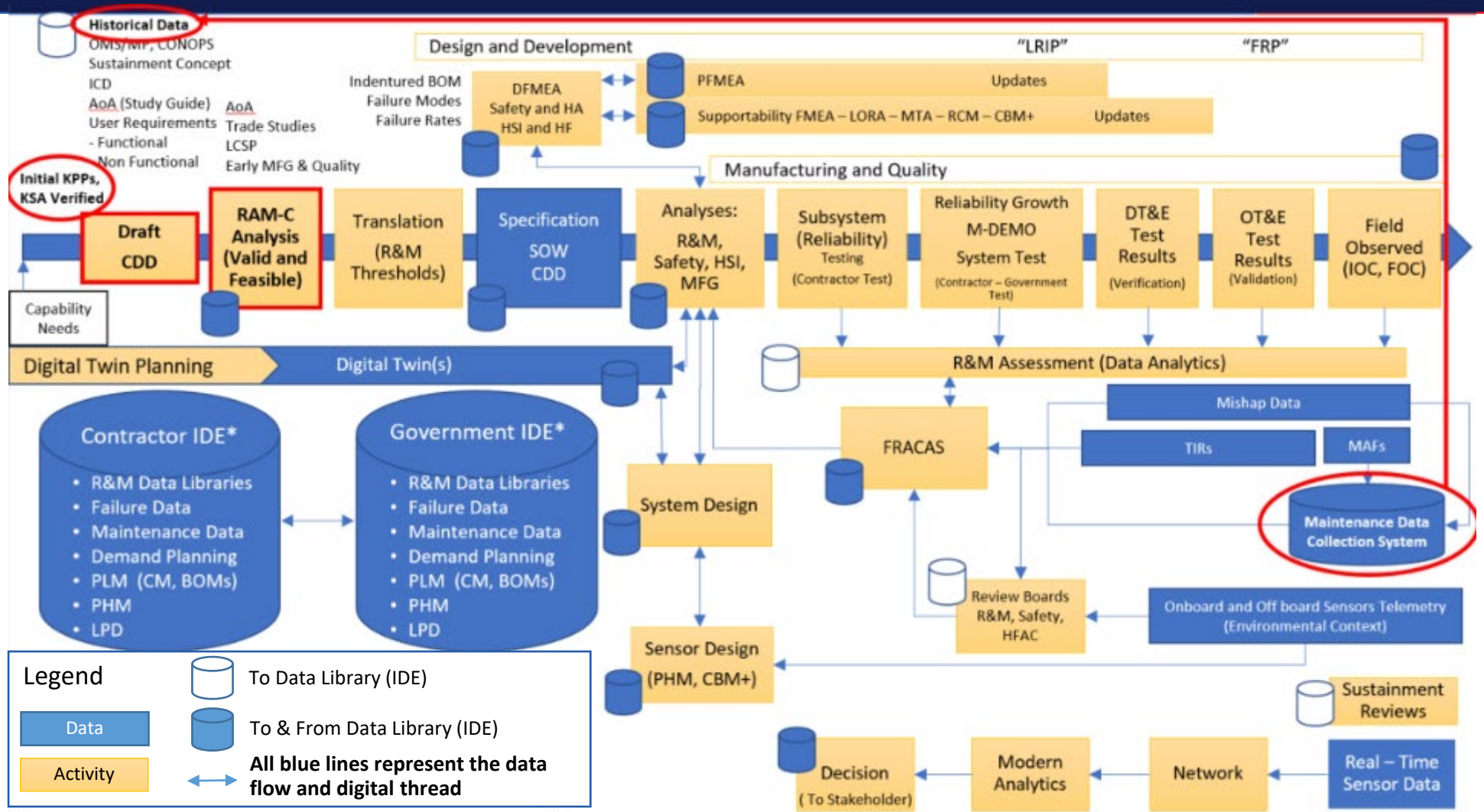
"Warfighters at all echelons require tested, secure, seamless access to data across networks, supporting infrastructure, and weapon systems out to the tactical edge"
DoD Data Strategy, 2020

Engineering Data in a DE Ecosystem



***Contractually agreed to content, views, access, and delivery of data.**

Early Application in Engineering Data



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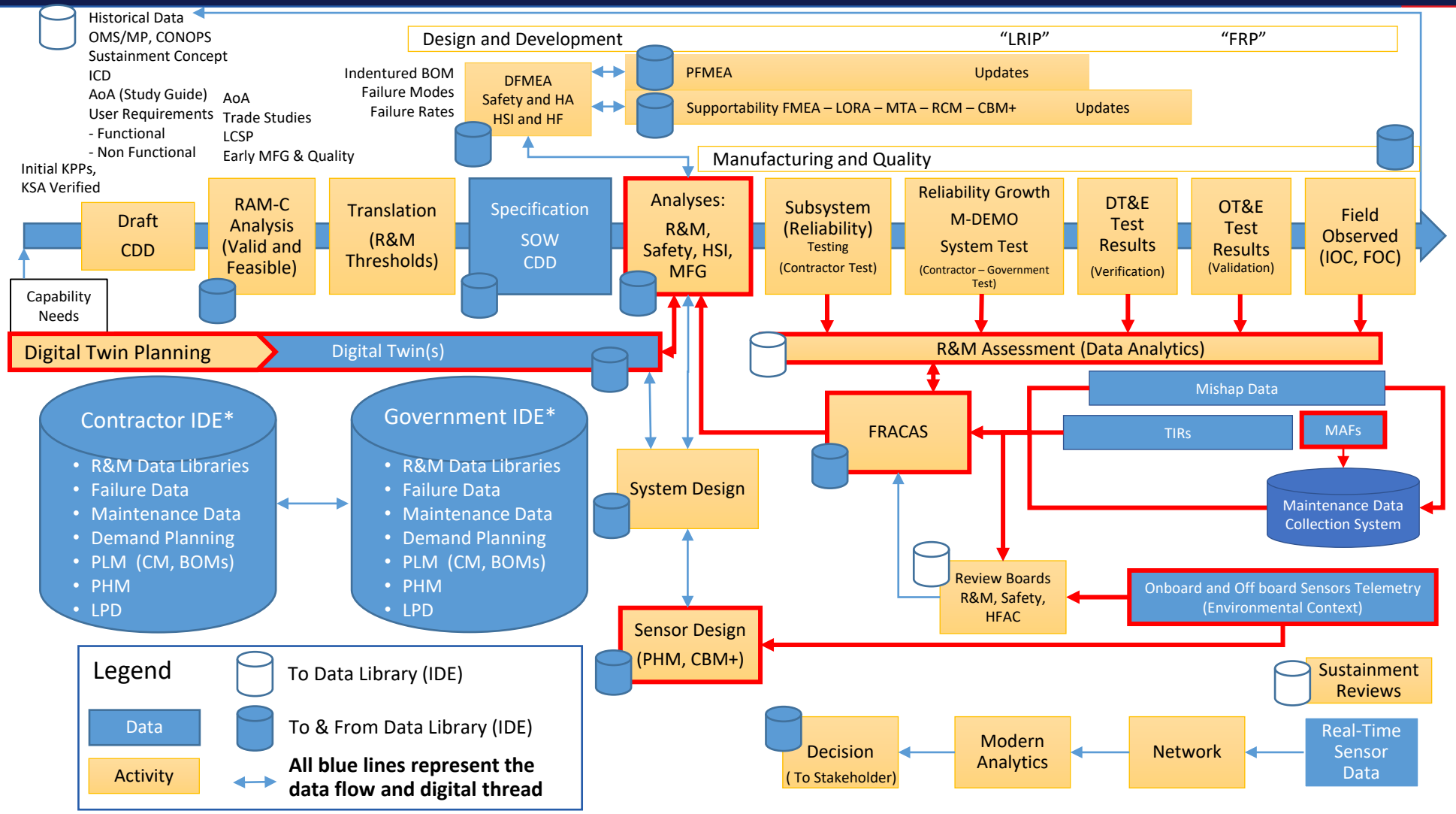
Failure Reporting Analysis and Corrective Action System (FRACAS) Feedback to the Digital Twin



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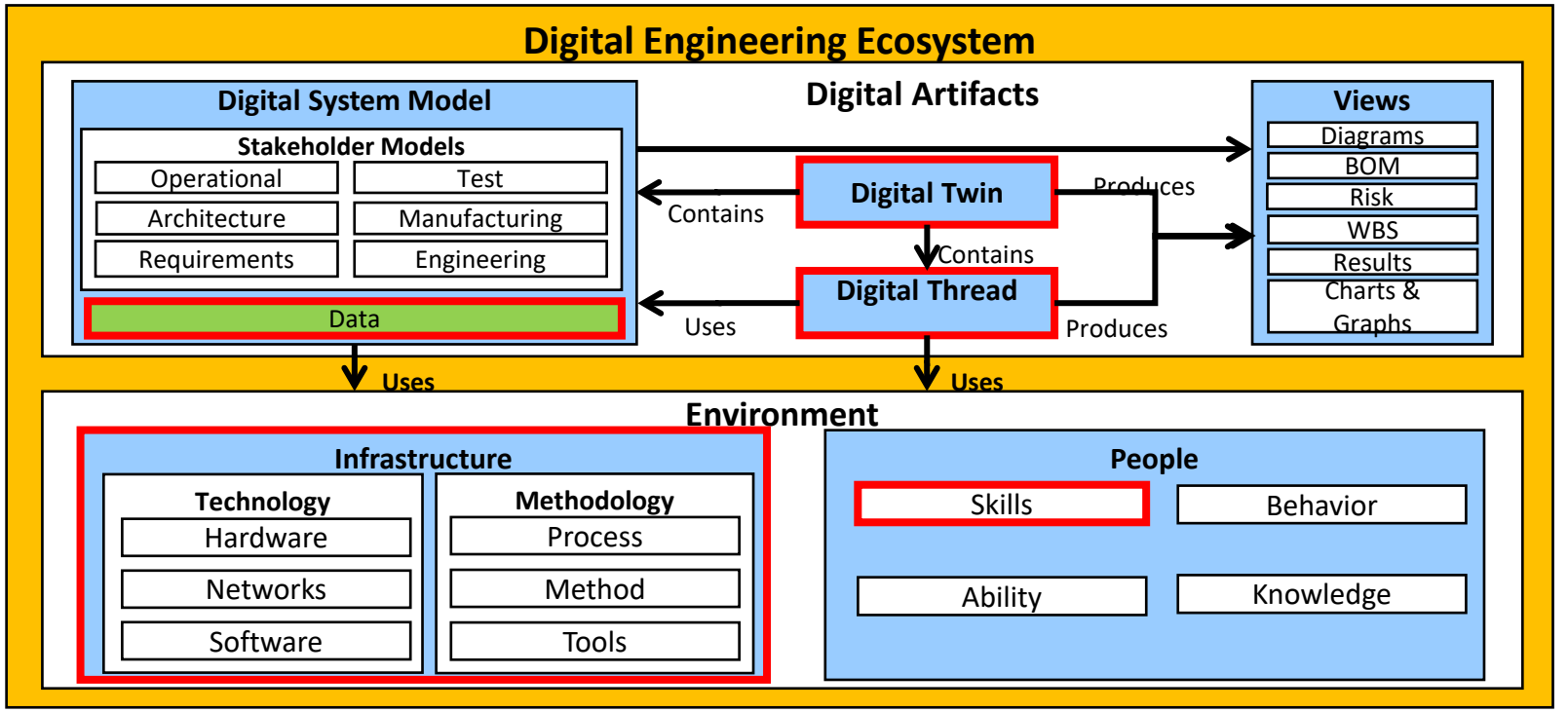
Digital Engineering Ecosystem



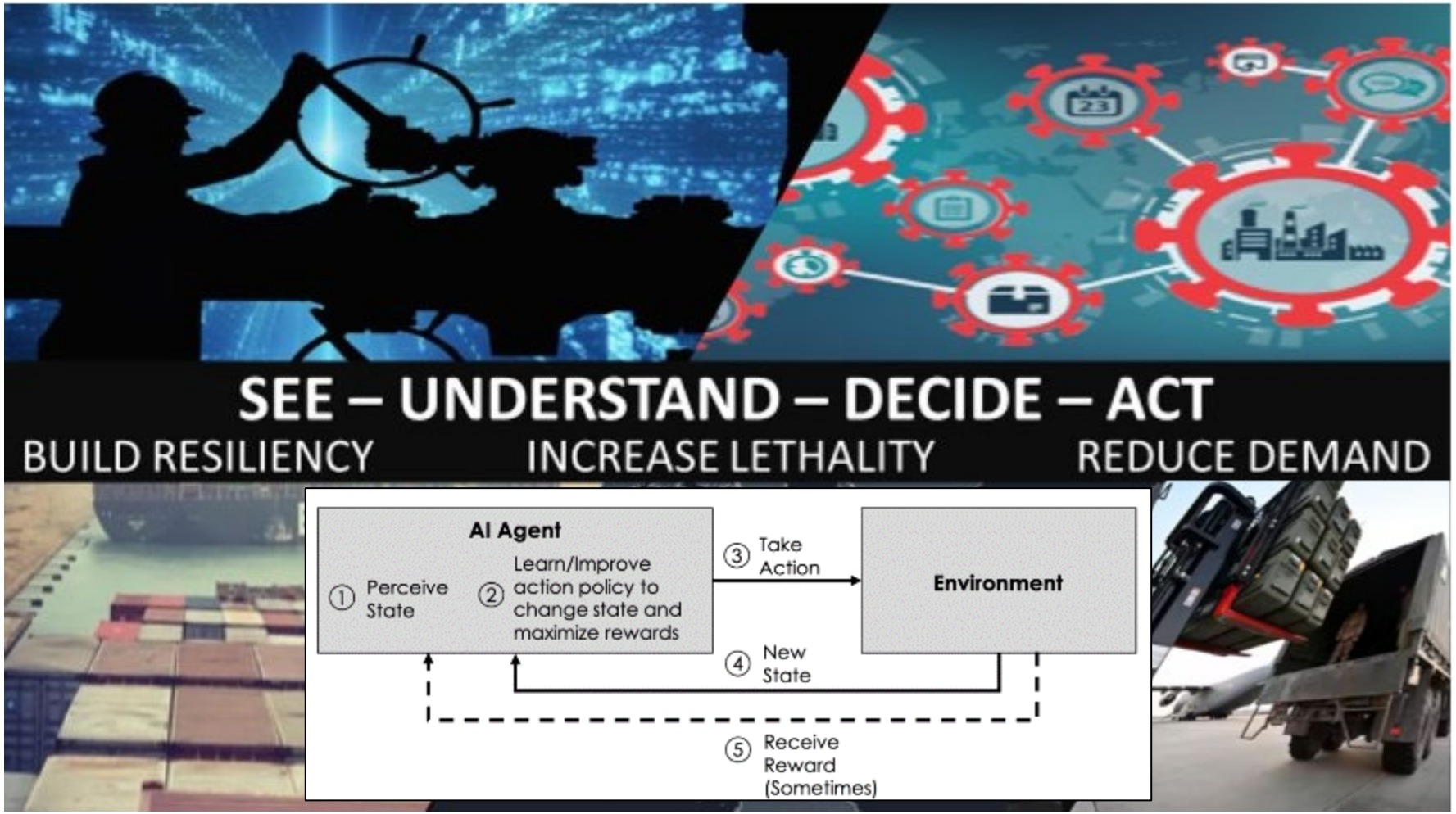
- Implementing digital twins and the digital thread requires a DE Ecosystem
- Infrastructure includes: Compute & Storage, HVAC, DevSec Op Tools, AI/ML/DT Tools, Simulation Tools, MLS/CDS Security, Authority to Operate (ATO) accreditation, Budget
- Skill sets include: IT, IA, Data Engineers, Data Scientists, Sys Admins, High Performance Compute, SW Developers, Scrum Masters, Security ISSO, System Engineers, HW Designers, Specialty Engineers

Its All About the Data

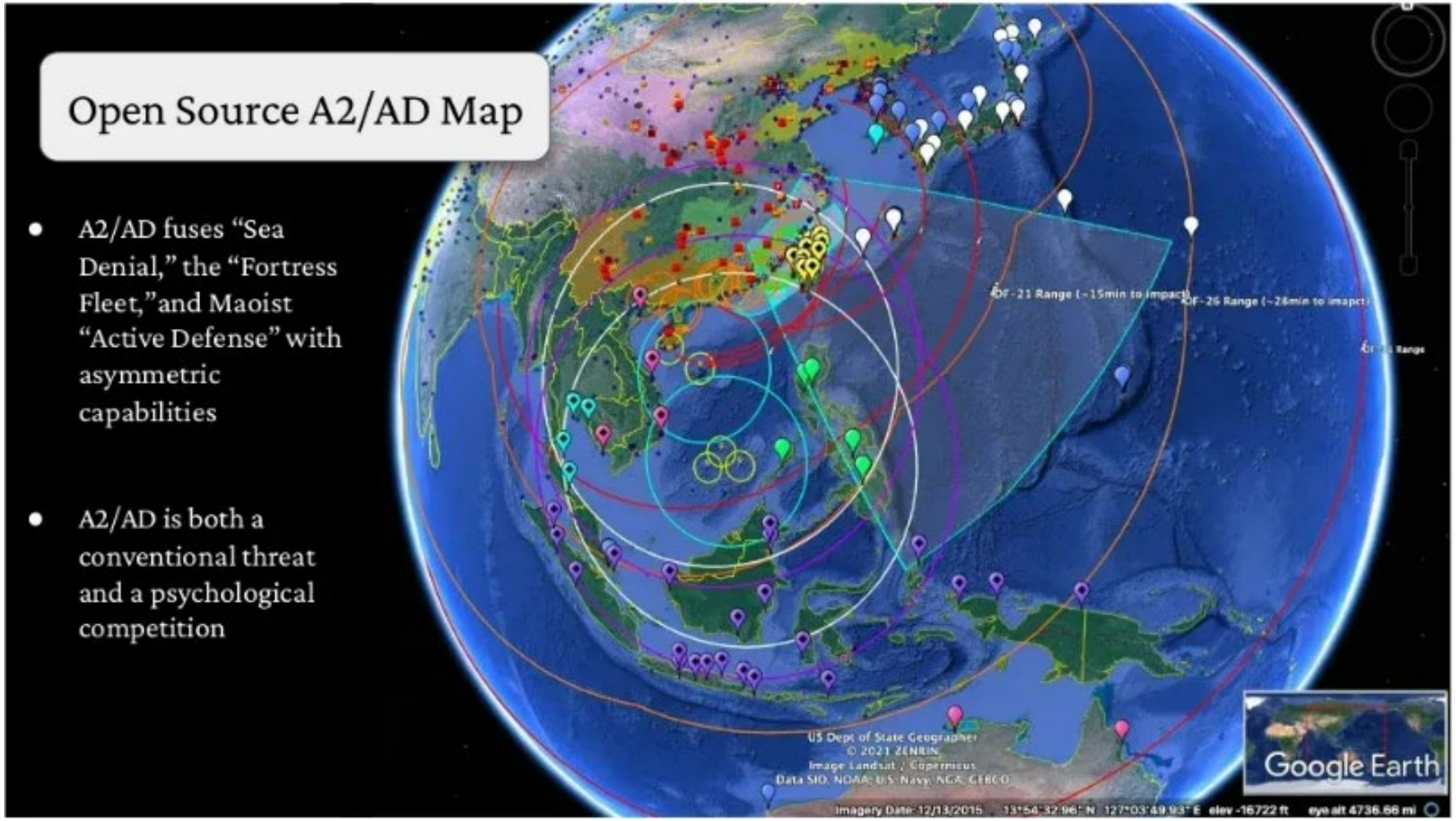
… AI, Machine Learning, NLP … to be continued

Photo By: Marine Corps Staff Sgt. Jacob Osborne, "DoD Incorporating AI Ethics into Systems Engineering" January 21, 2021 Defense.gov/News

Increasing Complexity and Challenges

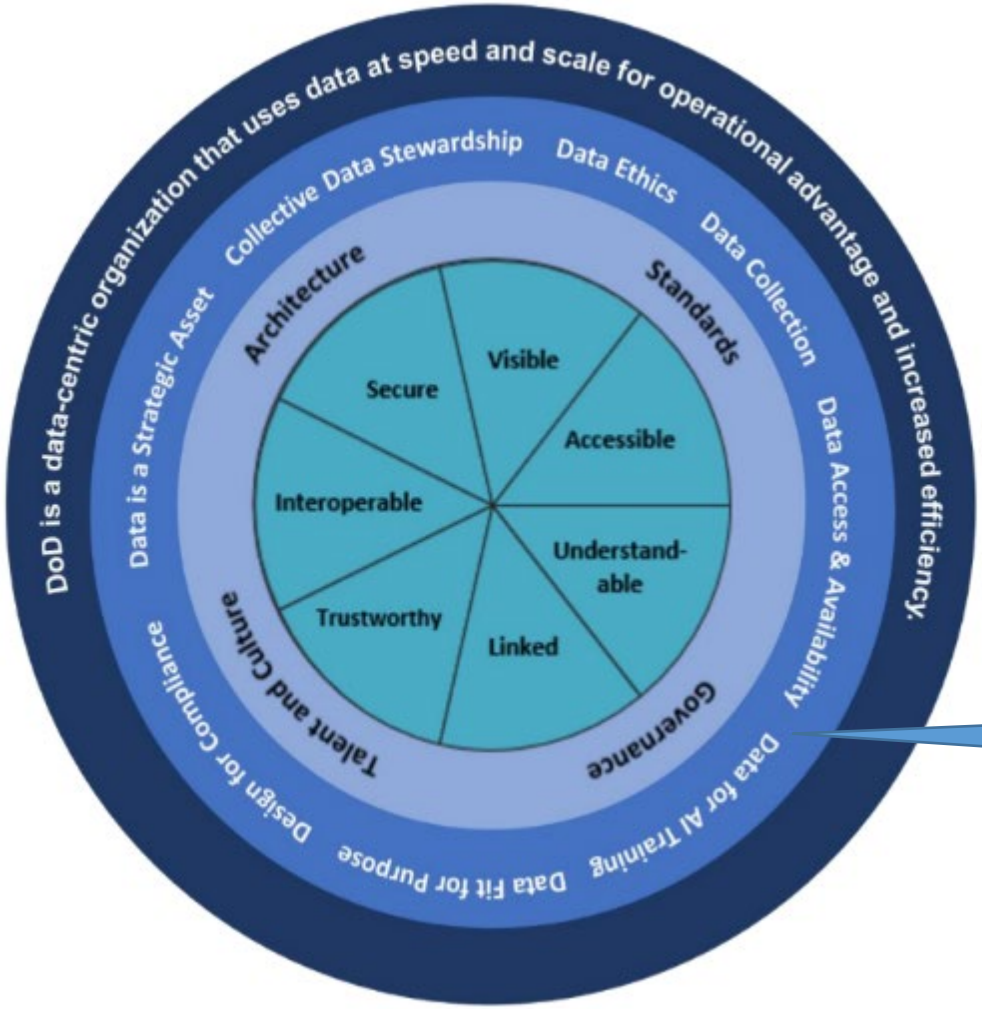


Source: 2022 PSM Workshop, RDML Dion English, SC, USN
Source: Understanding AI Technology, April 2020 (Figure 5)



Attributed to The Stanford Project Agrippa 2021
Source: 2022 PSM Workshop, RDML Dion English, SC, USN

DoD Data Strategy Framework



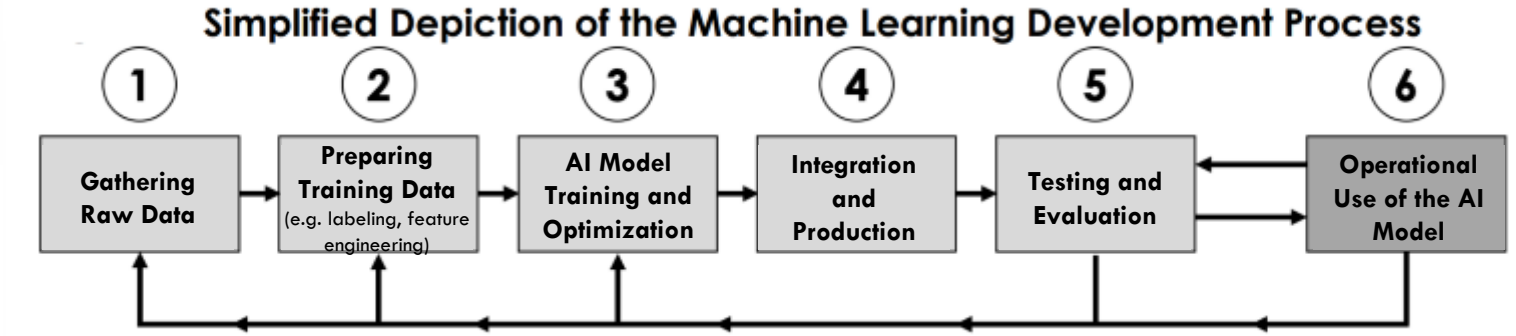
Vision Statement
Guiding Principles
Essential Capabilities
Goals

Guiding Principle #6:
Data for AI Training

Condition-Based Maintenance Plus (CBM+)

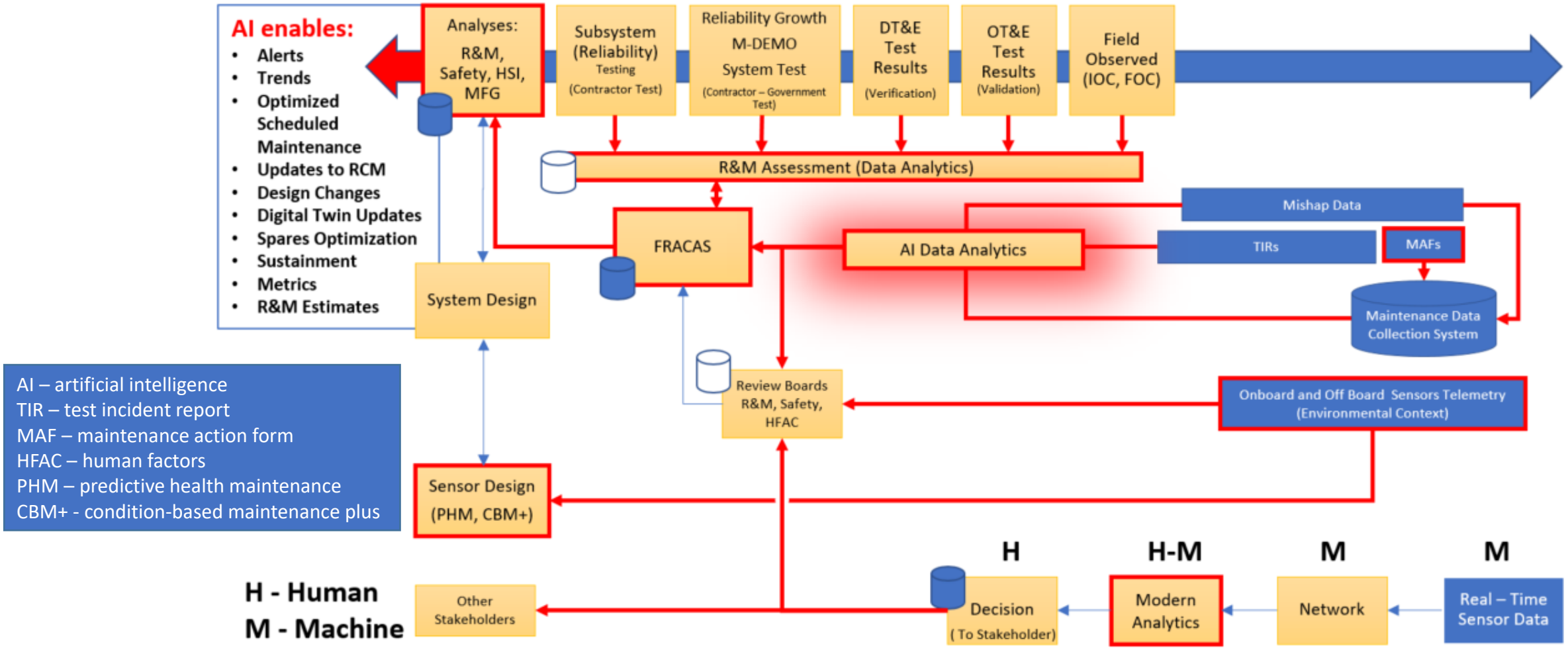
Photo By: R. Nial Bradshaw
"Face of Defense: Youngest Maintainer Launches Youngest Jet at Red Flag," February 22, 2017

Source: Office of the Under Secretary of Defense for Acquisition and Sustainment

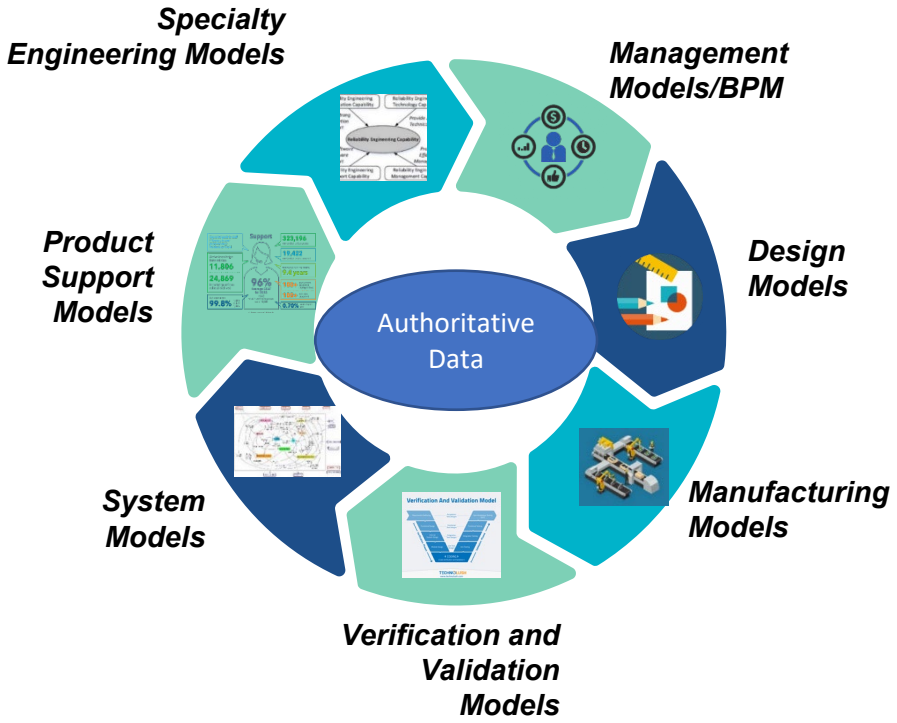


Source: Understanding AI Technology, April 2020 (Figure 5)

AI Application in FRACAS Data



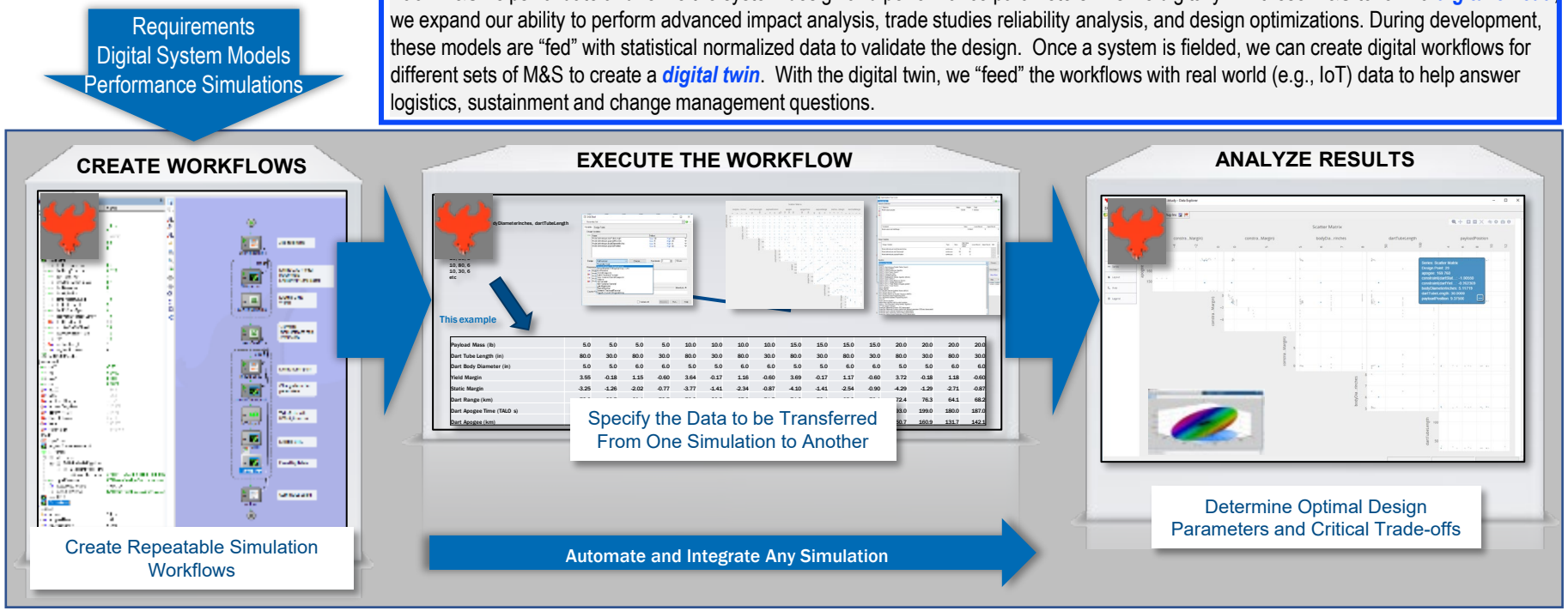
Digital Twin Models & Infrastructure



- An up-front Infrastructure is needed before embarking on AI, Digital Engineering and Digital Twins
- Infrastructure includes: Compute & Storage, HVAC, DevSec Op Tools, AI/ML/DT Tools, Simulation Tools, MLS/CDS Security, Authority to Operate (ATO) accreditation, Budget
- Skill sets include: IT, IA, Data Engineers, Data Scientists, Sys Admins, High Performance Compute, SW Developers, Scrum Masters, Security ISSO, System Engineers, HW Designers, Specialty Engineers

Digital Thread-to-Digital Twin Framework

Each M&S helps validate and refine the system design and performance parameters. As we digitally link these M&S to form a ***digital thread***, we expand our ability to perform advanced impact analysis, trade studies reliability analysis, and design optimizations. During development, these models are "fed" with statistical normalized data to validate the design. Once a system is fielded, we can create digital workflows for different sets of M&S to create a ***digital twin***. With the digital twin, we "feed" the workflows with real world (e.g., IoT) data to help answer logistics, sustainment and change management questions.



- For any given system there are multiple digital twins "answering" different lifecycle questions
- Digital Twin Framework allows us to efficiently create digital twins for those high-risk high-consequence system characteristics to best evolve the system based on real world data

Outcome: Enhanced Predictive Maintenance

DoD image VIRIN:195294-P-UOR35-506.jpg, available at https://www.defense.gov/observe/photo-gallery/igphoto/2001135702/

Its All About the Data – Enhanced by AI

Photo By: Army Spc. Kayla Anstey, “Digital Transformation, AI Important in Keeping Battlefield Edge” June 9, 2022 960cyber.afrc.af.mil/News

Contact

Office of the Under Secretary of Defense for Research and Engineering
osd.r-e.comm@mail.mil | Attn: Specialty Engineering
https://www.cto.mil