

- There may be silence until the meeting starts at 1130 hrs EDT. If you are seeing this slide or the agenda slide you are in the right place.
- Please log into the meeting with your name and company
- All conversations and chats are to be unclassified and no FOUO
- Please put questions in Q&A chat and we will answer as many as possible during the question and answer session. Answers to questions we don't get to will be posted at https://www.afmc.af.mil/digital/
- Dr. Roper will be answering questions during a separate period following his remarks. Please address Dr. Roper in the chat for his question and answer period.
- Please vote with the thumbs up button to help prioritize questions of most interest
- All material will be placed on <u>https://www.afmc.af.mil/digital/</u>
- This AFMC Digital Campaign Virtual Industry Exchange Day will be recorded and link provided on the website above
- The Digital Campaign intends to continue these exchange forums regularly as the Campaign progresses

AF Digital Campaign Industry Exchange Day





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AF Digital Campaign Industry Exchange Day Agenda

| 1100 - 1130 | Login | Administrative | | |
|--------------|--|--|--|--|
| 1130 – 1145 | Welcome/Kickoff Gen Arnie Bunch | | | |
| 1145 – 1215 | AF Digital Engineering Vision | Dr Will Roper | | |
| 1215 - 12:30 | Questions and Answers with Dr. Roper Dr Will Roper | | | |
| 1230 – 1315 | Digital Engineering Exemplars | | | |
| | 1230-1245 Ground Based Strategic Deterrent | Col Jason Bartolomei | | |
| | 1245-1300 WeaponONE | Dr Craig Ewing | | |
| | 1300-1315 Protected Anti-jam Tactical SATCOM | Mr Phu Tran | | |
| 1315 – 1325 | Break | | | |
| 1325 – 1335 | AFMC/SMC Digital Campaign | Maj Gen Bill Cooley/ Brig Gen Jason Cothern | | |
| 1335 – 1355 | AF Integrated Digital Environment | Mr Tom Lockhart | | |
| 1355 – 1415 | Evolving Acquisition Process | Mr Lansen Conley | | |
| 1415 – 1435 | Workforce and Culture | Ms Jackie Janning-Lask | | |
| 1435 – 1520 | Questions and Answers | Maj Gen Bill Cooley | | |
| 1520 – 1530 | Conclusion | Maj Gen Bill Cooley | | |

General Bunch

Welcome/Kickoff





Honorable Dr. Will Roper

Digital Engineering Vision



Digital Engineering Exemplars

Ground Based Strategic Deterrent WeaponONE Protected Anti-jam Tactical SATCOM



Headquarters U.S. Air Force

Integrity - Service - Excellence



Ground Based Strategic Deterrent (GBSD) Digital Engineering

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Col Jason Bartolomei Director, GBSD Systems Directorate

GBSD Land-Based Leg of Triad



Minot AFB, ND

Malmstrom AFB, MT



Bangor, WA



GBSD Digital Engineering Alignment with OSD's DE Strategy



- GBSD's digital engineering approach aligns w/ OSD Digital Engineering Strategy
- 1. Formalize the development, integration, and use of models to inform enterprise and program decision-making
- 2. Provide an enduring, authoritative source of truth
- 3. Incorporate technological innovation to improve the engineering practice
- 4. Establish a supporting infrastructure and environments to perform activities, collaborate, and communicate across stakeholders
- 5. Transform the culture and workforce to adopt and support digital engineering across the lifecycle



Formalize the development, integration, and use of models to inform enterprise and program decision-making



Gov't Reference Architecture



Cost vs. Capability Trades

- GBSD's SysML-Based Architecture Model
 - Government Reference Architecture Model (>500K elements)
 - Prime's Weapon Systems Architecture Model (>3M elements at PDR)
- Cost Vs. Capability Analysis
 - Connects engineering models with cost models (living "AoA")
 - Assessed the "knee in the curve" for every requirement before CDD validation
 - Examined >6B system designs
- Advanced Visualization Techniques
 - Developing cost, schedule, and risk assessment visualization tools



Provide an enduring, authoritative source of truth





- GBSD on path to produce a Digital Twin for every missile sortie, launch facility, and C2 element
 - Descriptive models found in Architecture Models and Product Life-Cycle Management Tool
 - Dynamic models in modeling and simulation environments
- GBSD Digital Twin provides an enduring, authoritative source of truth
- Provides new opportunities for Big Data/Advanced Analytics to inform maintenance, sustainment, transition
 - Enables Condition-Based Maintenance; and others



Incorporate technological innovation to improve the engineering practice





- GBSD established strong relationship with both operational and intelligence communities
- Pursuing a "Flexible Design" based on Intel Assessments and Technology Forecasts
 - Modular Open Systems Architecture
 - "Innovation-friendly" weapon system
- GBSD's Advanced Planning connects intel, ops, science & technology (S&T), & acquisition processes
 - Produce S&T investment roadmaps
 - Capitalize on flexible design
 - Share w/ Labs, FFRDCs, & industry



Establish a supporting infrastructure and environments to perform activities, collaborate, & communicate across stakeholders





GBSD Digital Engineering Operating Locations

- GBSD racing to establish Cloud Infrastructure for Digital Engineering and DevSecOps
 - Working closely with AF Chief Software Officer and OSD SAP CIO
 - Infrastructure aligns with SAF/AQ's initiatives
- Enables nationwide PMO capability
 - Inviting industry participation
- DevSecOps Infrastructure
 - Multi-classified Cloud architecture
 - Built GFE "Container-based" Software Factory



Transform the culture and workforce to adopt and support digital engineering across the lifecycle



- Industry Engagement and Contract Strategy are key
 - Industry Days/Contract Strategy/Data Rights
- IT one of the biggest hurdles to workforce adoption
 - Software availability & network connectivity have been "huge" challenge
- Finding "Digital Design + Open Mission Systems + DevSecOps" synergy
 - GBSD on-path to be an Innovationfriendly weapon-system
 - Faster design cycles...shortening longrework cycles

WeaponONE



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Dr Craig Ewing





WeaponONE

Dr. Craig M. Ewing, ST

Weapons Modeling & Simulation



AFRL WeaponONE One vision, many weapons.





Digital Campaign

PATH FINDER 17



▲ W1 Digital Agile Open Ecosystem



PATH 18





▲ Model-Based Systems Engineering (MBSE)



Digital Campaign

PATH FINDER 19

Weapons Digital Twin Lifecycle AFRL



► W1 Government Reference Architecture (GRA)





Useful across weapon life cycle

Promotes flexibility, reuse, collaboration

Speeds innovation

Protects Intellectual Property

Support O&S – Technical Baseline

Incorporates WOSA



"A Reference Architecture is not defined by what it contains....but what it does." Col (Ret.) Brent Peavy



AFRL W1 Authoritative Source of Truth (ASoT)



Weapons ASoT

Trusted, Federated, Enduring Digital Thread

Cloud-based repository – Cloud One

Git version control for MS&A data

AI/ML – Smart search and retrieval

Supports Data-driven Analysis & Decisions



Government Reference Architecture in Action



W1 Applications AFRL



PATH 23

DigEng Enabled LVC Weapons Test Bed **Digital Twin Enabled Operations** Connected Nission Planning 1. Weapon System in Combat 5. Enhanced Wpn System Capability RW 53WG People Facilities **KHILS Operations** Tools Data **VWaMS** Sustainment S-Vision LVC 2. Challenges Encountered on Mission 4. System Software Solutions 000 Support **ASoT** ACES Hardware Cloud On Fences Software Define **New Target Models** Identifying Targets the-Loop Weapon Capabilities New Behaviors Reaching Target DAO New Cooperative Algorithms Navigation **96TW** proved EW EB Sensing roved I.D. of Threats Ecosystem 90110**1**010 Surviving Countermeasures 010101110 nhanced Countermeasures 101110110 Communicating **Enhanced Communication** GWEF AoA AWS Model-Based Range DEATHSTAR OT&E **Combat Capability Through Real-Time System Performance Upgrades** M&S Primes W1 Applied Digital Engineering Networked Collaborative Autonomous Weapons (LCCM, Gray Wolf) Golden Horde Vanguard ٠ Hypersonics - NGHC ABMS/JADC2 – W1 On-Ramp AFMC Digital Campaign

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▲FRL Way Forward



AFMC

- Integration/interoperability & partnerships with industry
 - Cloud-based collaborative environments
 - Bi-annual industry council
- Utilize AI/ML leverage data (Authoritative, Traceable, Aggregated, Organized, Fused)
- Expand the weapons enterprise use of DigEng
 - Manufacturing
 - Costs
 - Logistics
 - Operations
 - Sustainment
 - Training



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Protected Anti-jam Tactical SATCOM (PATS) Digital Engineering Overview

Phu (Phil) Tran PATS Technical Director SMC/DCT





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PATS Operational View (OV-1)

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PATS Application of Digital Engineering



An integrated digital approach using authoritative sources of systems' data and models as a continuum across disciplines to support life cycle activities from concept through disposal



UNCLASSIFIED **Robust Implementation of PATS Digital Capabilities**





PATS Digital Engineering End State

PATS DE Infrastructure: One stop web portal that takes users everywhere to the PATS DE Ecosystem including PTES Development and Training Environment; supports functional teams and existing program processes



10 Minute Break



AFMC Digital Campaign

Transitioning to a Modern Ecosystem



Maj Gen Bill Cooley



One Team...One Digital Lifecycle Enterprise

OBJECTIVE: Deliver capabilities at ever increasing speed and efficiency by designing, sustaining, and modernizing them in an integrated digital environment

- IT Infrastructure (Clouds and Transport)
- Collaborative ecosystem (Models and Tools)
- Availability of data (Authoritative Source of Truth)
- Open Architectures (Standards)
- Integrated processes (Entire Lifecycle)
- Agile culture (Trained Workforce)



- <u>Workforce</u> recruitment, coaching and advancement in critical digital skills, data science and modeling competencies
- Strengthen engineering and all functional expertise, empowering <u>tradespace exploration</u> with early model-based assessments using mission analysis, for decision making at lowest level
- Secure <u>cloud-based modeling environment</u> bringing together tools and communities for continuous operational, acquisition, and system analysis across the lifecycle
- Enterprise <u>data architecture</u> with continuous <u>Authoritative Source of Truth (ASOT)</u> data sharing for paperless reviews; audits; certifications; decisions; and digital thread throughout product lifecycle and enable operations with artificial intelligence (AI) to improve accuracy at machine speed
- Government and domain <u>reference architectures</u> for accelerated iterative development, enhanced competition, interoperability, system agility, and rapid tech insertion
- Transform and optimize <u>processes</u> across assessments, systems engineering, intel, test and evaluation, and logistics and maintenance

UNCLASSIFIED Briefer: Maj Gen Bill Cooley (AFMC)



LOE #0: Integrated Environment – IT Infrastructure

 Provide overarching guidance to influence corporate IT improvement investments to enable a robust, secure infrastructure for the enterprise-wide Digital Campaign

LOE #1: Integrated Environment – Models and Tools

 Provide an Integrated Digital Environment (IDE) of models and tools for collaboration, analysis, and visualization across the functional domains of AF users

LOE #2: Standards, Data and Architectures

 Provide overarching guidance on the use of Government Reference Architectures (GRA) and related standards and datasets for use in an integrated digital environment for application at the enterprise and system levels

LOE #3: Lifecycle Strategies and Processes

 Develop Life Cycle Strategies and Processes for Technology Transition, System Acquisition and Product Support using an IDE, supporting lifecycle activities from concept development to disposal

LOE #4: Policy and Guidance

 Assess and define the required policy and guidance updates/changes to enable full implementation of the Digital Transformation

LOE #5: Workforce and Culture

 Drive culture change across the AFMC enterprise through training and change management, enabling a workforce well versed in Digital Engineering



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US Space Force – Space and Missile System Center

The Digital Ecosystem is necessary for the future success of space systems acquisition and operations

- Speed react to threats, implement innovations, respond with new technologies
- Complexity managing enterprise, welcoming change
- Mission Assurance success at launch and operations in contested environments

Partnering with the AF in the Digital Campaign

- DE Environment and Modeling Tools (LOE 0 & 1)
- Ontology, Style Guides and Standards (LOE 2)
- DE Policy, Processes and Contract Language (LOE 3 & 4)
- Workforce Training and Culture Change (LOE 5)

Briefer: Brig Gen Jason Cothern (SMC/CV)

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The Space Force will be a Digital Service – Gen J. Raymond





ncludes Civilians, Military, A&AS support contractors and FFRDC personnel

Integrated Digital Environment



Mr. Tom Lockhart, SES Mr. Mitch Miller, SES Executive Champions

What is needed for Integrated Digital Environment (IDE)?

Big "4"

- ✓ Model Based
- ✓ Product Management
- ✓ Analysis
- ✓ Visualization

Multiple Tool Vendors Interoperability w/Standards Distributed Workforce

□ Multi-Level Security

The I want

Continuous Authority To Operate

Own & Access to Program Baseline

Complexity Science

Bede Systems Engineering "Vee" Framework



---Product Lifecycle Management--

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Briefer: Tom Lockhart (AFNWC/EN-EZ)

Integrated Digital Environment



Briefer: Tom Lockhart (AFNWC/EN-EZ)



Deliverables

- Delivery 1: Identify and catalog <u>assorted tools and models</u> for programs to conduct business across their multi functions
- **Delivery 2:** Setup an <u>enterprise contract</u> for ordering Sandbox, Tools, and Training
- Delivery 3: Develop IDE <u>Sandbox</u> for on premise/client server Program Executive Office (PEO) to develop models for migration into the CloudOne/PlatformOne





Government Reference Architecture (GRA)

Reference Architecture:

 An authoritative source of information about a specific subject area that <u>guides and constrains</u> the instantiations of multiple architectures and solutions – **DoD Reference Architecture Description**, June 2010

Governance Reference Architecture: (Proposed)

The reference architecture provided by the government to guide the system design, development, production, and sustainment processes.

Purpose:

- Provides Ontology
- Supports Model Reuse
- Supporting the validation of solutions against a proven Architecture
- Provides Style Guide and Standards
- Defines the business, regulatory, and technical boundaries



Benefits:

- Increases speed
- Provides a starting point--across programs
- Removes ambiguity--reduced integration time
- Decreases requirements creep
- Sets standards for MBSE for effectiveness and efficiency
- Delivers Interoperability across users and providers of data

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Government Reference Architecture (GRA) Example





Develop Library of GRAs Modeled in Systems Engineering Tools

- Leverage GRA & System Architecture for Architecture centric analysis
 - Entities
 - Attributes
 - Relationships
- Link Architecture to tools for early, dynamic, & continual analysis of requirements
- Connect other analytical tools via Application Programming Interfaces (API's)
 - API = a re-usable set of functions
 / subroutines used for software development
- Enable Automation of Processes
- Enable Multi-Domain Analysis
- Tie Solution Architecture to DoD Enterprise Architecture
- Maintain authoritative source of truth

An Example Digital Toolchain



Build the Digital Ecosystem Data Architecture



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Align Current MBSE work (best of the best) DoD DevSecOps Reference Design

Real-time/Embedded Systems

Standardized data formats

Government Reference Architectures

Cultural and Mindset Changes



Leverage Cloud Infrastructure

CloudOne/PlatformOne Foundation

Leading edge agile software processes

Automate what we can

Machine Learning/Artificial Intelligence – New ways of handling/validating/managing/appl ying data



Development Open Source/Common Tools Configuration management, data health, data checking

Near Continuous Design Reviews

Understand SoS Level Interfaces

Assess System Performance Virtual Dress Rehearsal Missions



Manage, Share, and Curate Data

Make Data Accessible to the People Who Need It

Pre-program activities to program of record to operations

Living data repository – allows customization for program & Operational needs

Establish the pipeline to the warfighter!

UNCLASSIFIED Briefer: Mitch Miller (AFLCMC/EZ)



- Identified initial Integrated Digital Environment (IDE)
 - Coordinating CloudOne/PlatformOne
- Identifying Enterprise tools to enable Model Based System Engineering, Product Lifecycle Management, Analysis, and Visualization
- Working Product Lifecycle Management (PLM) capability across enterprise with special emphasis on programs in sustainment
- Built / Contributed to DOD Digital Dictionary synchronized effort with OSD/R&E
- Developed methodologies and specifications for how to use models in the digital environment

Evolving Acquisition Process



Mr. Tom Doyon, SES Mr. Lansen Conley, SES Executive Champions



- Evaluated as part of Policy and Guidance (LOE #4)
 - One of Five Focus Areas
 - Most complex area of the five
 - Imperative to balance contractor rights with government rights and needs
 - Key Issues:
 - Determine optimal extent of data sharing in a digital ecosystem
 - > Determine needed license rights
 - 10 USC § 2320(f): Preference for specially negotiated licenses
 - DFARS 215.470(b); DoDI 5000.85; DoD 5010.12-M: DD Form 1423s
 - Recognition that current Data Rights regime had inception in hardware-centric world and we now live in a software-centric world
- Way Forward
 - Continue to assess necessary license rights to implement the USAF's digital transformation
 - USAF can't do this alone; we need open and transparent dialogue with industry



Evolving Acquistion Processes

Strategy: Systematically identify and promote digital enhancements to acquisition processes using Agile methodology—data, tools, infrastructure, policy



Encompass AF enterprise...from requirements generation through Operations and Sustainment

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Briefer: Lansen Conley (AFLCMC/LG-LZ)



Integrated Digital Ecosystem and Processes



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Briefer: Lansen Conley (AFLCMC/LG-LZ)

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Notional AF Digital Transformation Metrics

| | Digital Transformation: Target vs Baseline | | | | | |
|------------------------|--|--------|----------|--|--|--|
| | | Target | Baseline | | | |
| | | | | | | |
| Infrastructure | Digital Infrastructure | | | Draft Threads & Subthreads based upon an AF adaptation of the INCOSE Capabilities Matrix | | |
| Modeling / Analysis | | | | | | |
| | | | | | | |
| | Model/Data Quality | | | • | | |
| | | | | | | |
| Process / Policy | Model Management | | | To be applied periodically to engineering labs, centers, and programs | | |
| | Data Management | | | | | |
| Workforce / Culture | | | | | | |
| | Workforce Capability | | | | | |
| | Adoption | | | | | |

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Briefer: Lansen Conley (AFLCMC/LG-LZ)



- Reviewed statute, policy and regulations impacting Digital Engineering
- Identified acquisition & certification processes for digital acceleration
 - Eg: Engineering Data Management, Authority to Operate (ATO), Risk Management, Tech Data, and Maintenance Planning
- Translating templates / guides for digital acceleration
 - Tech Transition Plan (TTP), Acquisition Strategy (AS), Test and Evaluation Master Plan (TEMP), Systems Engineering Plan (SEP) and Lifecycle Sustainment Plan (LCSP)
- Identified 23 Digital Features and contracting language for programs
 - Request Industry feedback in the coming weeks
- Refining INCOSE Digital Engineering Metrics and applying to pathfinder programs – preparing to scale in the coming months

Workforce and Culture



Ms Jackie Janning-Lask, SES Executive Champion



Shepherd the Command through the pivot of Digital Transformation via deliberate change management; by conducting a **stakeholder analysis**, creating **messaging timelines/modes**, driving continual **leadership engagement**, and partnering with experts to identify and fill workforce **knowledge gaps**

| Understand Process Baseline & Lessons Learned Industry & Gov't Engagements Boeing MITRE Lockheed Navy Digital U AFIT Change Management Approach Prosi—ADKAR model Build matrixed support team | Data Collection & Quick Wins Data Collection Stakeholder Analysis Training Evaluation/Criteria Quick Wins Digital Engineering Landing Page Matrixed Change Mgt Support in each Center Dialogue w/workforce | Resources & Metrics POM Inputs IT tools, infrastructure, survey tools, manning, website Metric Creation & Coordination Impact vs Activity # of programs using digital tools Efficiencies gained by going digital Defining "success" and applying criteria to programs | Execution Stand up Execution Office Functional Communities A1, EN, others Programmatic Communities PEOs Clarify roles & responsibilities Enduring change team vs functionals vs leaders |
|---|---|--|--|
| Phase 0 | Phase 1 | Phase 2 | Phase 3 |
| SSIFIED | . | | |

Briefer: Jackie Janning-Lask (AFRL/RY)



Workforce and Culture: Training

Provide a **menu of AF approved training** for "going digital" by determining level of expertise needed (basic, intermediate, expert), targeting specific **positions**, ensuring **multiple modes** for dissemination, and frequency, just-in-time training vs traditional approach for workforce across all functional organizations.



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Briefer: Jackie Janning-Lask (AFRL/RY)



Create a **single profile** for Command-wide workforce "career progression/leadership development" Tracking workforce from **recruitment to retirement.**



A DIGITAL TWIN FOR ALL OF OUR DIGITAL AIRMEN

- "Digital 971" Employee Record
- Career Progression and Leadership Development
- Competency Management
- Repository of Knowledge
 Management

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Briefer: Jackie Janning-Lask (AFRL/RY)



- Create a Change Management Plan
 - Conduct a stakeholder analysis
- Review and assess available DE training, courses, seminars, workshops, etc. to leverage for training opportunities
- Create a technical, support and functional career development plan to exercise levels of DE competencies



AF Digital Campaign

Questions and Answers



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Thank you for your participation

All material, recording and questions/answers will be put on https://www.afmc.af.mil/digital/