



USAF Digital Thread Initiative Overview

**Claudia V Kropas-Hughes
AFLCMC/XZE**

***Presented to NDIA M&S Committee
April 8, 2014***



Agenda



- **Digital Thread**
- **DPAAS – Digital Thread Workshop, 21 Nov 13**
- **Workshop Results:**
 - **Guiding Principles**
 - **Follow-on Activities**
- **Digital Thread Working Group (DTWG)**
- **Next Steps**



What if...

- The **performance** capability and total ownership **cost** of a weapon system could be **quantitatively estimated** at every stage of the acquisition lifecycle?
- **Program risks** could be **identified** and **quantitatively estimated up front**?
- The **expected impact** of specific program activities/decisions on program risks, performance capability, and total ownership cost could be **quantitatively estimated up front**?
- Program risk, performance capability, and total ownership cost estimates could be **updated** as program activities are completed?

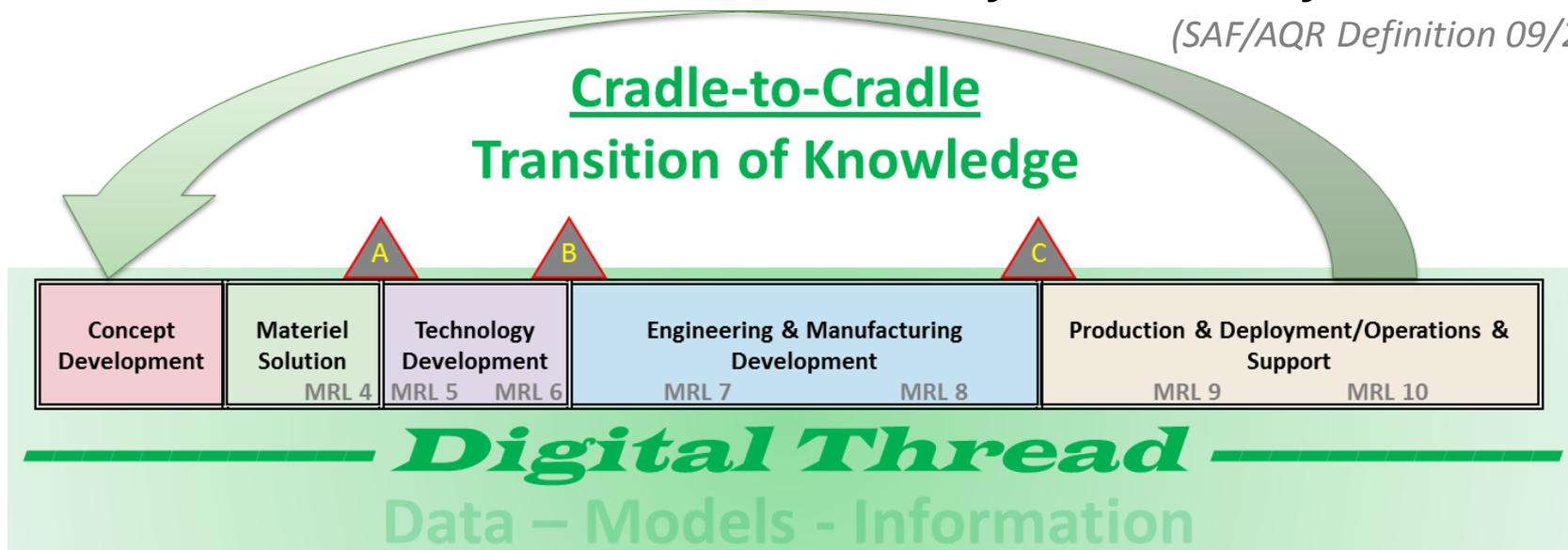
Enables rapid development and acquisition of capable, reliable, and affordable weapon systems.



Digital Thread Defined

- “Digital Thread is the creation and use of a **digital surrogate** of a materiel system to allow dynamic, real-time assessment of the system's current and future capabilities **to inform decisions in** the Capability Planning and Analysis, Preliminary Design, and Detailed Design, Manufacturing, and Sustainment **acquisition** phases. The **digital surrogate** is a physics-based **technical description** of the weapon system resulting from the generation, management, and application of **data, models, and information** from authoritative sources across the system's life cycle.”

(SAF/AQR Definition 09/2013)





Digital Thread Concept



Main Goals:

- Use **ALL AVAILABLE INFORMATION** in analyses
- Use **PHYSICS** to inform analyses
- Use **PROBABILISTIC METHODS** to quantify program risks
- **CLOSE THE LOOP** from the beginning to the end and back to the beginning of the acquisition lifecycle

Make ***INFORMED DECISIONS*** throughout acquisition



Digital Thread Analysis Progression



- Develop preliminary models & req'ts in **Concept Development**
- Develop detailed “as designed” models & req'ts in **Design**
- Validate/calibrate in **Test & Evaluation**
- Update using “as built” data from **Production**
- Update using “as flown” data from **Operation**
- Update using “as maintained” data from **Sustainment**

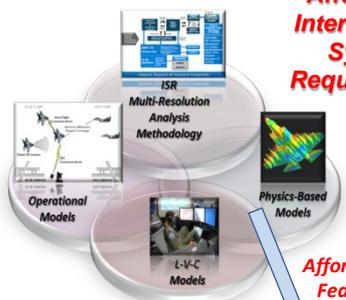
Requires formalized framework(s) for linking & updating across both acquisition phases *and* technical domains.

MDD

A

B

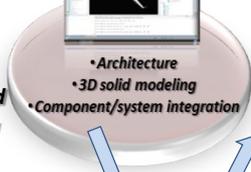
C



Digital Simulation for Capability Planning & Analysis

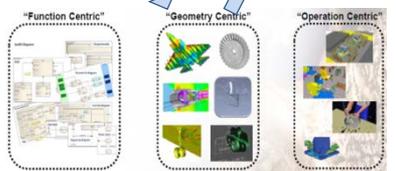
Affordable, Interoperable System Requirements

Affordable, Feasible Design Space



Model Based Engineering & Design

Detail Design

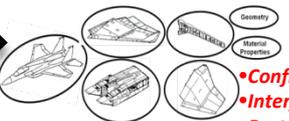


Process Workflow

3D Parts Rendering

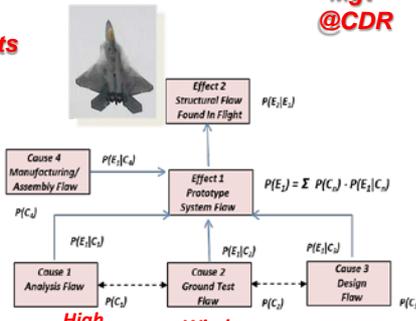
Manufacturing Logistics

Configuration Control



- Configuration Management
- Interface Control
- Part Number ID

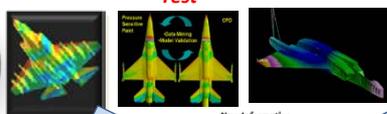
Initial Meta Data For Digital Twin



High Fidelity Aero Loads Model

Wind Tunnel Loads Test

Prototype Vehicle Design



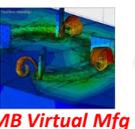
MIN/MA X Loads

PSD

Bayesian Learning Model



Design in Reliability



MB Virtual Mfg

Weight Mgt @CDR

Minimum Defects Discovery After 1st Flight

Ground Tests



Flight Tests

- System Reliability
- System Weibull Statistics
- Accelerated Mission Testing



Early Reliability Assessment

Rig Tests

- Component Reliability
- Component Weibull Statistics
- Bayesian Assembly of Component Reliability to System Reliability

Validated Components, Structures And Materials Models



Digital embodiment of the current state of physical components, systems

Assured Suitability (RAM) At FRP Decision

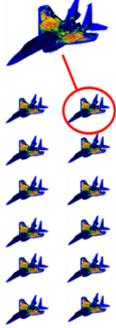
Reduced O&S Costs Thru Optimum Maintenance, SLEP Planning

Rapid Response, Repurposing for Changing Mission Threads, Crisis Management



Probabilistic Prognosis & Decisions

Fleet & Tail # Lifecycle Management



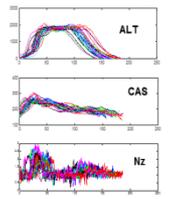
Inspections



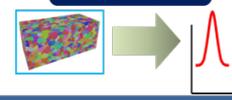
Models



Usage



Materials State Awareness



Digital Twin

Engineering Knowledge Management



Digital Thread (DT) Workshop, Nov 21, 2013



- **Defense Planning and Analysis Society (DPAAS) host**
- **Purpose: to facilitate a dialogue/ collaboration between Industry and Government**
- **A continuation of previous meetings; broaden the recommendations of Global Horizons**
- **The workshop**
 - **10 Industry and Government presentations on current efforts**
 - **Industry/Government panel discussion on the way forward**
 - **Follow-on Activities and Guiding Principles**



DT Workshop “Guiding Principles”



- **The burning platform = escalating cost of development and need for faster timelines**
- **More pilot programs needed – chosen wisely**
 - **Do early wins – Low hanging fruit could be structural life applications for sustainment**
- **Acquisition community needs to fully engage**
- **Manage Expectations: It will take several years to succeed**
- **Digital Thread and Digital Twin are closely aligned**
- **Collaboration may involve complex networking issues and cybersecurity challenges**



DT Workshop Follow-on Activities



- **Potential next steps:**
 - **Develop glossary of terms**
 - **Inventory current tools and methodologies**
 - **Establish working group of system engineers to define way ahead (strategic plan)**



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Digital Thread Working Group (DTWG)



- **Knowledgeable personnel to define way ahead for DT (strategic plan)**
 - **Government and Industry participants**
 - **Glossary of terms**
 - **Baseline current activities**
 - **Develop a strategic roadmap (where we want to go)**
- **AFLCMC/XZ – point on establishing the DTWG**



Digital Thread Working Group (DTWG)



- **AFLCMC/XZ – point on establishing the DTWG**
- **Representatives include:**
 - **DoD – Air Force (SAF/AQR/ AFMC/ AETC/ AFLCMC/ AFRL) and Navy/Army**
 - **Industry – ABDA, AGI, Aurora Flight Sciences Corp., BAE, BAH, Boeing, Camo LLC, CRG, Etegent, GE, ISSI (DPAAS), Lockheed Martin, MacB, MERC, NGC, Peerless Technologies, Stevens Aircraft Engineering, RR Associates, OAI, Shahady Consulting, TDKC (DPAAS), Textron Systems, Wright State Univ**



Next Steps

- ***First Telecom: Thurs, Feb 27***
 - *Finalize Charter*
 - *Glossary*
- ***Second Telecom: Thurs, Mar 13***
 - *Glossary*
- **Third Telecom: TBD, April 2014**
 - **Focus will be on the Air Force perspective on Digital Thread – identify what our needs are, what our areas of interest are, etc.**
 - Provide specific examples/outline issues to be addressed
 - CONOPs for AF DT along with particular use cases
 - Provide examples and use cases – What capability is the Air Force looking to have?



Next Steps

- **Aerospace Enterprise Dialog with Industry (AEDI)**
 - April 16-18, 2014, Hope Hotel, Dayton OH
 - Will include a Panel discussion on Digital Thread and CREATE
 - **Focus will be**
 - Air Force overview on Digital Thread
 - Role of CREATE in the Air Force

For more information on this Event:

<http://www.defenseinnovationmarketplace.mil/aedi.html>