



Realizing Value from Digital Engineering ... Together

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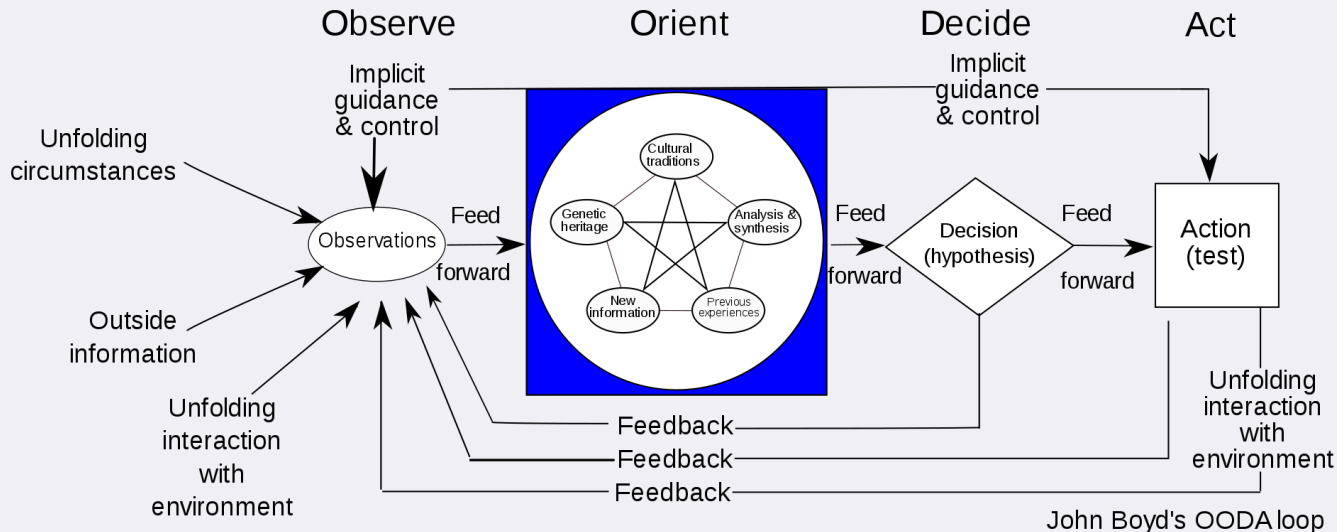
“China is inside our OODA loop... We need ability to change things inside our systems faster”

- Lt. Gen. Shaun Morris

Call to Action:

“Accelerate change or lose”

Gen. Charles Q. Brown, Jr.
USAF Chief of Staff



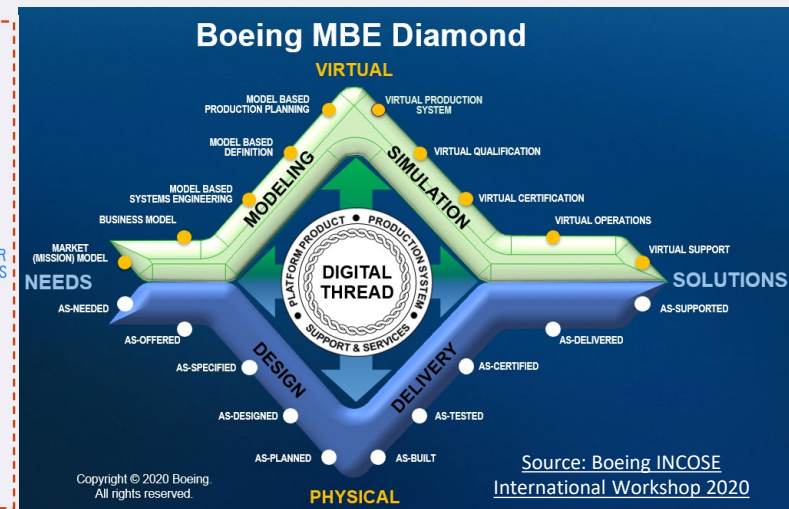
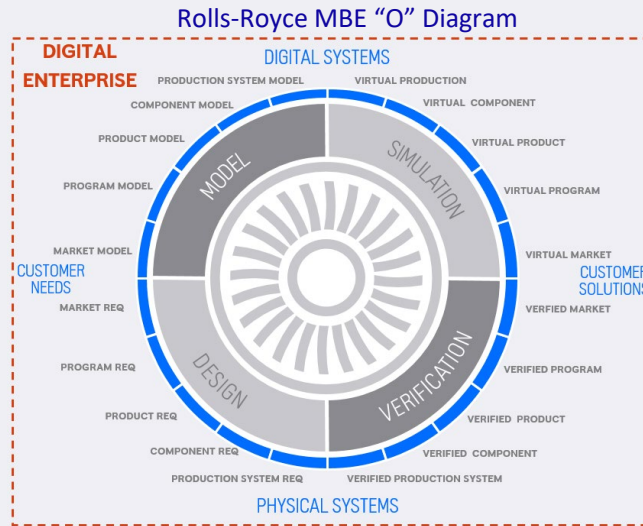
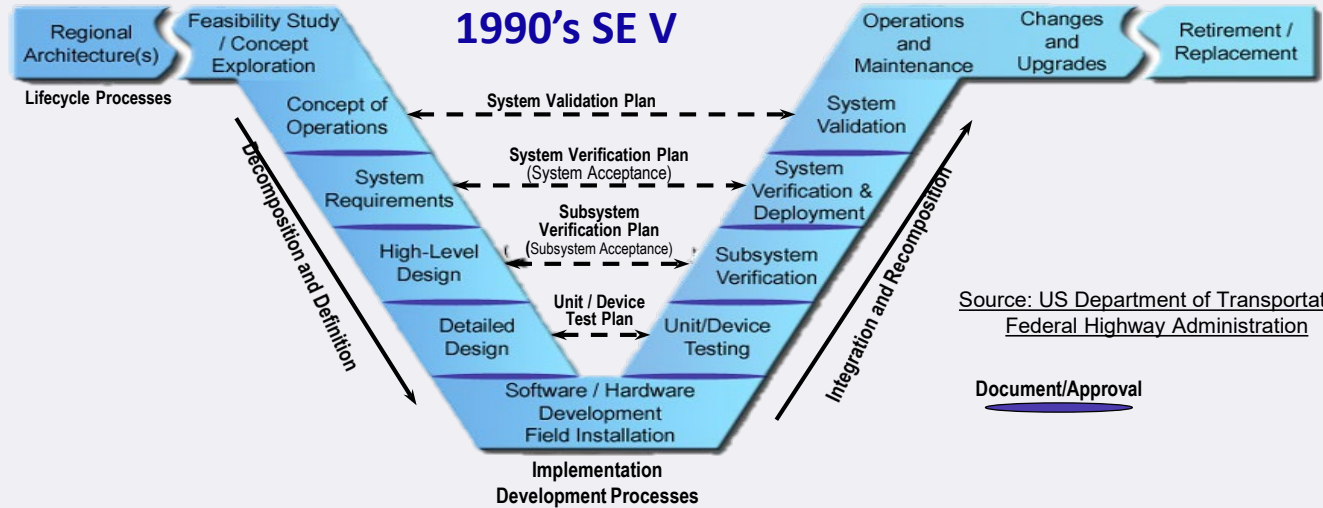
Full diagram originally drawn by John Boyd for his briefings on military strategy, fighter pilot strategy, etc



Toward a Model-Based Enterprise (MBE)

Digital Engineering in context

Leveraging developing cross-Industry alignment toward a common Model-Based Enterprise framework & taxonomy





Industry Value Driven
Alignment:

Focus on Value ... not
on Digital

Leveraging Industry
Position Papers to move
toward alignment on
definitions & value first
... then move forward on
realization together.

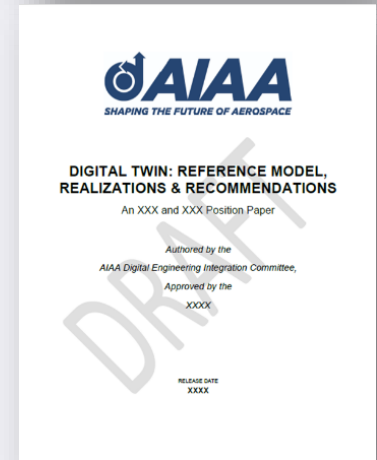
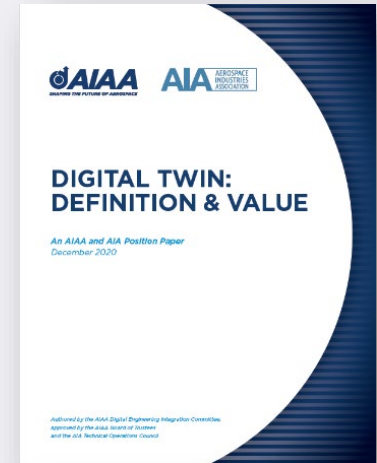
AIAA / AIA Digital Twin Position Papers

First AIAA/AIA endorsed Position Paper on Digital Twin Definition & Value

<https://www.aia-aerospace.org/report/digital-twin-paper/>
<https://www.aiaa.org/advocacy/Policy-Papers/Institute-Position-Papers>

Digital Twin: Reference Model, Realizations & Recommendations Paper

Release expected imminently (i.e. Fall 2022)
Endorsed across AIAA, AIA, NAFEMS & INCOSE

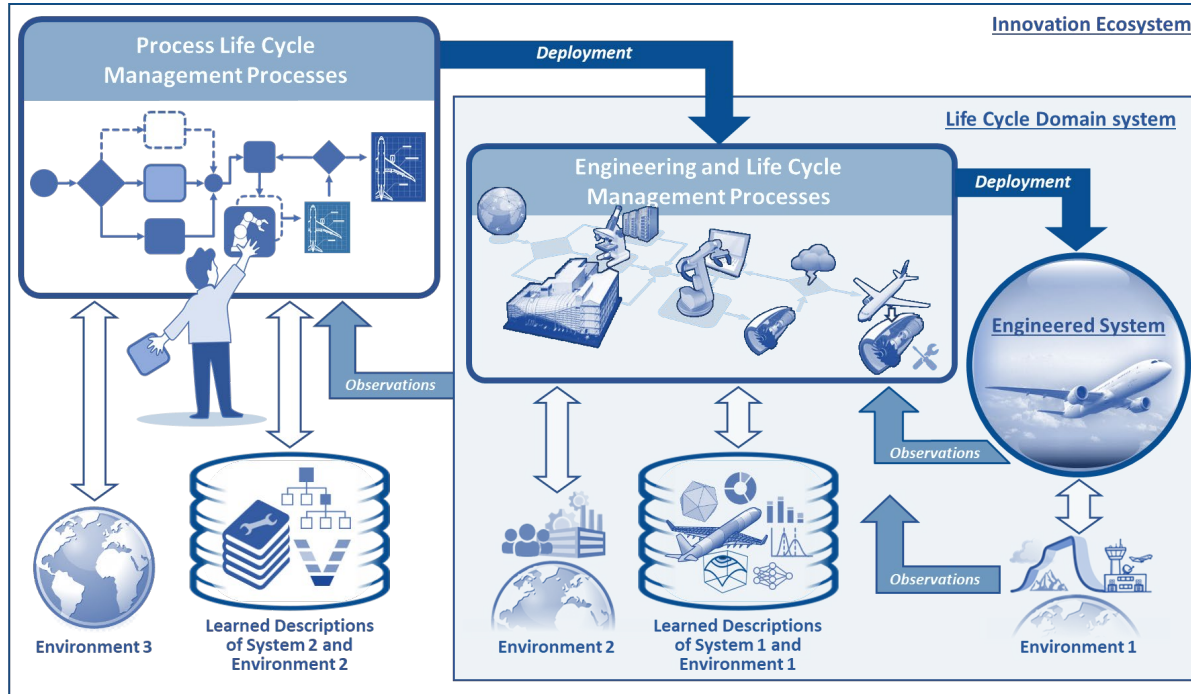


Digital Twin Implementation Paper - Contributing Authors

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The Digital Twin Implementation Paper is the result of a joint effort from a number of organizations representative of academia, industry and government including: AIAA, AIA, NAFEMS, INCOSE and the OMG Digital Twin Consortium

Generic Reference Model / Pattern Overview



Agile Systems Engineering Life Cycle Management (ASELCM) Logical Architecture – Level 0

Reference: Schindel, W. D. (2022). Realizing the Value Promise of Digital Engineering: Planning, Implementing, and Evolving the Ecosystem. *INSIGHT*, 25(1), 42-49.
 Reference: "Report on the AIAA DEIC Digital Thread Position Paper: Digital Thread Subcommittee", AIAA Aviation Forum, Chicago, 30 June 2022

Selected Digital Twins Case Studies

Realization Case Studies

1. Cygnus Orbital Ferry Vehicle Twin (Northrop Grumman)
2. Aurora D8 Airliner Advanced Composite Twin (NASA)
3. Rotorcraft Component Twin (Vanderbilt University)
4. Manufacturing Twin Family (Raytheon Technologies / STEP Tools, Inc)
5. Airplane Seat Certification Twin (The Boeing Company)
6. Building Twin (Georgia Tech)
7. Digital Ghost – Cybersecurity for critical assets leveraging Digital Twins (GE Research)
8. Iron Bird Digital Twin (Turkish Aerospace Industries, Inc)

Use Case attributes & intent:

- Open & Non-proprietary
- Stay aligned to Position Paper
- Pervasively relevant & prioritized by multiple Orgs to get “Aerospace Voice”
- Demonstrate vertical alignment (cross supply chain/system) & horizontal alignment (across life cycle) for Space, Air and Ground Use Cases
- Case Studies/Use Cases will be a select subset configured from the much larger Digital Twin reference/pattern model

Papers anchored in actual realizations

Industry Recommendations - Methodology

- Adopt a **methodology** that ...
 1. Requires enterprise level ***systems engineering***
 - **Managing change** across enterprise functional silos and life cycle stages
 - **Representing the enterprise system** in an integrated way
 2. Aligns with ***related enterprise efforts***
 - **Leverage many programs of change** across Aerospace Industry
 - **Promote complement, not compete** where possible
 3. Manages ***'trust' over time***
 - **Understand level of model trust** for the decision being informed
 - **Conscious management of Digital Twin credibility** as model of a real system
 4. Pursues on-going ***multi-level group learning***
 - **Leverage Digital Twins as "learning"** of the real-world systems they describe
 - **Realize learning occurs at all levels** of a system of systems

Industry Recommendations – Future Steps

- Create/leverage **Aerospace Digital Transformation Consortia**
 1. **Tactical:** Provide focus
 - Define & launch appropriately **scoped pathfinders** (e.g. JADC2, CBM+, LCAAT)
 - Accelerate adoption of **digital inspection** across supply chain & life cycle
 2. **Strategic:** Ensure scalability
 - Realize **consistency management** for digital engineering
 - Establish **trust** in models and use of models
 - Promote digital **standardization**
 3. **Marketing:** Promote awareness
 - Facilitate cross consortium **collaboration**
 - Benchmark and publicize **benefits**
 4. **Political:** influence policy & regulation
 - Inform creation of smart **policy & regulation**
 - Facilitate realization of **digital airworthiness certification**
 5. **Education:** Inform workforce development
 - Focus **tools and methods** development
 - Establish digital **maturity model and assessments**
 - Leverage **competitions & grand challenges**

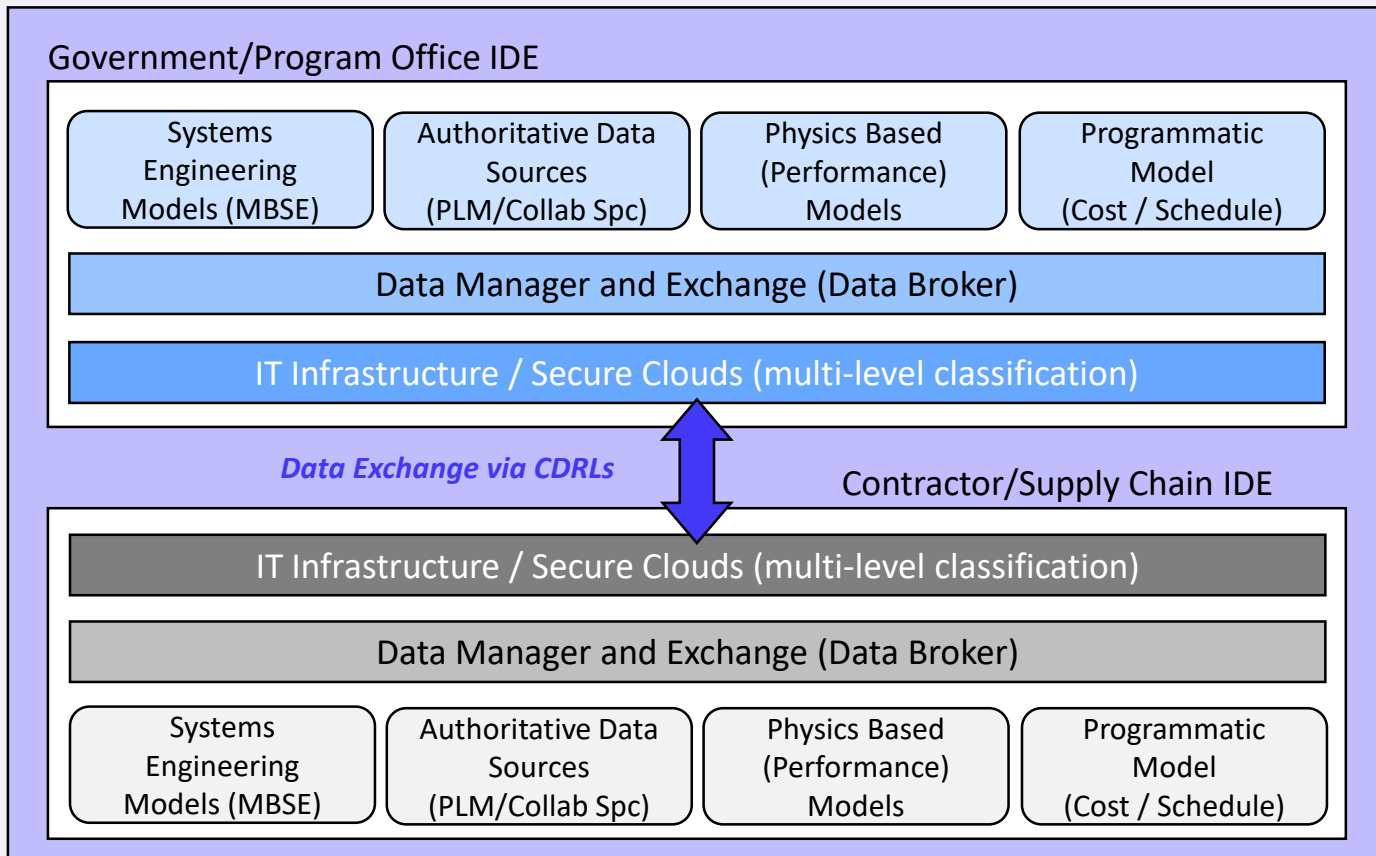


Integrated Digital Environment (IDE)

Our New Digital Collaboration Reality

Secure cloud enables increased collaboration across lifecycle and across supply chain

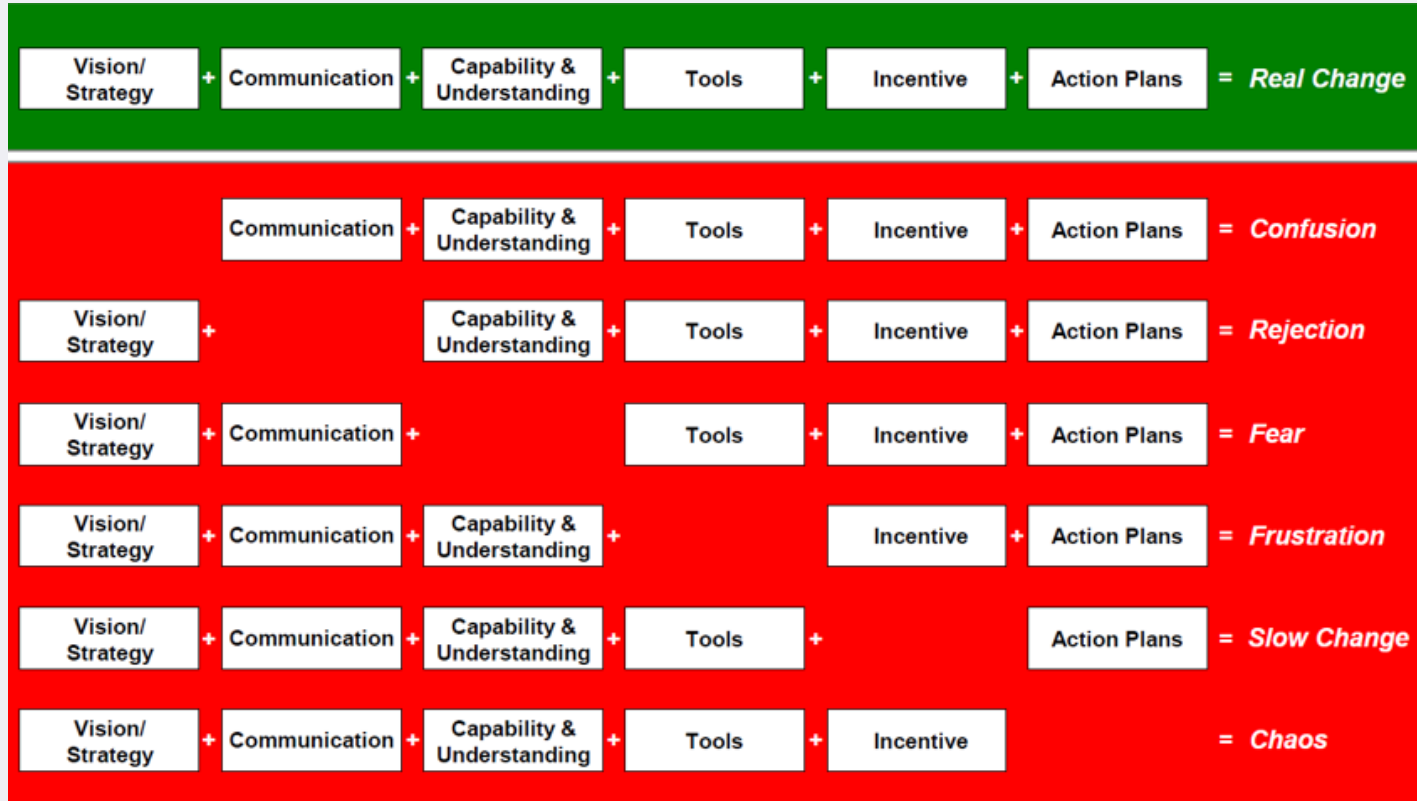
Collaboration must respect **Security, Export and Intellectual Property**





Elements required for real change

Respecting Cultural Realities When Driving Change



Courtesy Bob Bucci
2018 Lincoln Award Winner
ASIP Conference

<http://www.asipcon.com/pages/lincoln2018.html>



Summary

To accelerate value realization from Digital Engineering together we must:

- Focus on value (not digital)
- Consider Operations (not only Technology)
- Pursue collaboration (vs silos)
- Learn by doing (vs discussing)
- Leverage reference model(s) (vs one-off projects)
- Realize standardization (vs immature standards)
- Establish trust (in models, environments & teams)
- Respect Culture, Intellectual Property & Security

