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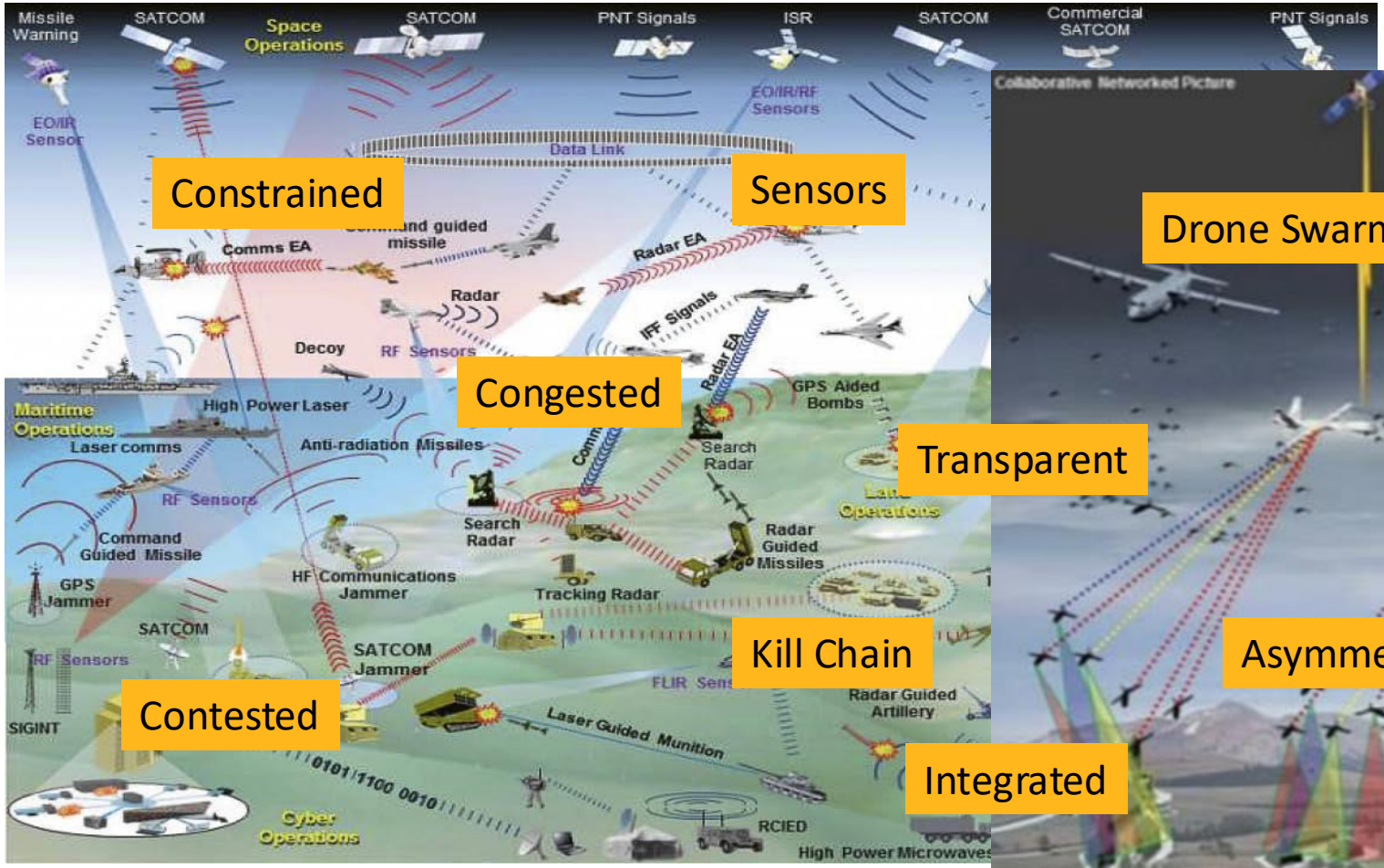
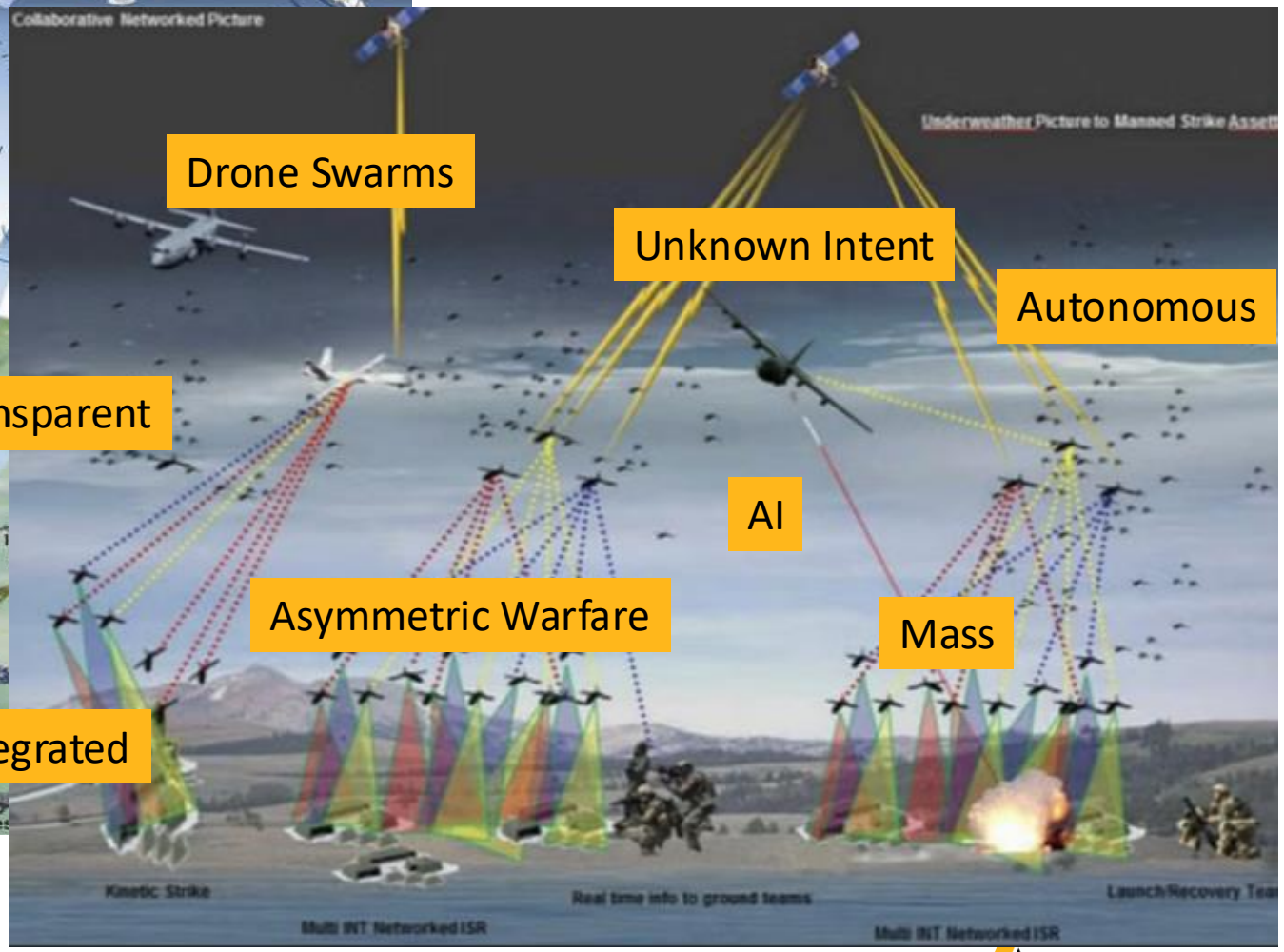
How to Accelerate Next Generation Products by Leveraging Digital Mission Engineering and Model-Based Systems Engineering Methodologies

Stockholm, FT 2025 Oct 14th 2025

The Future Battlefield is Now!





Constrained

Sensors

Drone Swarms

Unknown Intent

Autonomous

Congested

Transparent

AI

Asymmetric Warfare

Mass

Kill Chain

Contested

Integrated

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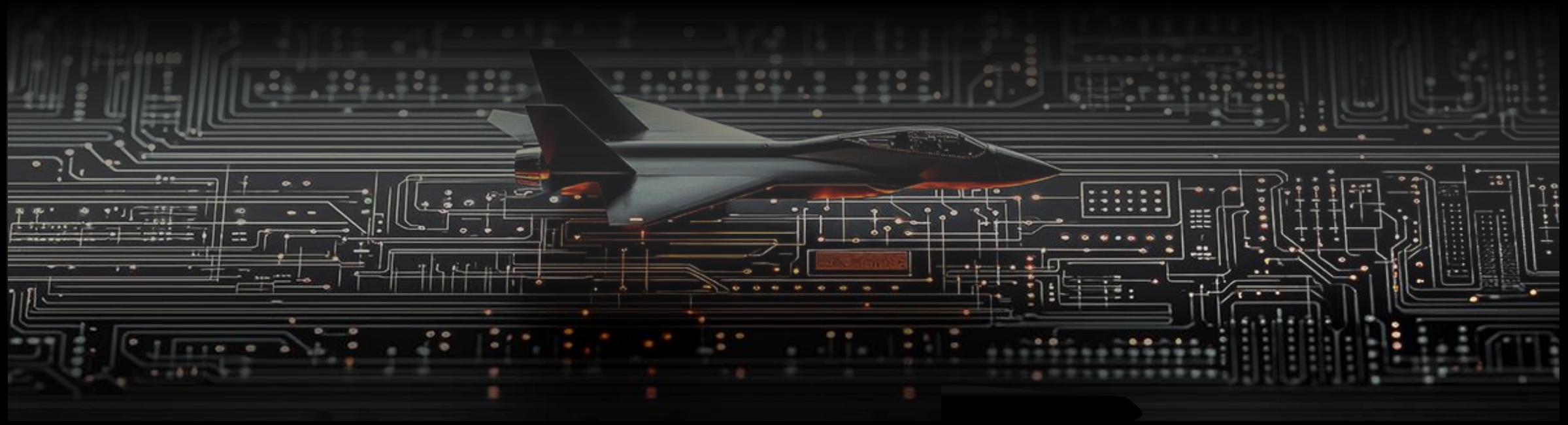

TECHNOLOGY IS RAPIDLY ADVANCING

SYSTEMS ARE INCREASING IN COMPLEXITY

DEMAND FOR INNOVATION & AGILITY

DYNAMIC CONSEQUENCES OF COST, SCHEDULE, AND RISK

Paradigm Shift in Defense: The Pursuit of Systems Over Platforms

"Built to Last"

- Expensive, exquisite platforms based on today's requirements
- Not built to address future unknowns

"Built to Adapt"

- Common systems, architecture, and standards
- System-of-systems
- Rapidly field both large and small-quantities of platforms
- Easily integrate new sub-systems

"Collective Agility"

- Requires ability to pursue digital engineering maturity
- Pursuit of virtualization
- Rate of innovation far outpacing scale of adoption

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Adm. Sir Ben Key, First Sea Lord and Chief of Naval Staff of the U.K.'s Royal Navy

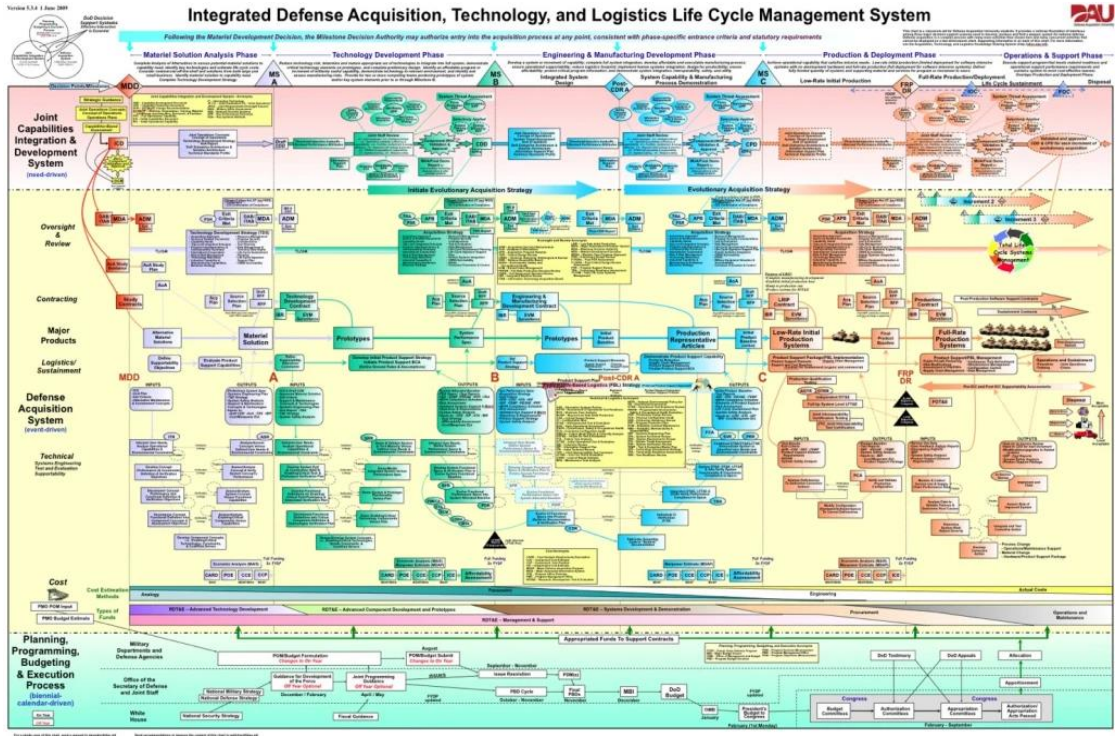
"We're living through kind of one of those moments of really significant change in the way we have to think about the application of power at sea, or maritime power," - Nov 2024

French Navy Chief of Staff Adm. Nicolas Vaujour

"We have to build adaptable by design, … You must build the ship to be adaptable during 40 years, which is quite tricky. If you stay with your old doctrine, you will be dead very rapidly … What we saw in the Red Sea is that we have to adapt very quickly our system." - Nov 2024

The Imperative for Digital Engineering in Defense Acquisition

Integrated Defense Acquisition, Technology, and Logistics Life Cycle Management System



Speed up this complex acquisition process with Digital Engineering

- **Speed, Cost, Capability, Capacity** Paradigm shifts are mandatory
- The commercial technology exists to make Digital Engineering real
- **Defense Industrial Base** must accelerate
- Dec 2023 -- DoDI 5000.97 mandates DE/DME

Digital Engineering Goal	Speed, Agility & de-risk
Digital Transformation Challenge	Implement @ scale

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Department of Defense System-Level Digital Connectivity

Key Elements

- **Digital Artifacts**
  - Specifications, technical drawings etc.
- **Digital Thread**
  - Design and cost trades
  - Integration of components, system & system definitions
  - Product/ operational support
- **Digital Models**
  - Functional models | Physics, human interaction, business processes
- **Digital Twins**
  - A computational representative systems model that serves as the R-T digital counterpart of a physical system or process

DoD Instruction 5000.97

Digital Engineering

Originating Component: Office of the Under Secretary of Defense for Research and Engineering

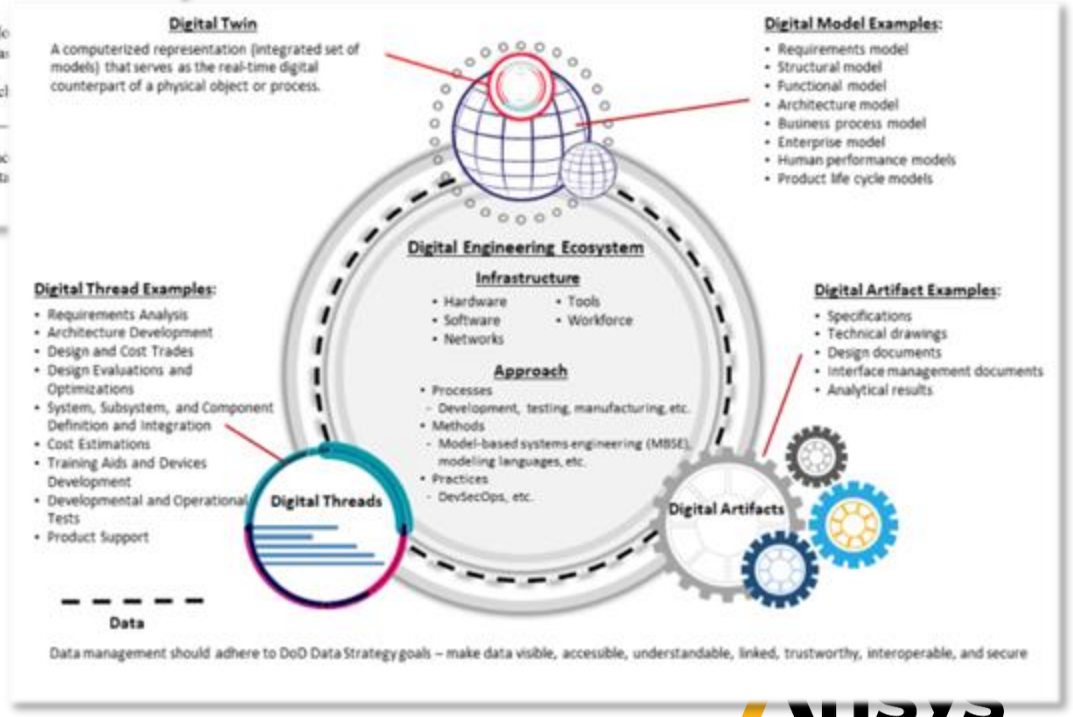
Effective: December 21, 2023

Releasability: Cleared for public release. Available on the Directives Division Website at https://www.esd.whs.mil/DD/.

Incorporates and Cancels: Department of Defense Directive 5000.59, "DoD Mo Simulation (M&S) Management," August 8, 2007, a

Approved by: Heidi Shyu, Under Secretary of Defense for Research

Purpose: In accordance with the authority in DoD Directive 5137.02, this issuanc assigns responsibilities, and provides procedures for implementing and using digita development and sustainment of defense systems.



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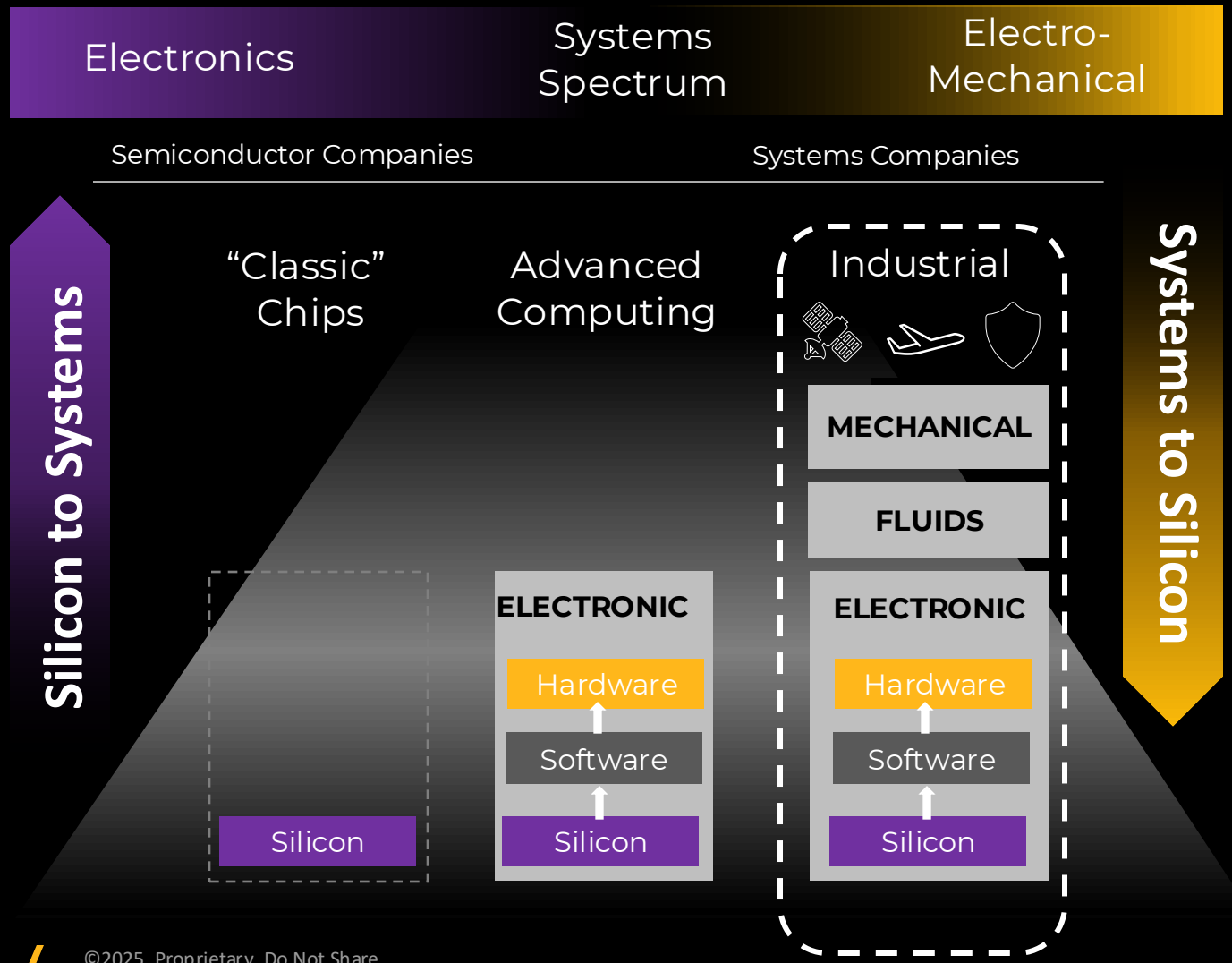
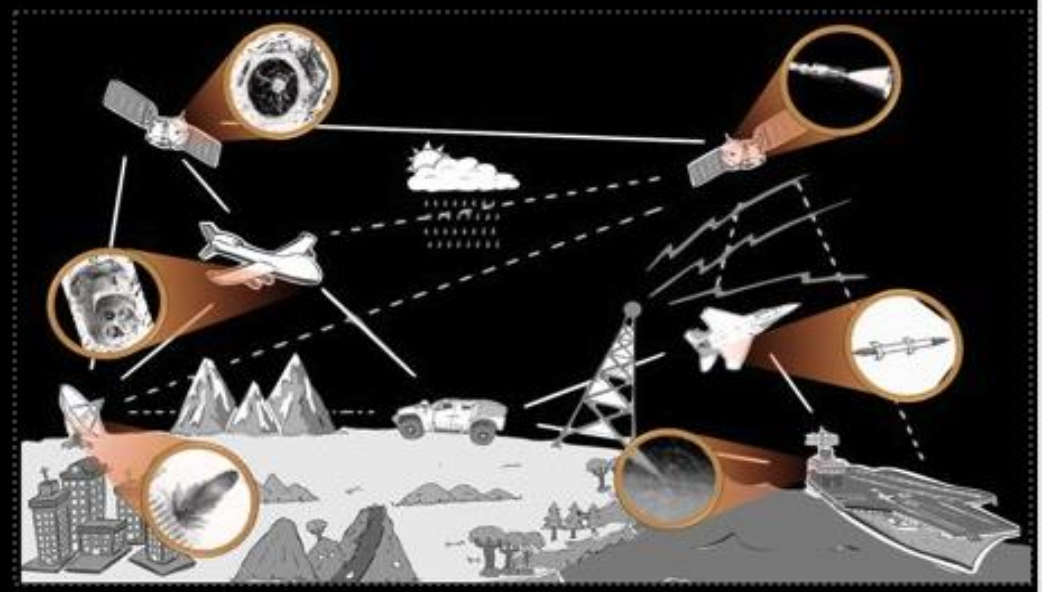
From Silicon to System: Navigating the Complexity of Aerospace & Defense

Where chip-level decisions now define mission-level performance





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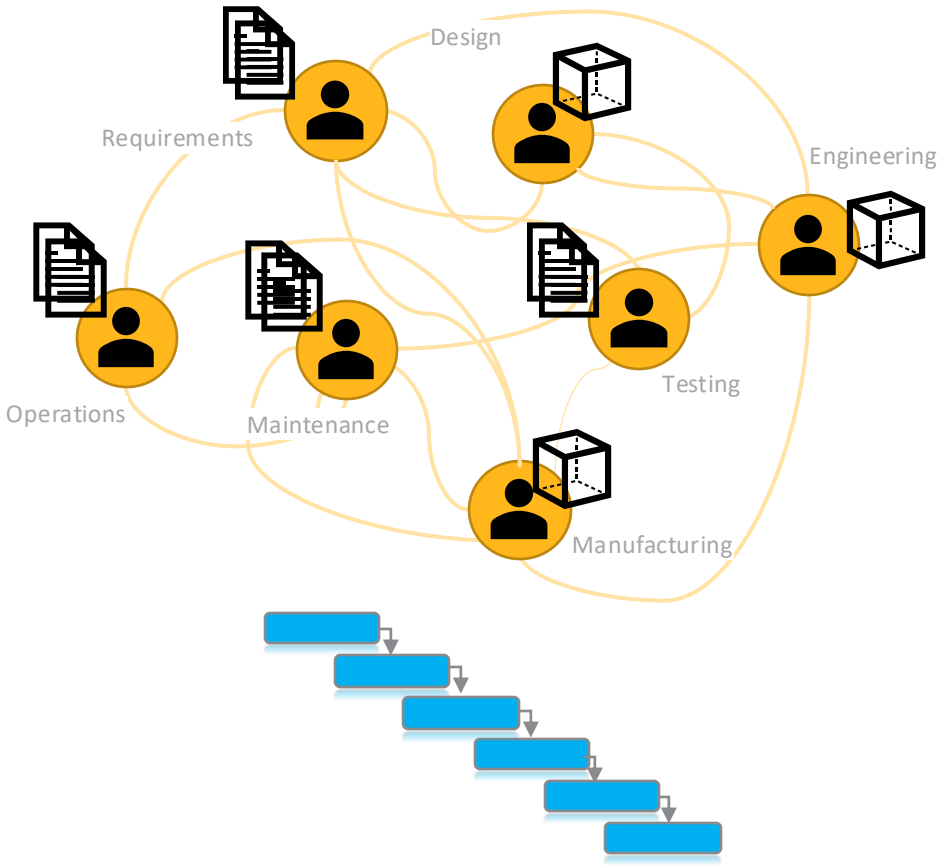
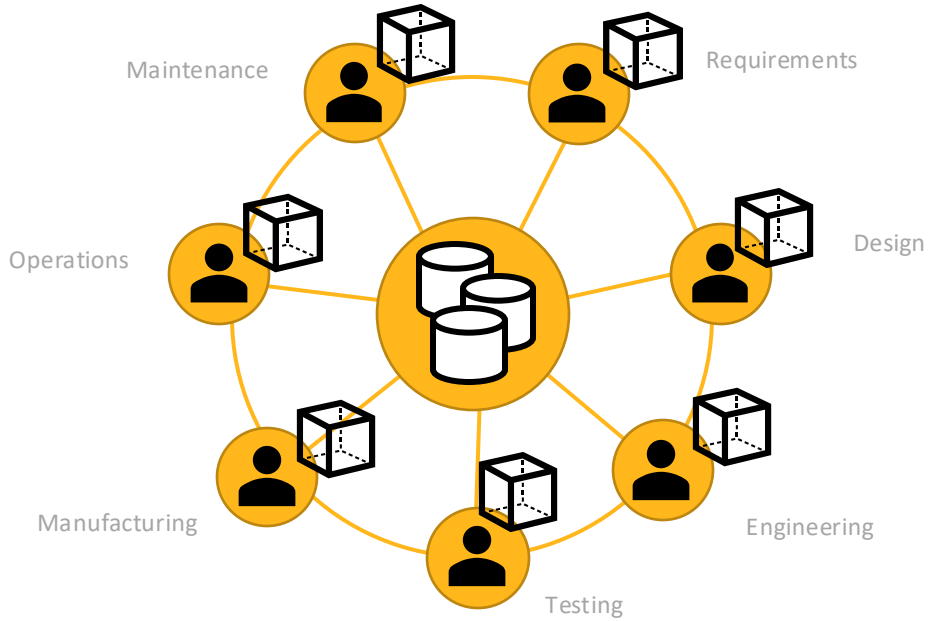
Shift from Traditional Engineering to Digital Engineering

Current State



- Model-based
- Collaborative
- Agile
- Connected
- Traceable:
  - Right Information
  - Right Time
  - Right Format
- Dev(Sec)Ops

Future State



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Current State of Digital Engineering

People

Deep domain expertise

- Structures
- Fluids
- Materials
- Electronics
- Optics

Challenges

- Silos of knowledge
- Context behind design changes lacking or missing

Technology

Hundreds of tools generating data:

- COTS
- GOTS
- MOTS
- In-house

Challenges

- Explosion of data and ad hoc storage
- Proprietary tools that prevent integration

Processes

- Collaboration
- Project Management
- Governance
- Democratization

Challenges

- Disruptions, delays, and failures due to vendor lock
- No standard architecture to implement digital engineering

Outcome

- Not layering into existing enterprise, IT, and cybersecurity
- Attempting to replace expertise instead of empowering engineers
- Not engaging key aspects of the organization
- Pursuing in the absence of increasing win rates or increased efficiencies

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Common Traits of Successful Digital Transformation Initiatives

Open Ecosystem

Access to new, innovative commercial capabilities and expertise to compound the value of digital engineering

Benefits

- Maximum interoperability
- Grows and evolves with your technology
- Open development community within and outside the enterprise

Mission-Centric

Evaluating mission performance to inform every decision of consequence

Benefits

- Understanding how components, subsystems, and systems will perform in the operational environment

Connected Digital Thread

Intelligent and open framework that enhances, extends, and amplifies the value of digital engineering

Benefits

- Full life-cycle traceability
- Variable fidelity within a shared environment
- Force multiply expertise across the enterprise

Benefits

- Improve odds and confidence in program capture
- Reduce risks and timelines with streamlined design, engineering, and continuous testing
- Validate requirements immediately
- Transition to operations rapidly
- Get better and faster portfolio investment insights

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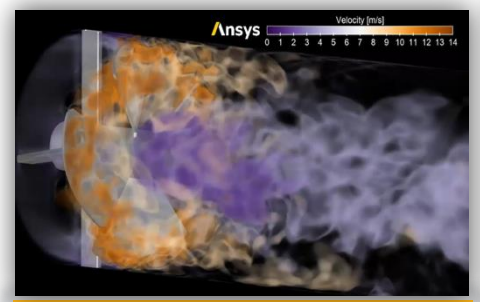
Accelerating Engineering | ”Tailwind” Technologies & Ansys Investments

CORE PHYSICS NUMERICAL METHODS AND MODELS



- *Solver methods*
- *Geometry and meshing*
- *Shape and topology optimization*
- *Advanced analysis*
- *Multi-physics*
- *Multi-scale*

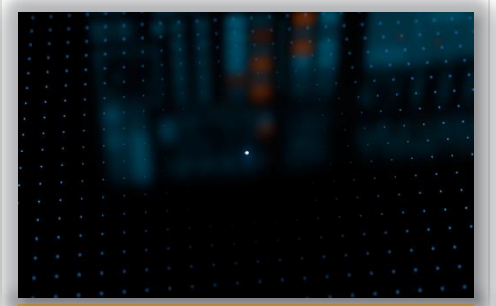
HIGH-PERFORMANCE COMPUTING

- *Shared-memory*
- *Message-passing*
- *Fine-grained GPUs*
- *New architectures: FPGAs & AI hardware*
- *Quantum computing*

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

- *Solver acceleration*
- *Solver settings*
- *Top-down methods*
- *Bottom-up methods*
- *Reduced order models*
- *Generative AI*

CLOUD, PLATFORM, AND USER EXPERIENCE



- *Cloud Enabled*
- *Cloud Native*
- *Platform, Collaboration*
- *Open APIs and developer ecosystem*
- *Common user experience*
- *IoT Sensor connectivity & enablement*

DIGITAL ENGINEERING

- *Model Based System Eng.*
- *Requirements & architecture Connections*
- *Safety, security, & software*
- *Digital twins*
- *Simulation process & data management*
- *Mission engineering*

Five digital engineering hyperscalers – compressing maturity times and enabling digitally paced global collaboration …

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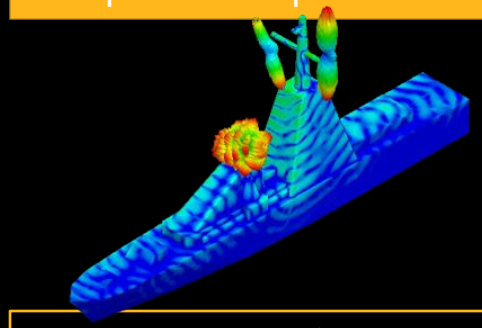
Addressing Defense Challenges

Interoperability of Systems

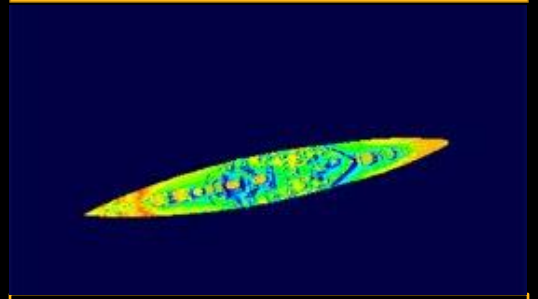
- Multi Domains
- Multi Systems
- Multi Threats

Spectrum Operations



- Electronic Warfare
- Communications & Radar
- Tracking Systems

Survivability & Detectability



- Shock & Blast
- Signatures & Search/Track
- Cybersecurity

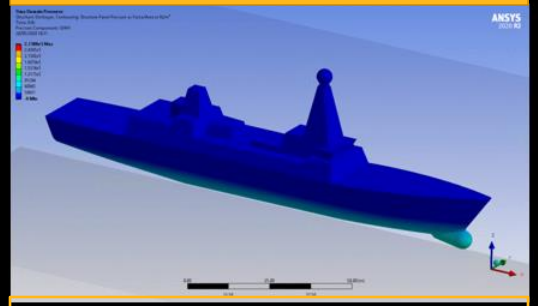
Lethality & Weapons

- Directed Energy
- Very high speed re-entry
- Weapons Systems

Autonomous Drones & AI

- Underwater Vehicles
- Surface Vehicles
- AI based systems training

Mobility & Capability

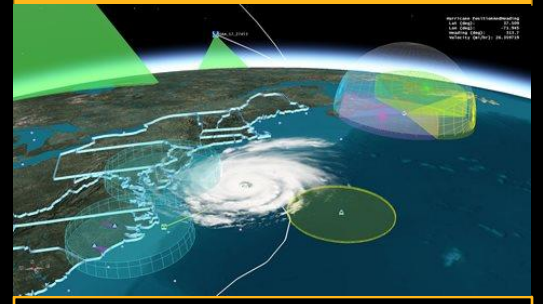


- Power & Propulsion
- Hydrodynamics
- Deck Operations

Availability

- Digital Twin
- Additive Manufacturing
- Predictive Maintenance

Space Operations



- Telecommunication
- Awareness
- Highspeed re-entry

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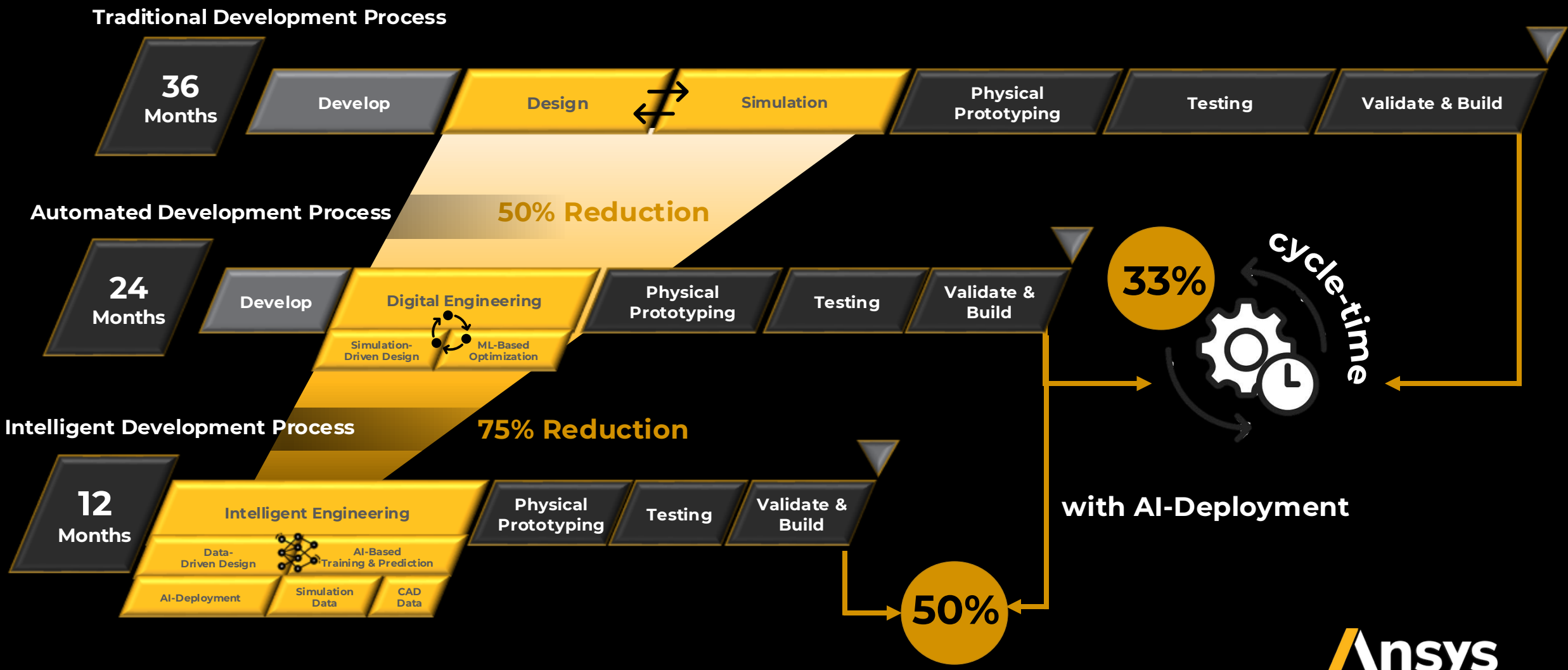
Accelerating Development Timelines



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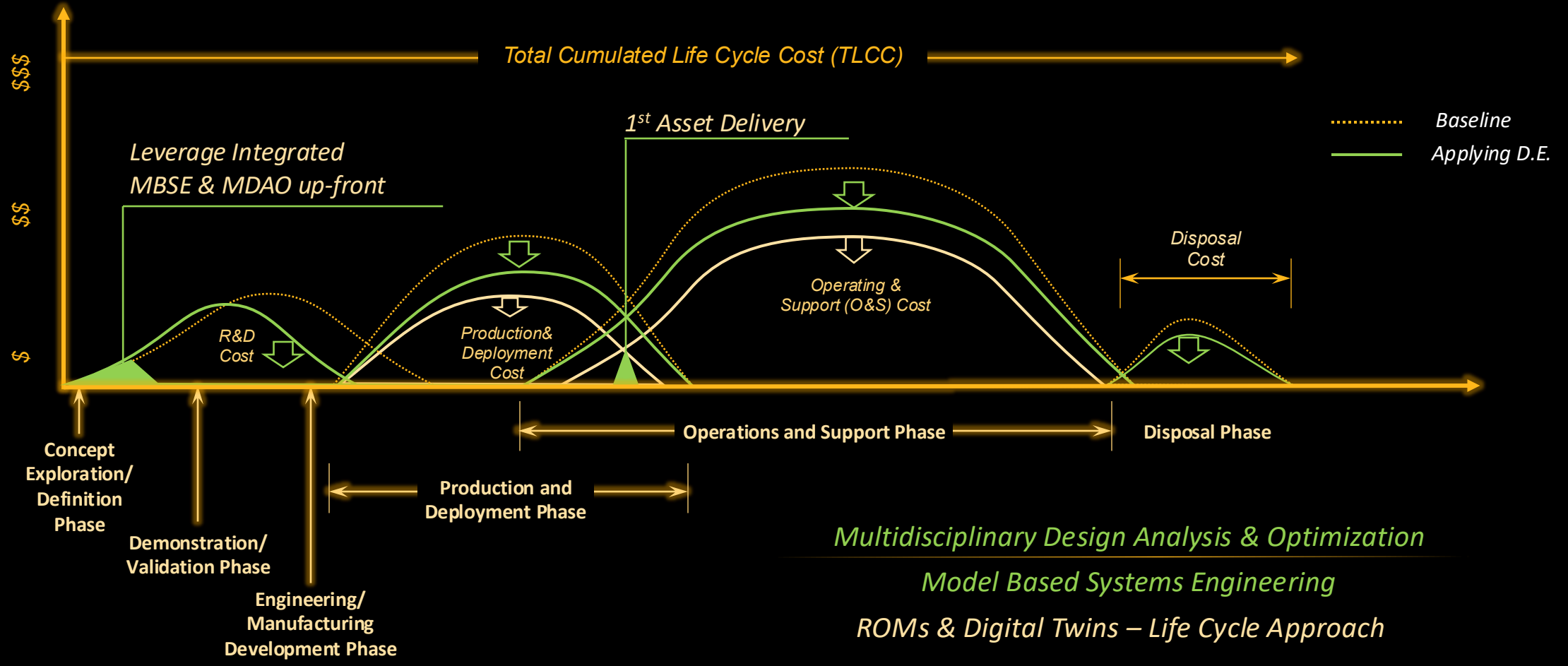
Life Cycle Value Creation | Strategic Methodologies MDAO to MBSE

OEMs realize larger (ROI) throughout the product life-cycle – extended to ROMs for Digital Twins



Multidisciplinary Design Analysis & Optimization

Model Based Systems Engineering

ROMs & Digital Twins – Life Cycle Approach

Applying digital engineering methodologies will deliver higher ROIs throughout the entire product's life's cycle …

Your Partner for Digital Engineering

DIGITAL TWIN
-link digital models to physical assets
-simulation-driven reduced order models

MISSION ENGINEERING
-model systems in a virtual environment
-test thousands of alternatives virtually

AI
-feed AI models with analysis
-AI-enabled optimization

MBSE
-link analysis to requirements
-develop simulation-driven trade study

HYPER-SCALER
-purpose built HPC for sim
-cloud-powered simulation

SPDM
-manage and reuse simulation data
-democratize simulation workflow

APPLICATIONS
-develop custom simulation apps
-integrate with Python

MATERIAL INTELLIGENCE
-input quality material properties
-build-in sustainability

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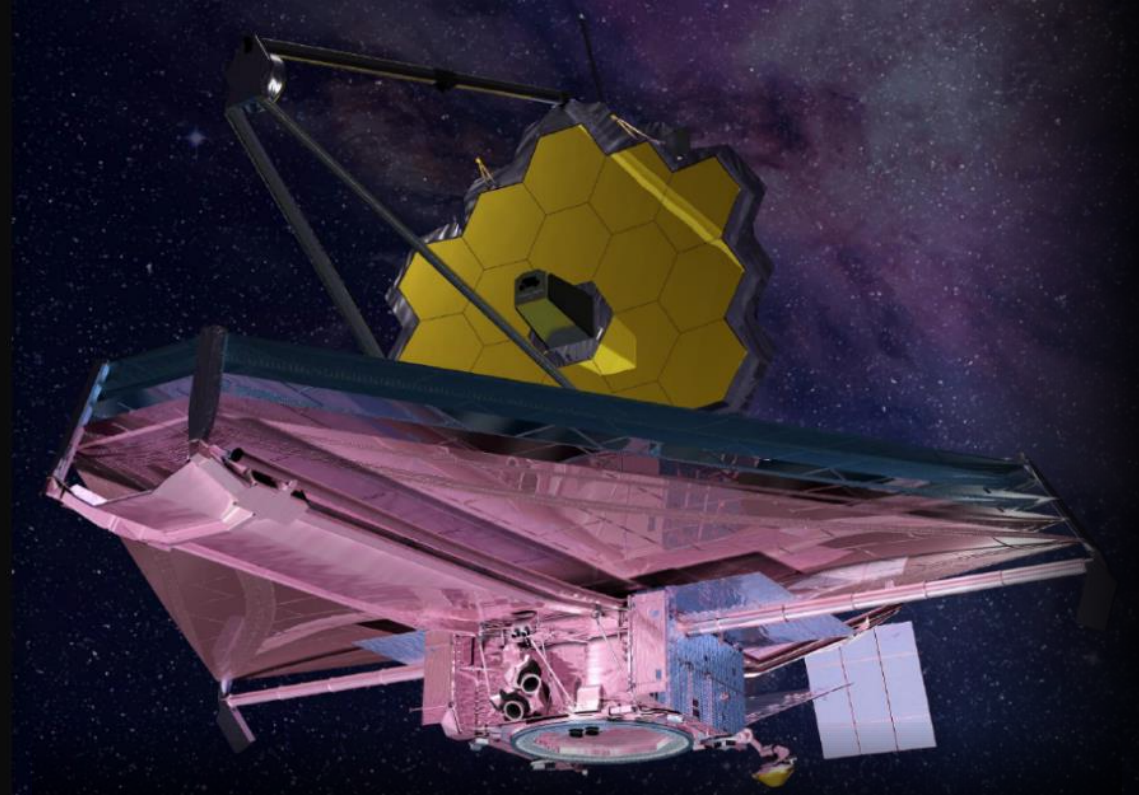
Full Life-Cycle Success

James Webb Space Telescope



Design Reference Mission

Digital engineering and digital thread

Perform virtual testing early and often

Validate models, test what you must, simulate the rest

Push validated models into operational decision tools

Mission · Structure · Optics · Thermal Evaluation
Orbit Determination · Operational Flight Dynamics

Image: Humanity's Last Glimpse of the James Webb Space Telescope (NASA)

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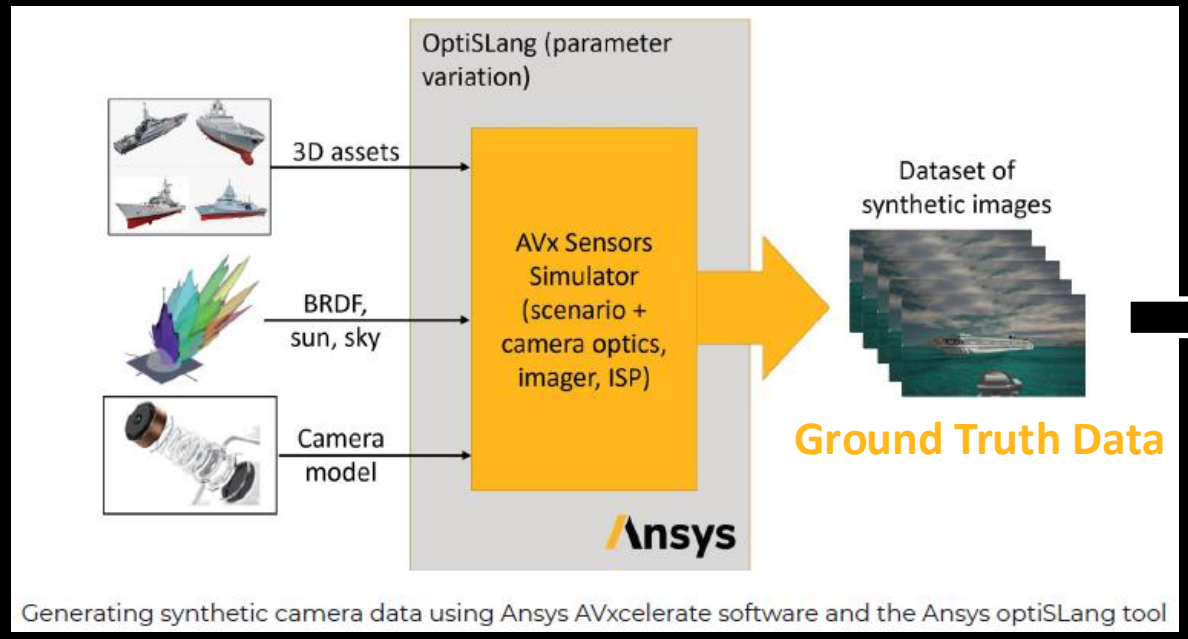
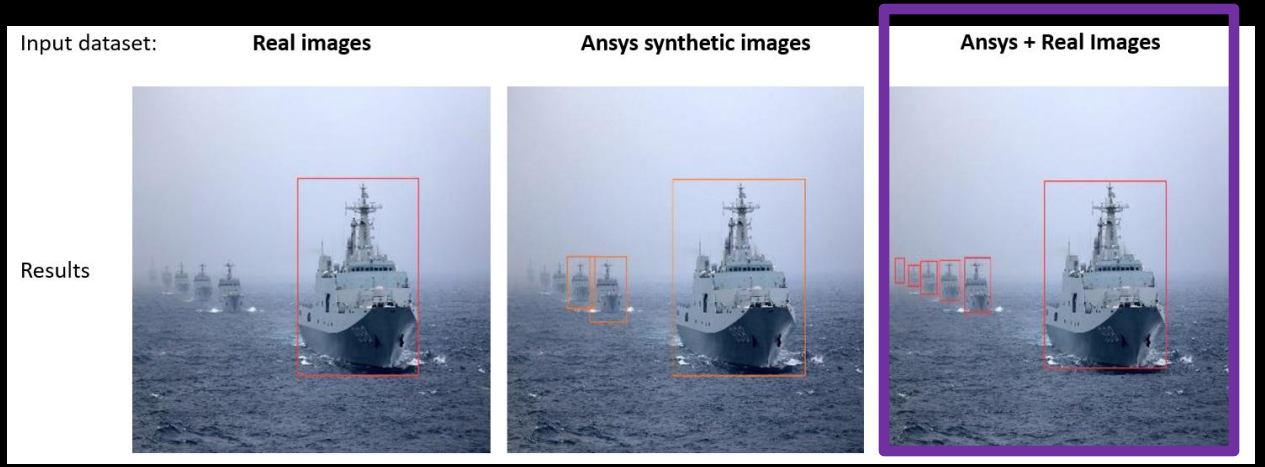
Improve Performance with Physics-Based Synthetic Data



Generating synthetic camera data using Ansys AVxcelerate software and the Ansys optiSLang tool

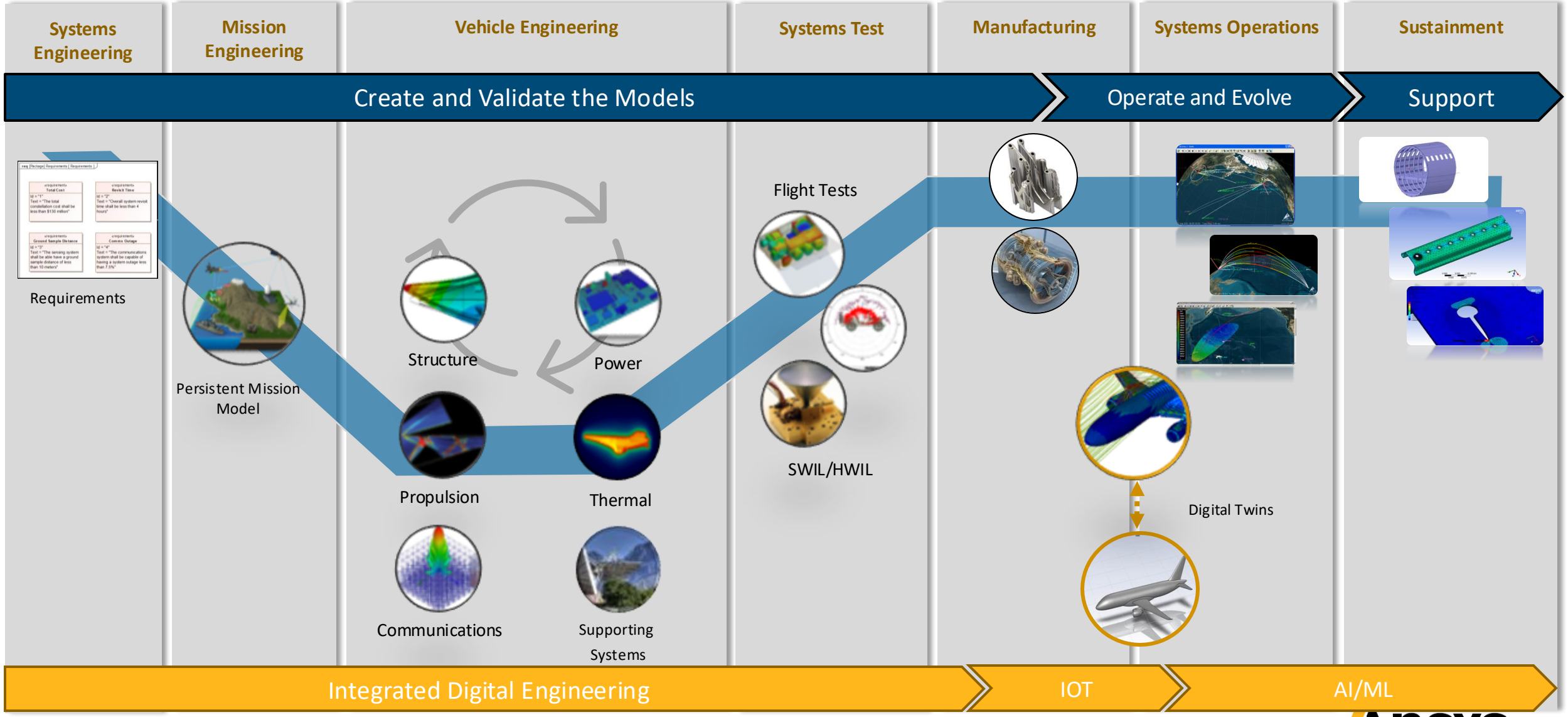
Higher-Quality Synthetic Data (significantly enhancing real data)

Better Detection Performance



Ansys Open Architecture Synthetic Data Framework provides higher-fidelity datasets to 3rd Party Supervised Learning Frameworks (Yolo, PyTorch, TensorFlow, etc.)

Accelerating Digital Product Engineering



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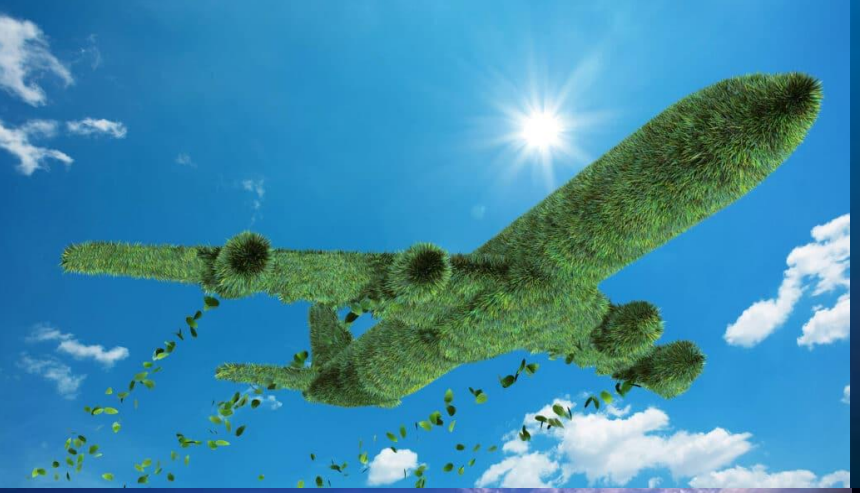
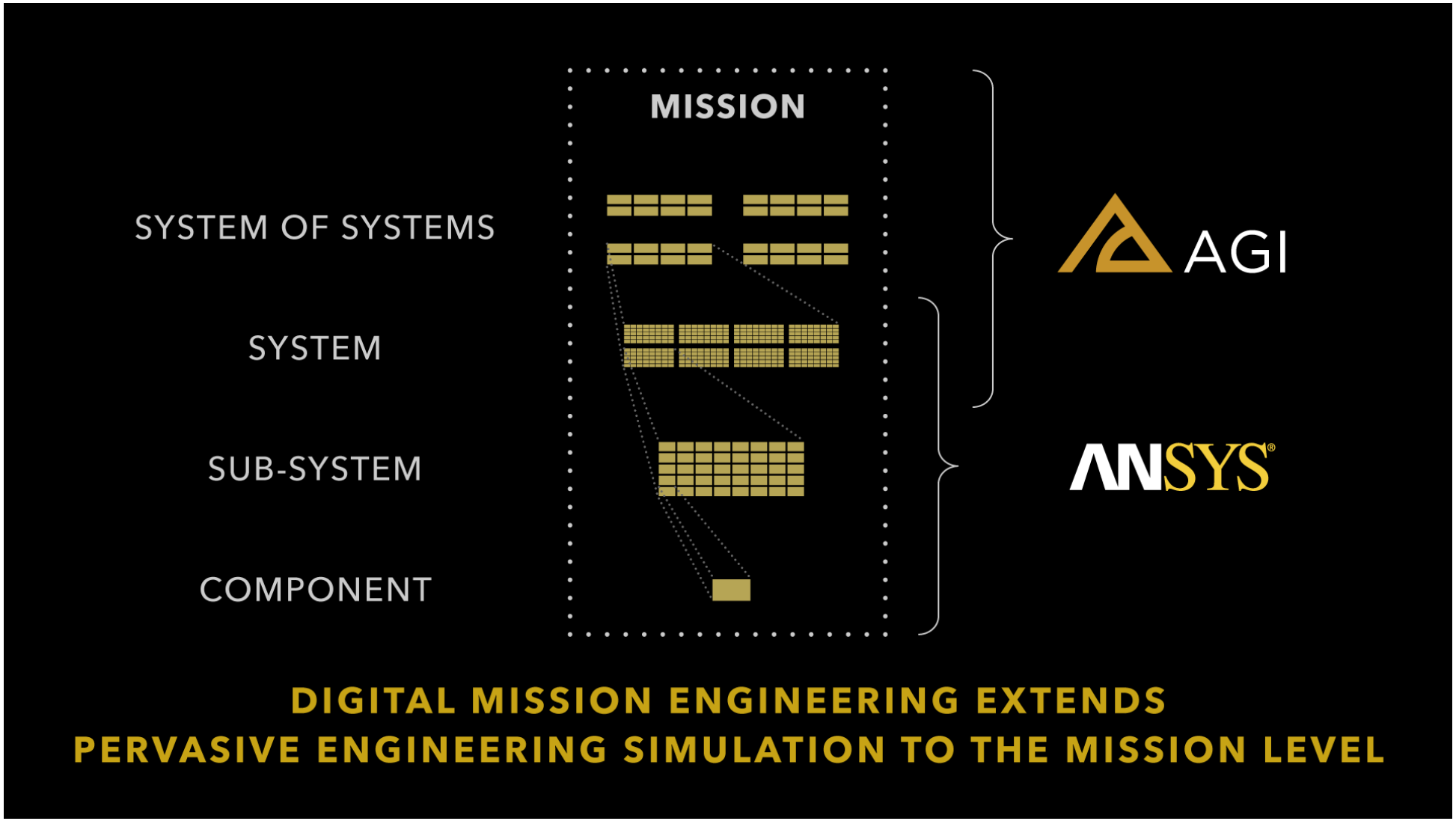



N2800M
BOOM
OVERTURE

Digital Mission Engineering Video



Thank You!