Extending digital engineering from the component to the mission level

GLOBAL PRODUCT DATA INTEROPERABILITY

SUMMIT 2019

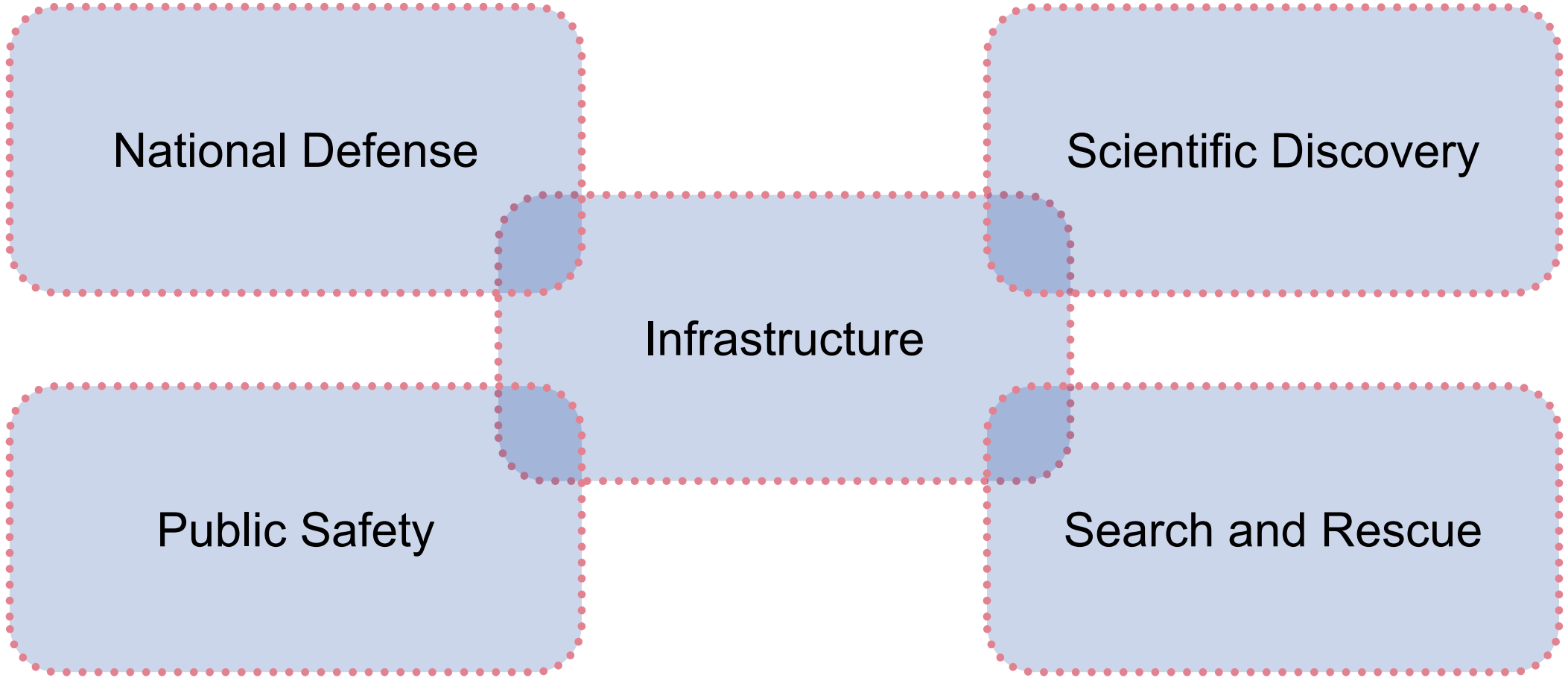
Extending digital engineering from the component to the mission level with digital mission engineering

Mission

Important assignment emphasizing:

- **Timeliness**
- **Performance quality**
- **Reliability**

Mission Areas



Mission Engineering

Planning, analyzing, organizing, and integrating capabilities to achieve desired mission objectives*

Mission Environment

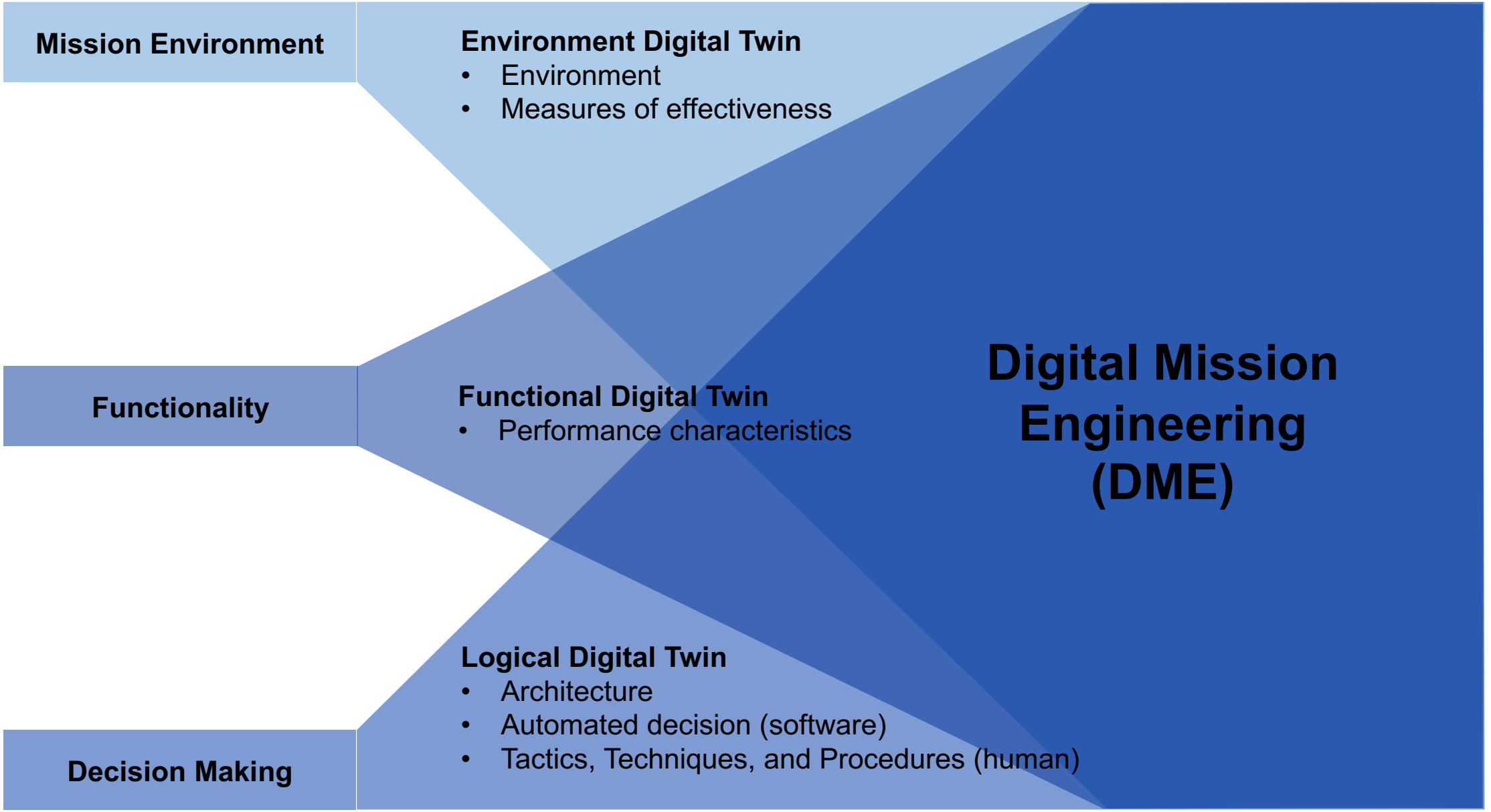
Environment Digital Twin
- Environment
- Measures of effectiveness

Functionality

Functional Digital Twin
- Performance characteristics

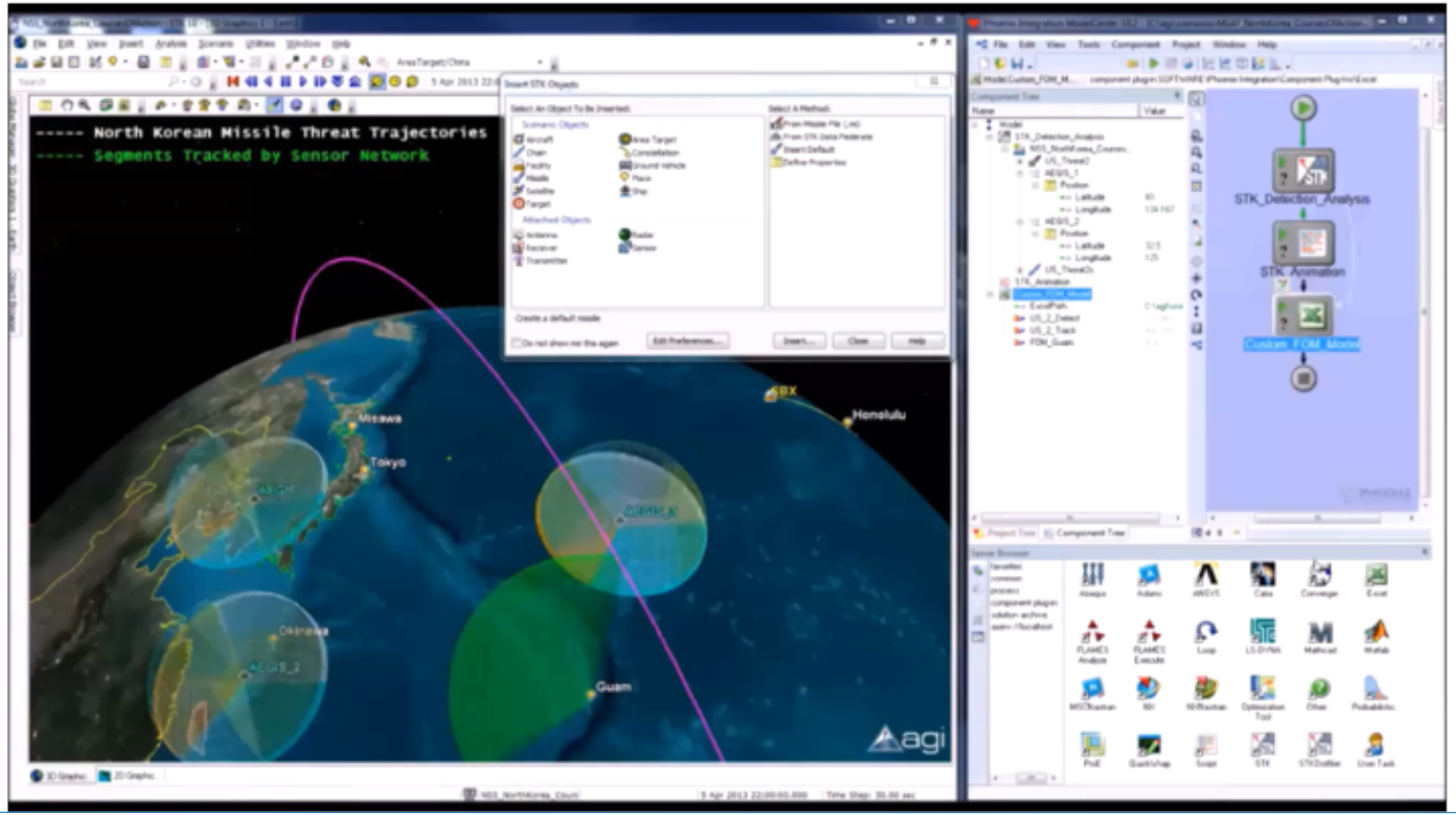
Decision Making

Logical Digital Twin
- Architecture
- Automated decision (software)
- Tactics, Techniques, and Procedures (human)

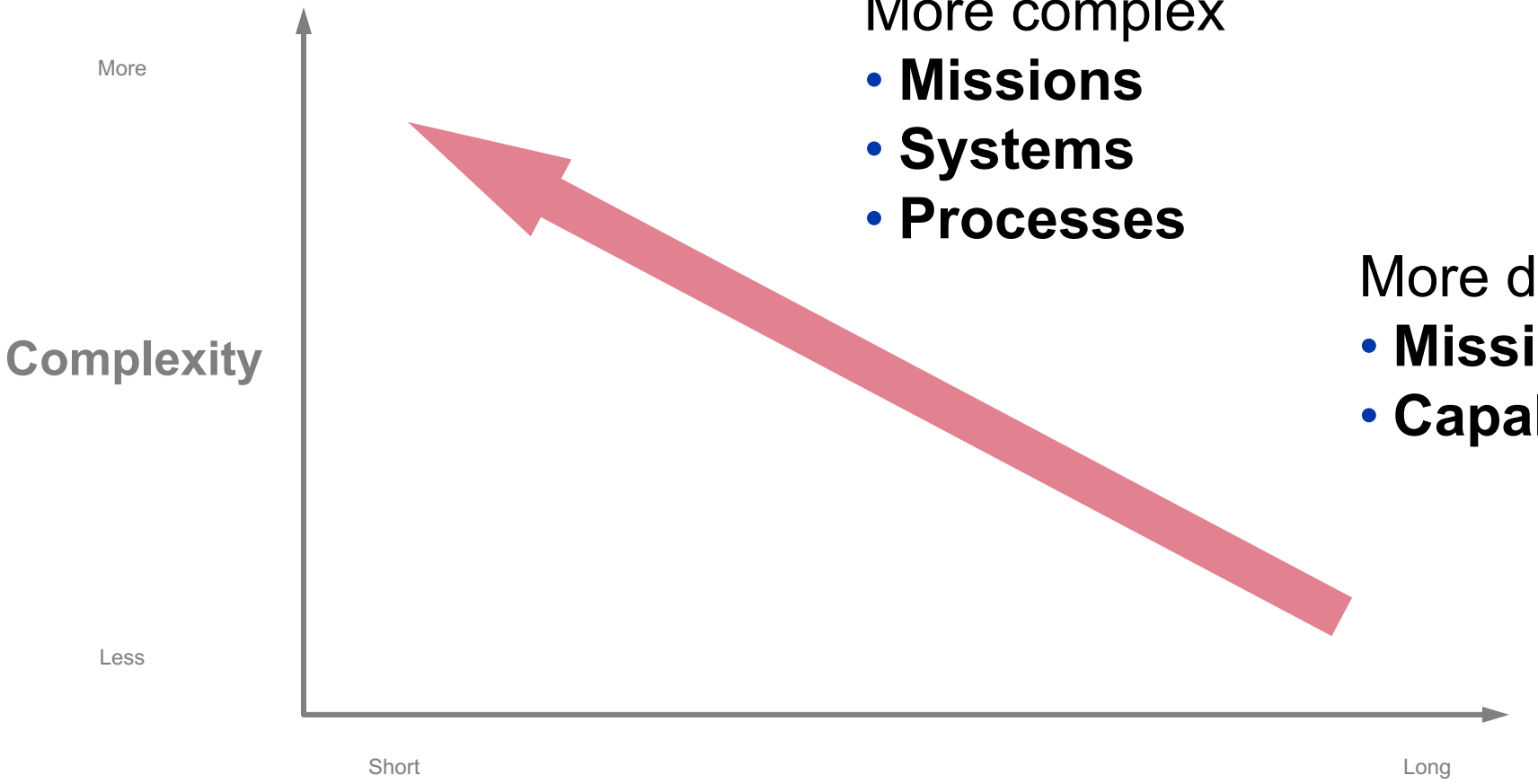

Mission Environment
Environment Digital Twin
• Environment
• Measures of effectiveness
Functionality
Functional Digital Twin
• Performance characteristics
Digital Mission Engineering (DME)
Logical Digital Twin
• Architecture
• Automated decision (software)
• Tactics, Techniques, and Procedures (human)
Decision Making

Multi-Domain Example

Global Product Data Interoperability Summit | **2019**



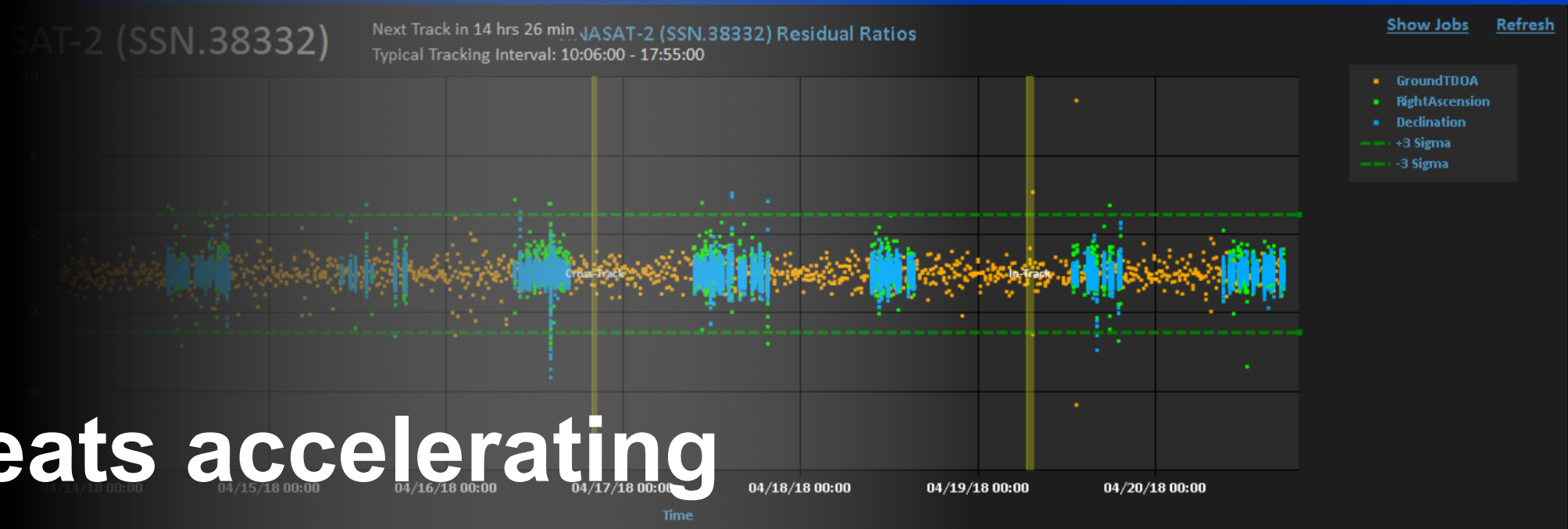
Why DME is Important Now



More complex
- **Missions**
- **Systems**
- **Processes**

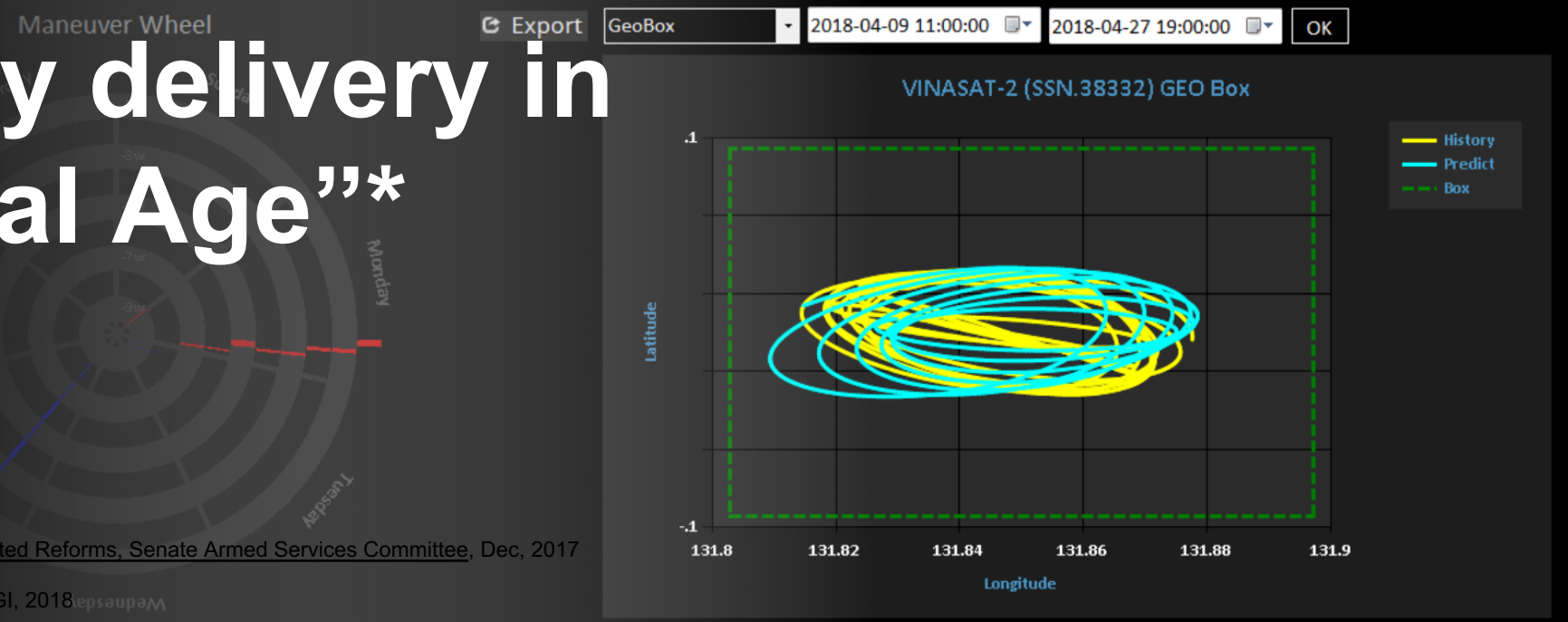
More demanding
- **Mission Definitions**
- **Capability Delivery**

National Defense



Threats accelerating

Capability delivery in "Industrial Age"*

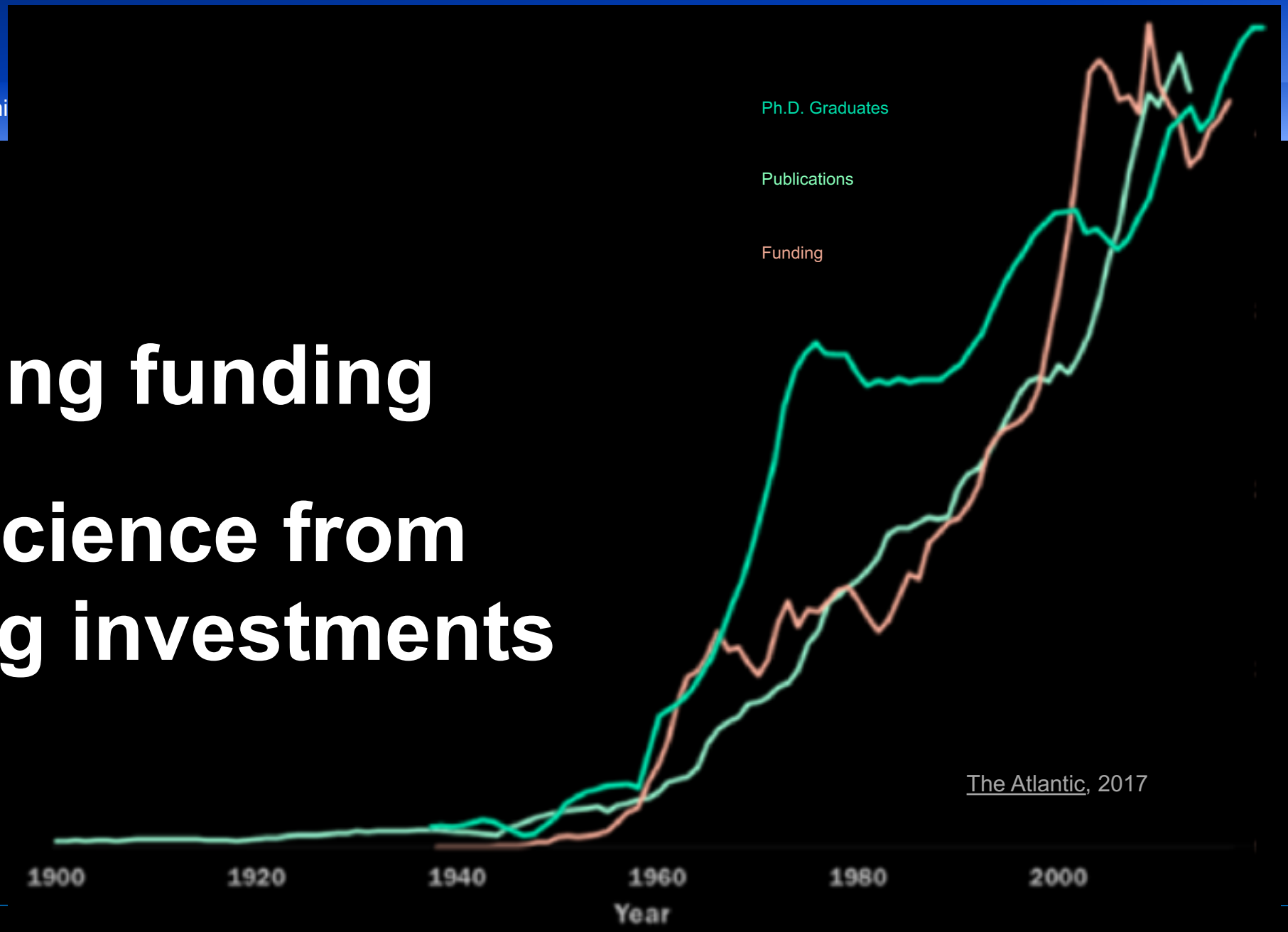


Enterprise and Associated Reforms, Senate Armed Services Committee, Dec, 2017

Threat OODA Loop," AGI, 2018

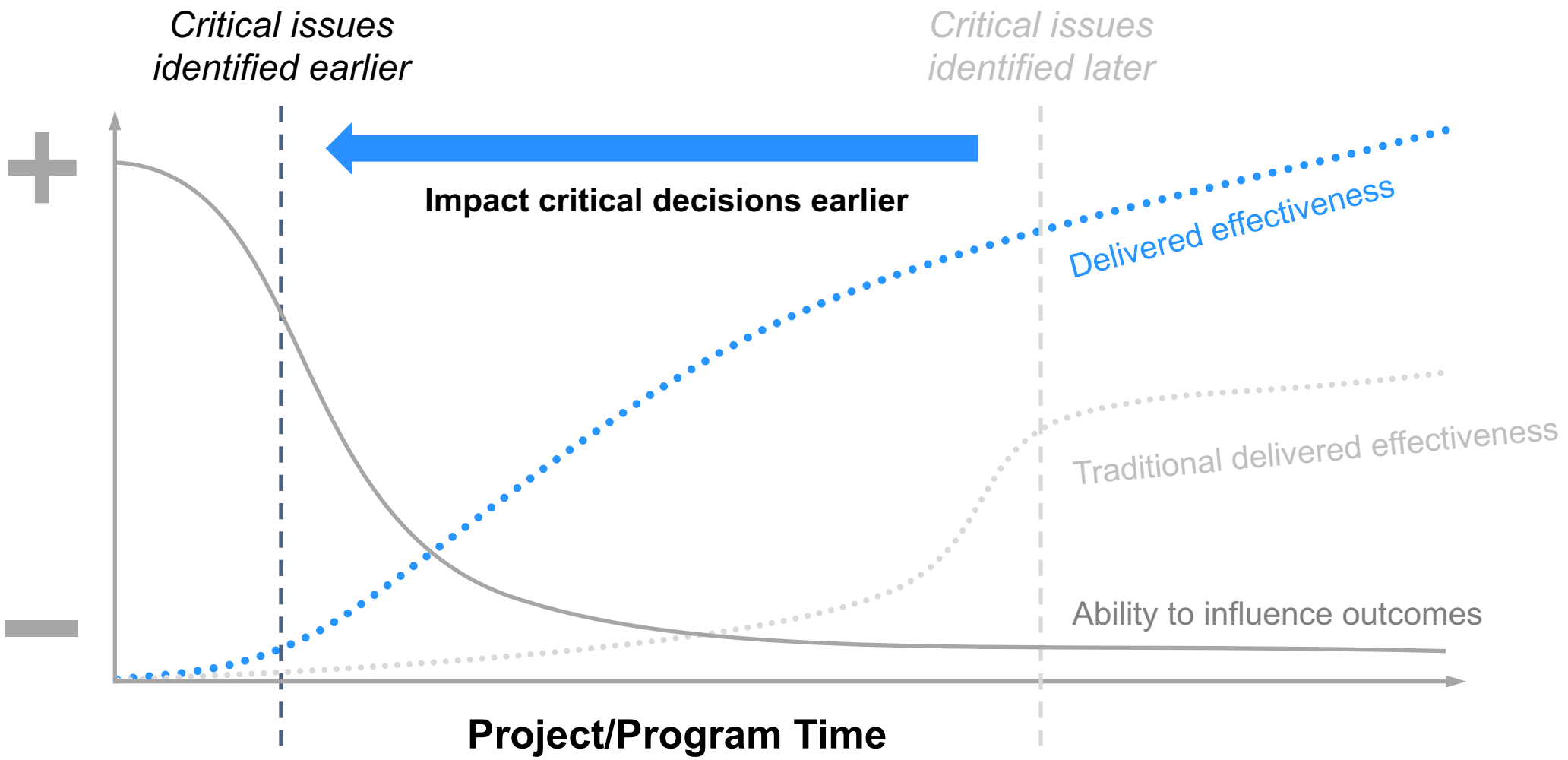
Declining funding

More science from existing investments

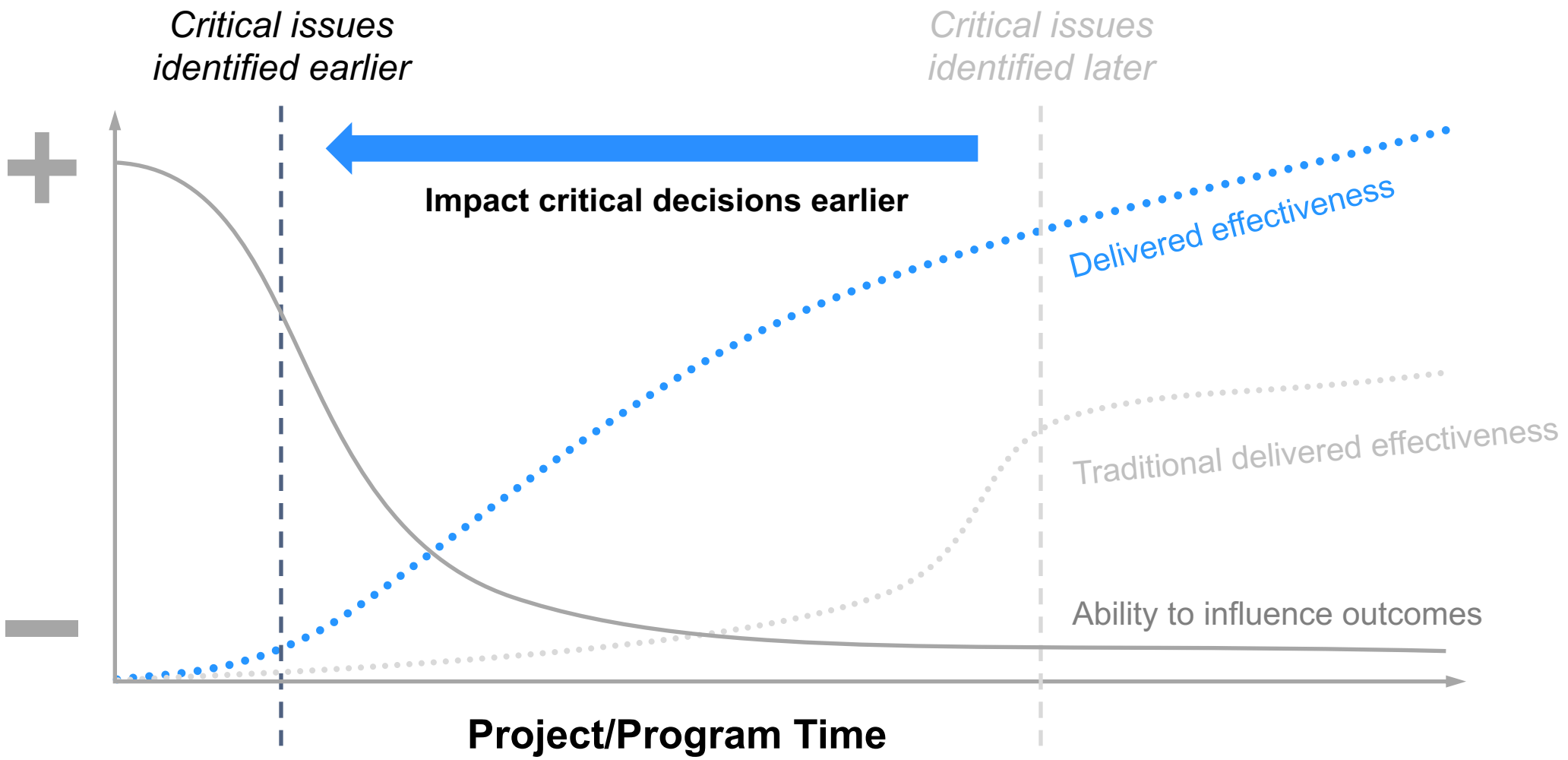


The Atlantic, 2017

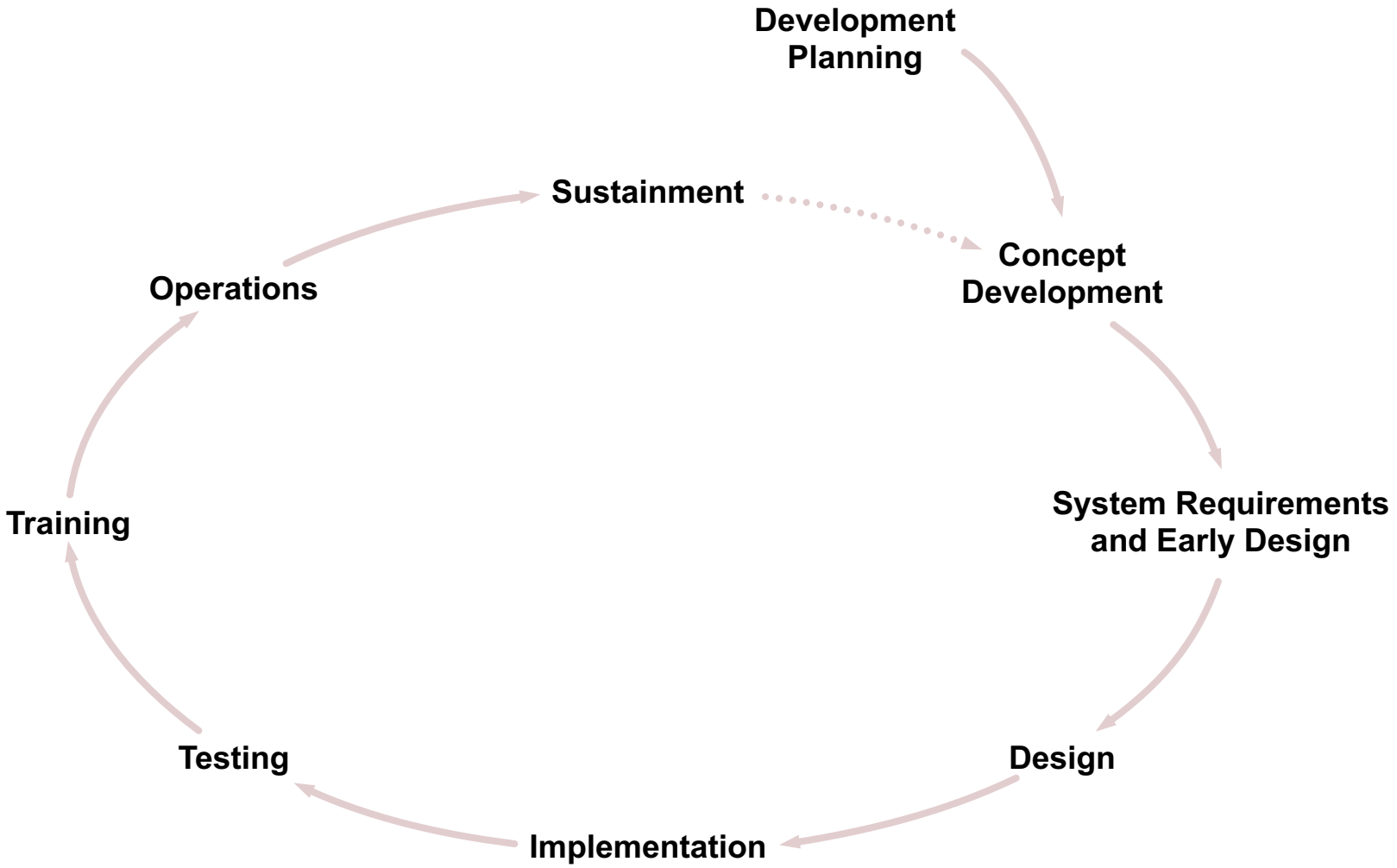
Influence-Effectiveness Curve



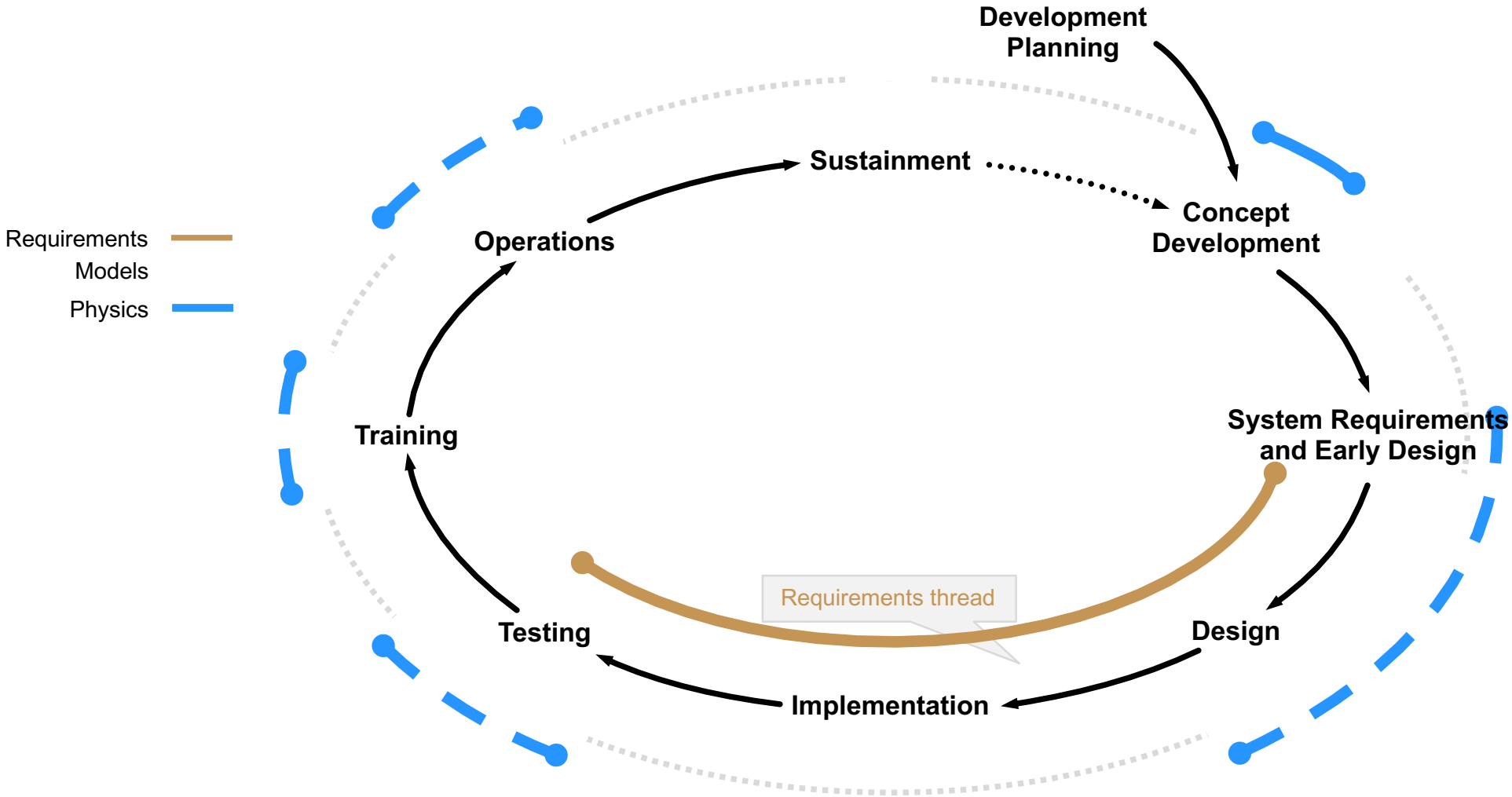
Influence-Effectiveness Curve

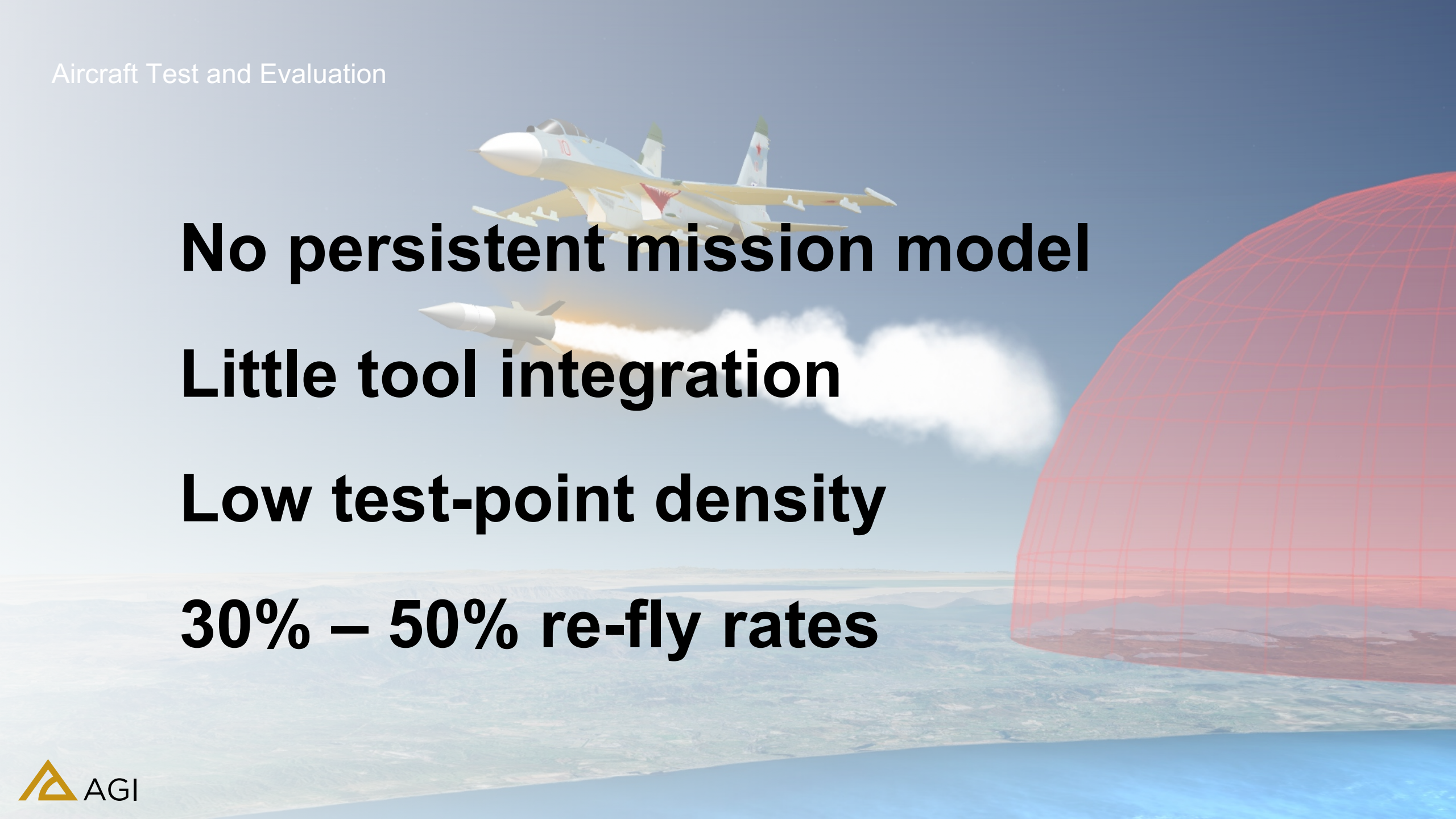


Need for DME: Life Cycle Perspective



Need for DME: Life Cycle Perspective





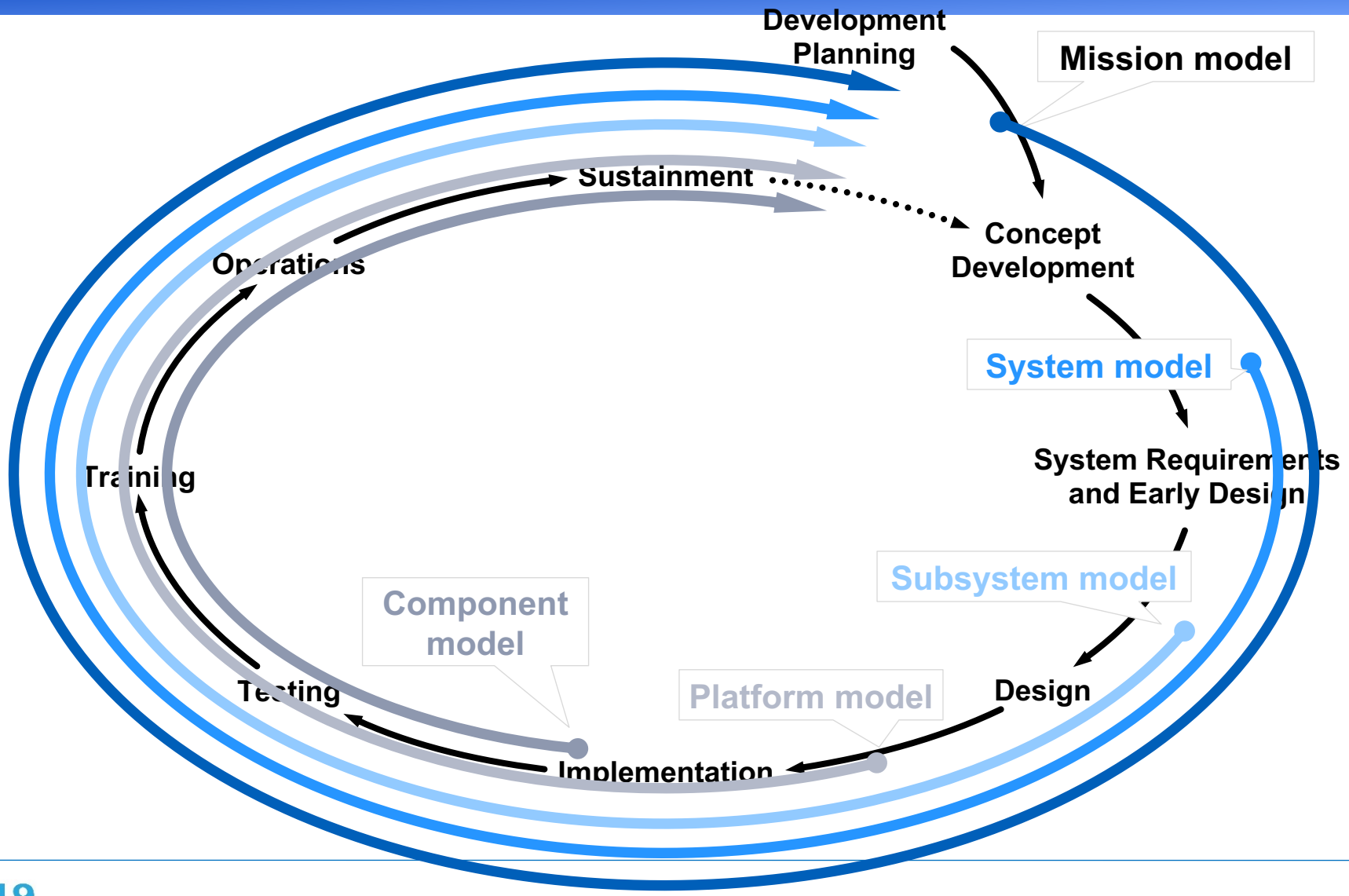
No persistent mission model

Little tool integration

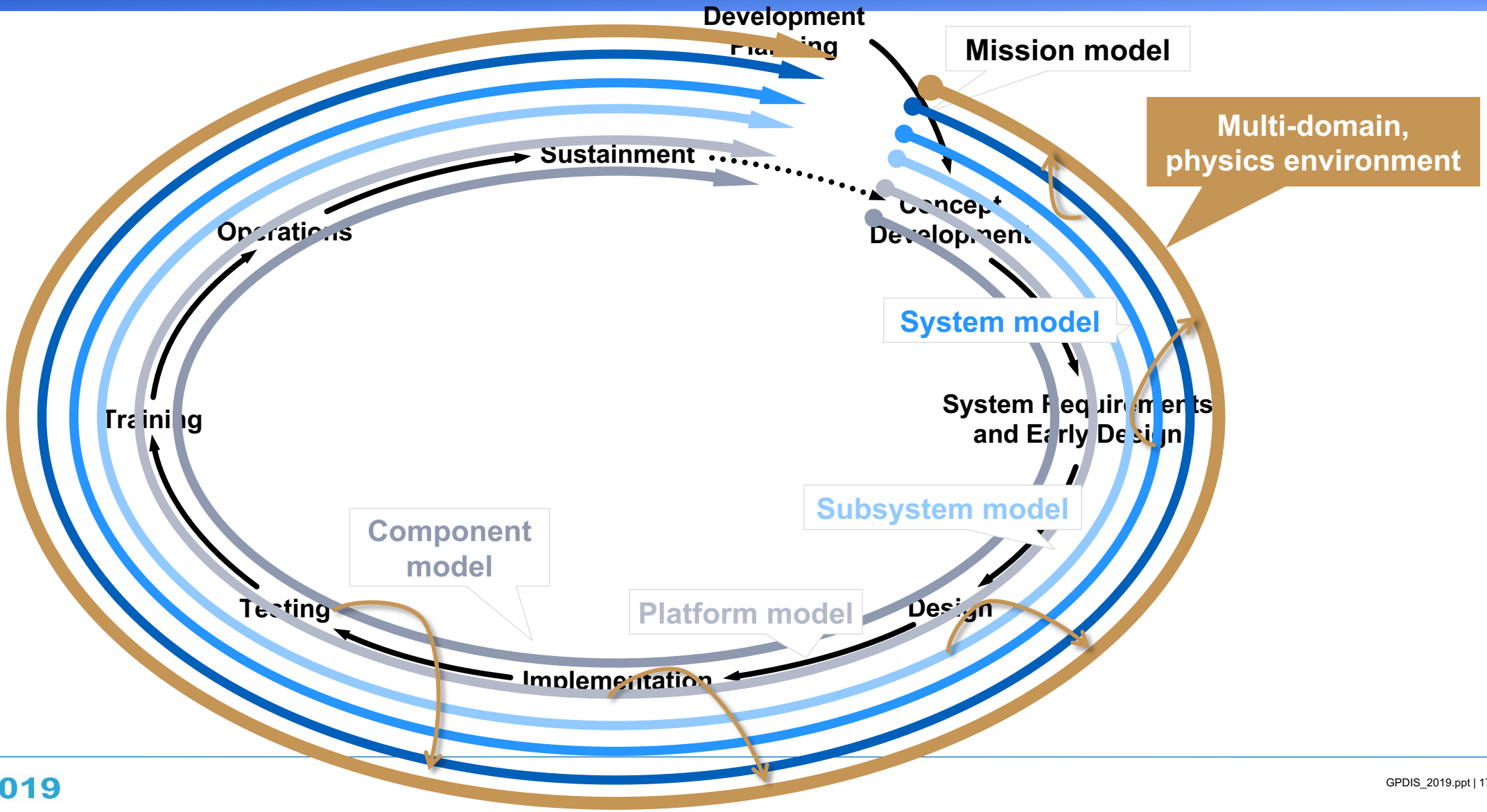
Low test-point density

30% – 50% re-fly rates

Need for DME: The Vision



Need for DME: The Vision



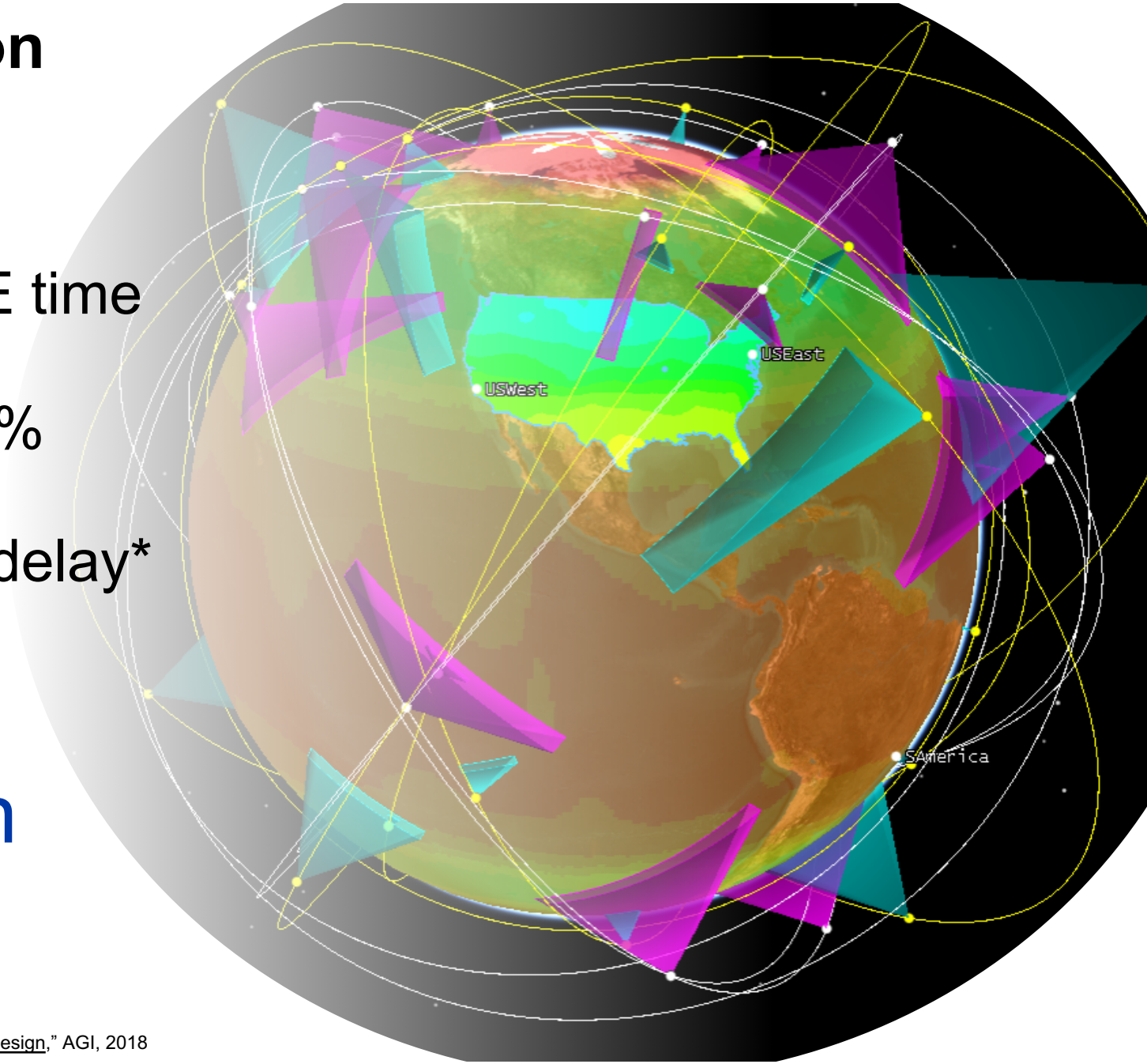
Representative Acceleration

Tool reinvention – 24% of SE time

Model recreation – 30% - 50%

Lack of tool integration – 6x delay*

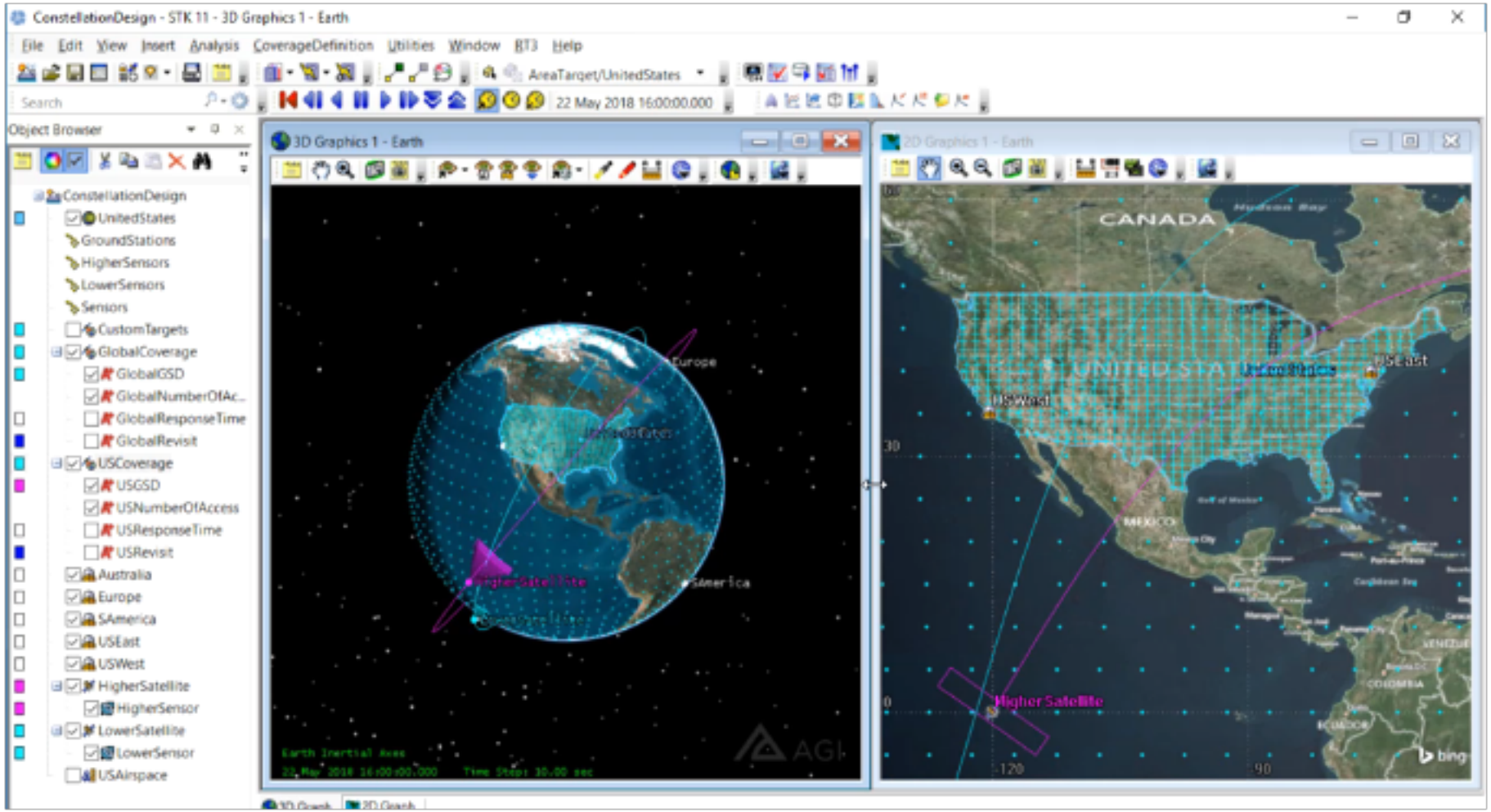
Overall ~2.5× – 6× delivery acceleration



AGI

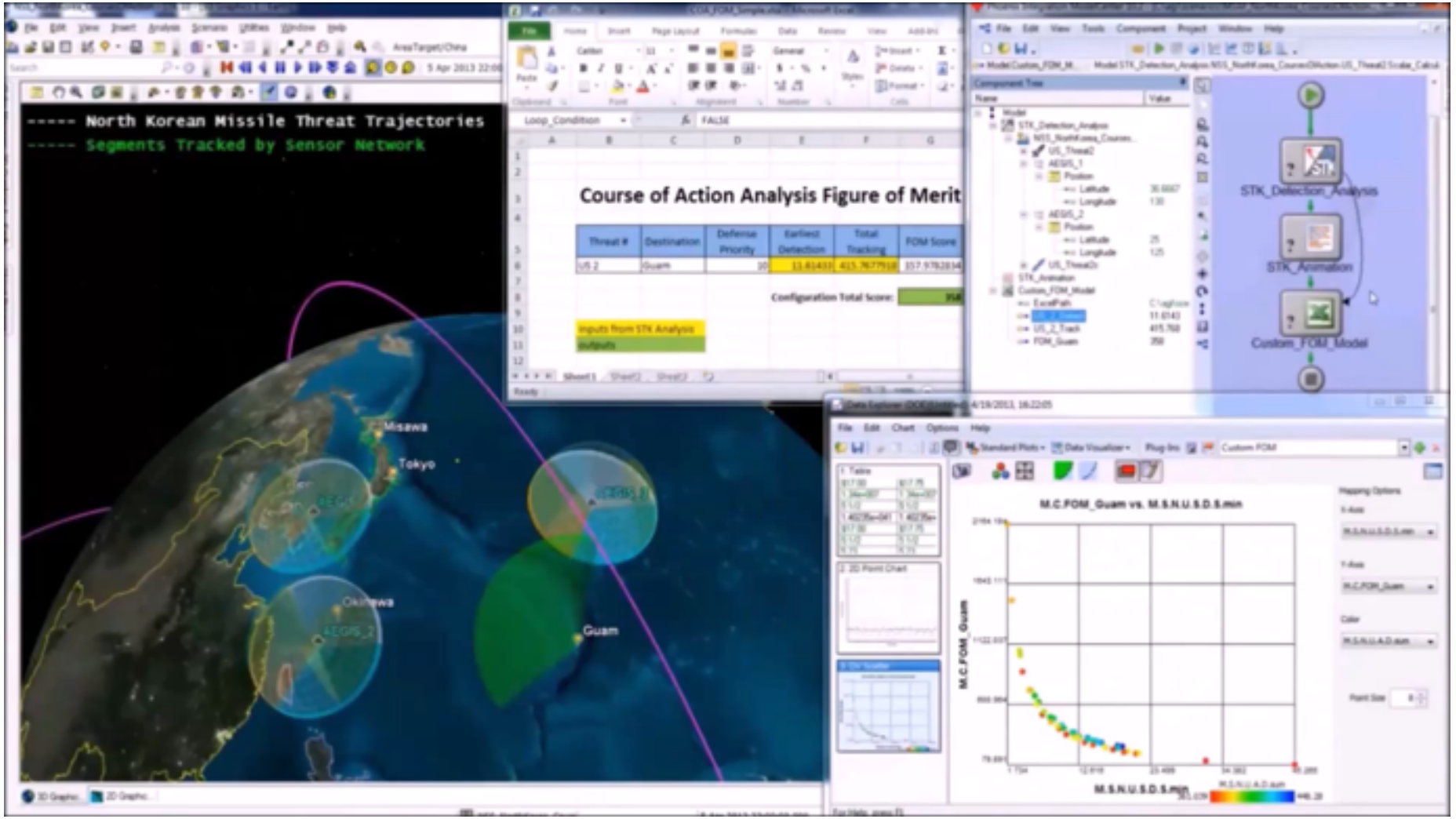
*See "Automated Space System Architecture Design," AGI, 2018

Systems Engineering Example



Systems Engineering Example

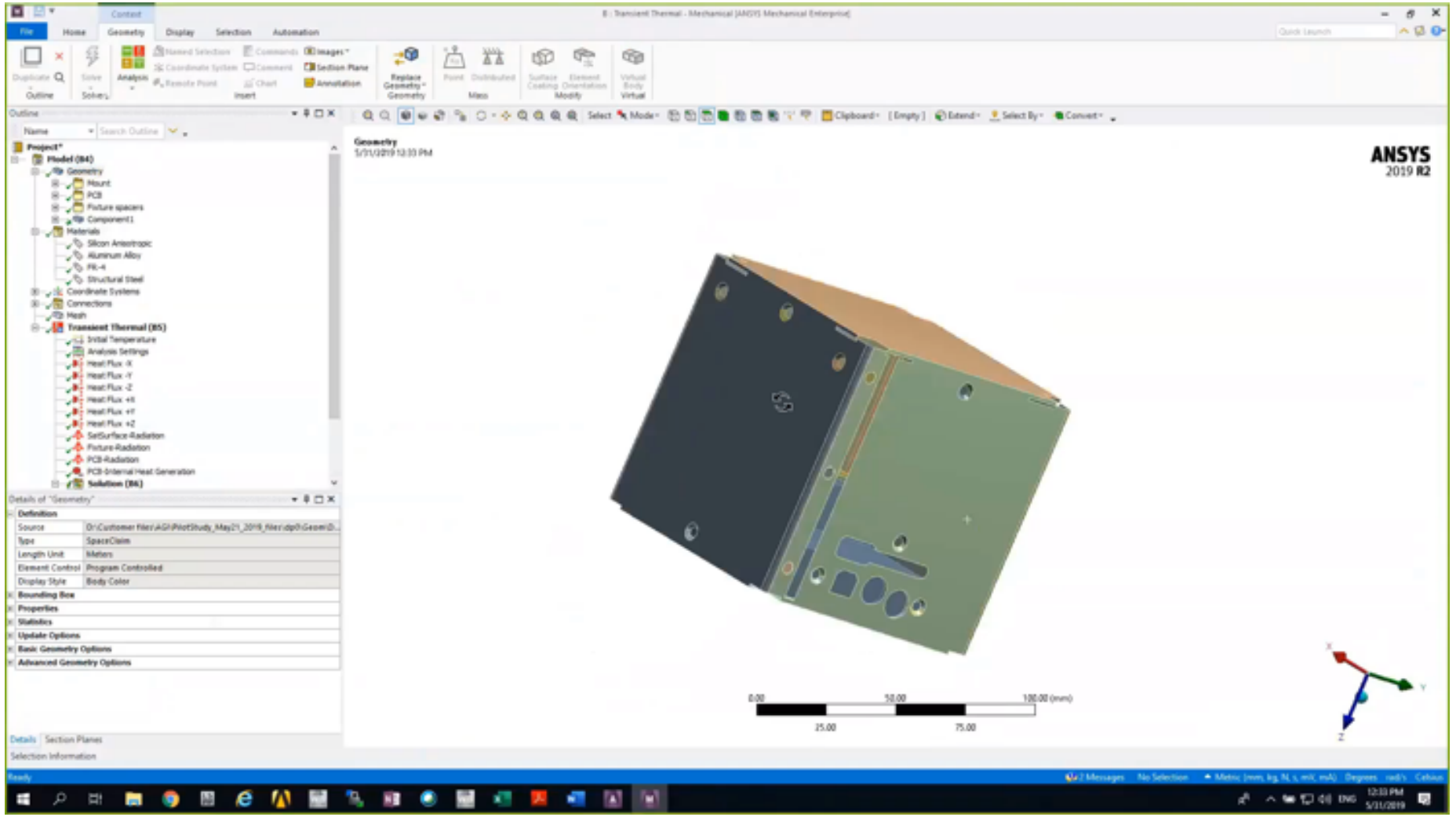
Global Product Data Interoperability Summit | **2019**



Test Planning Example

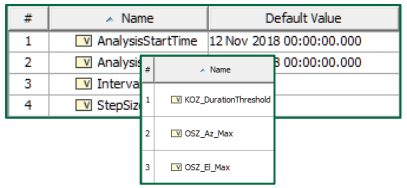
Engineering Design Example

Global Product Data Interoperability Summit | **2019**

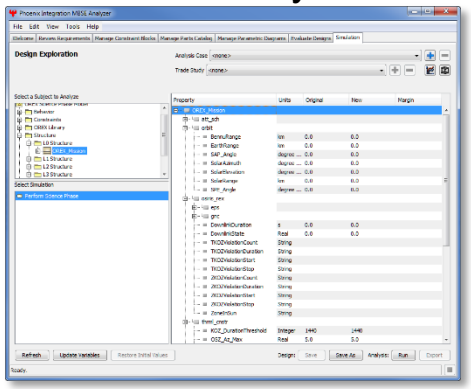


Pre-Integration Example*

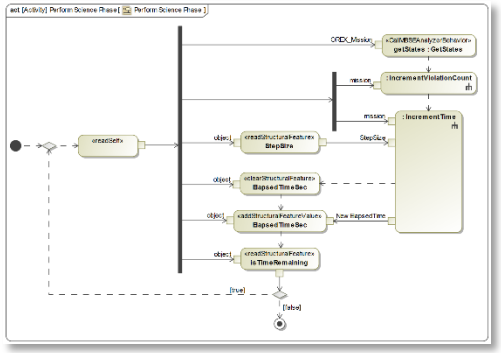
1. Enter simulation settings and constraints.



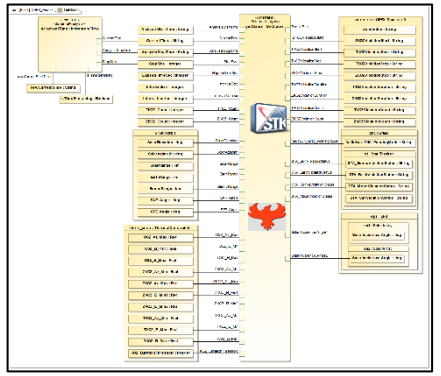
2. Initiate simulation from MBSE Analyzer.



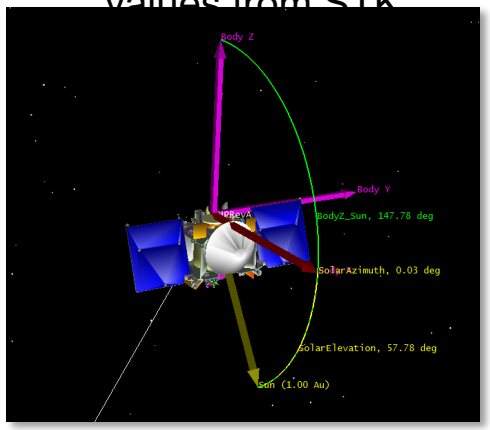
3. Step through the mission simulation.



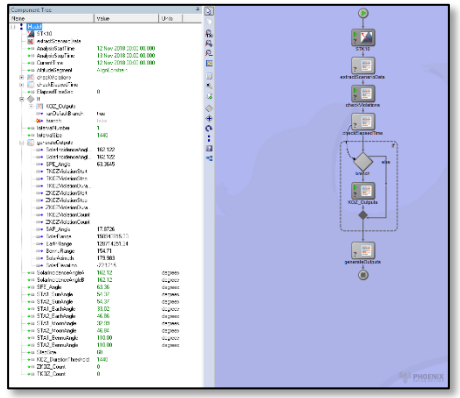
4. Point to external analysis tools.



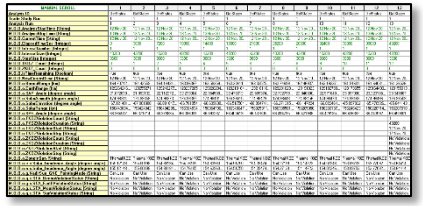
5. Retrieve parameter values from STK



6. Evaluate STK parameters; return results to MBSE



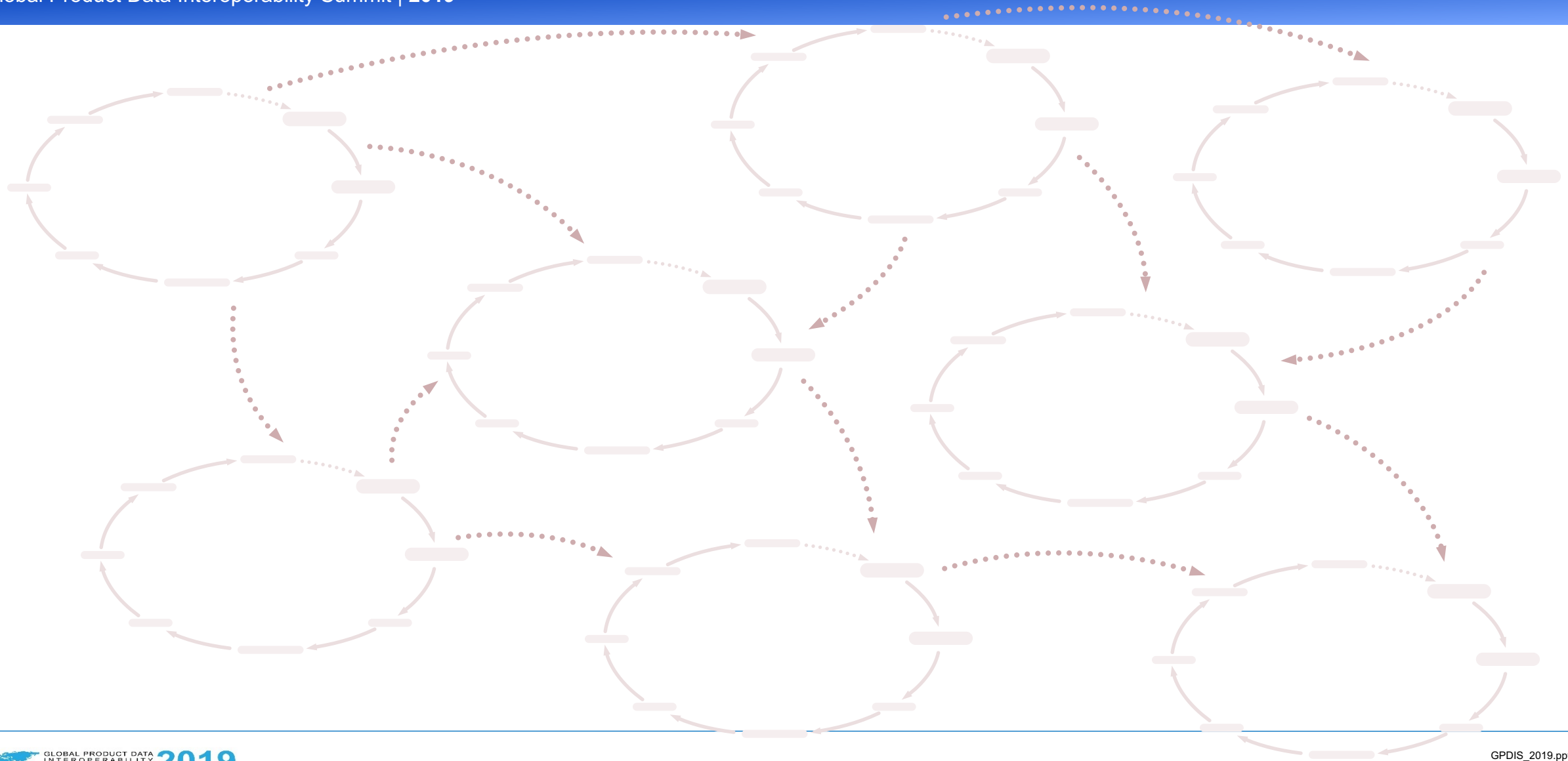
7. Display simulation results for each time step.



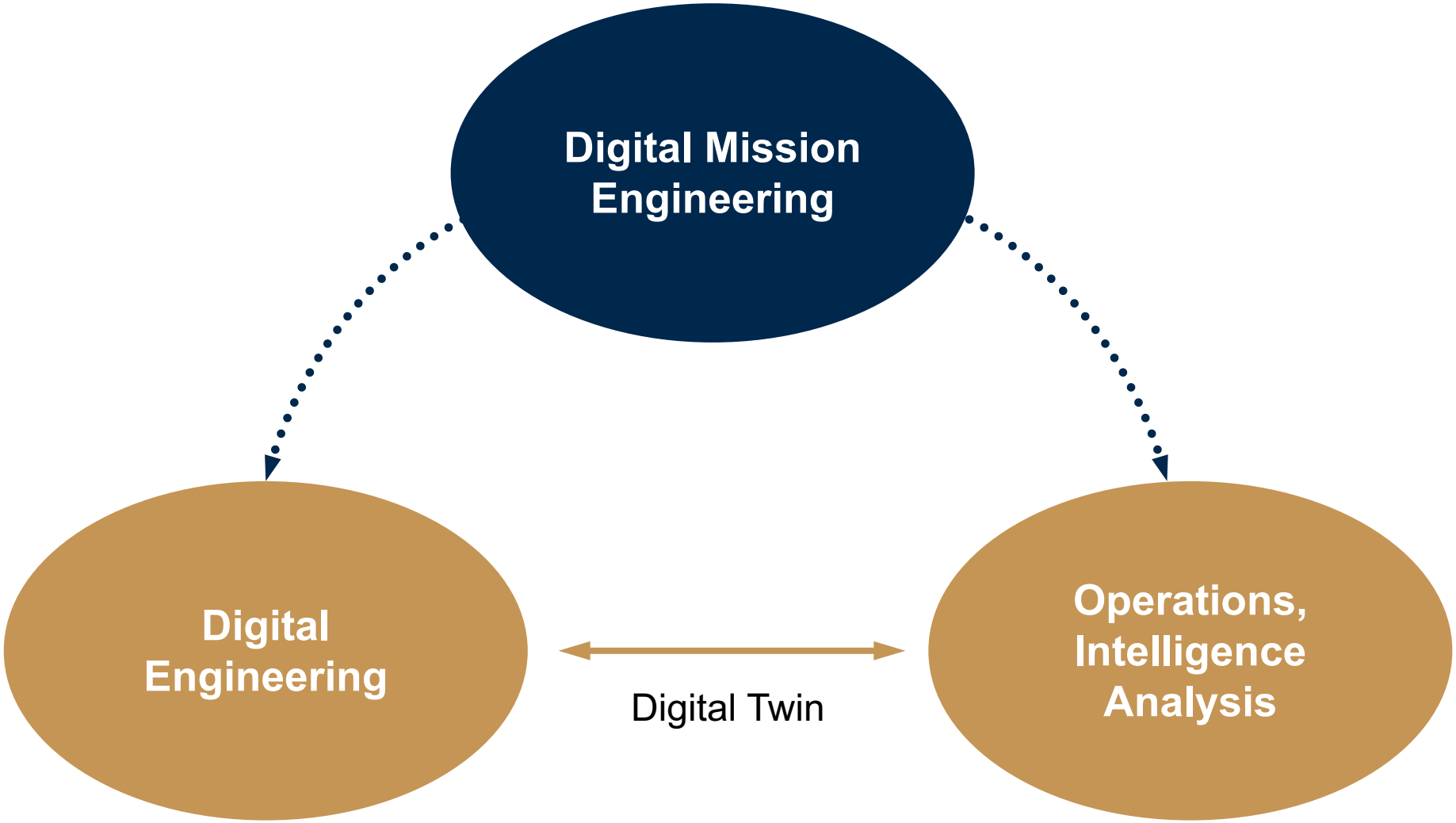
[1] P. Donald, "Integrated Model-Based Systems Engineering (MBSE) Applied to the OSIRIS-REx Mission," Phoenix Integration International Users' Conference, 2018

Beyond Digital Engineering

Global Product Data Interoperability Summit | **2019**



Operations Analysis



Operations Analysis: Strait of Hormuz

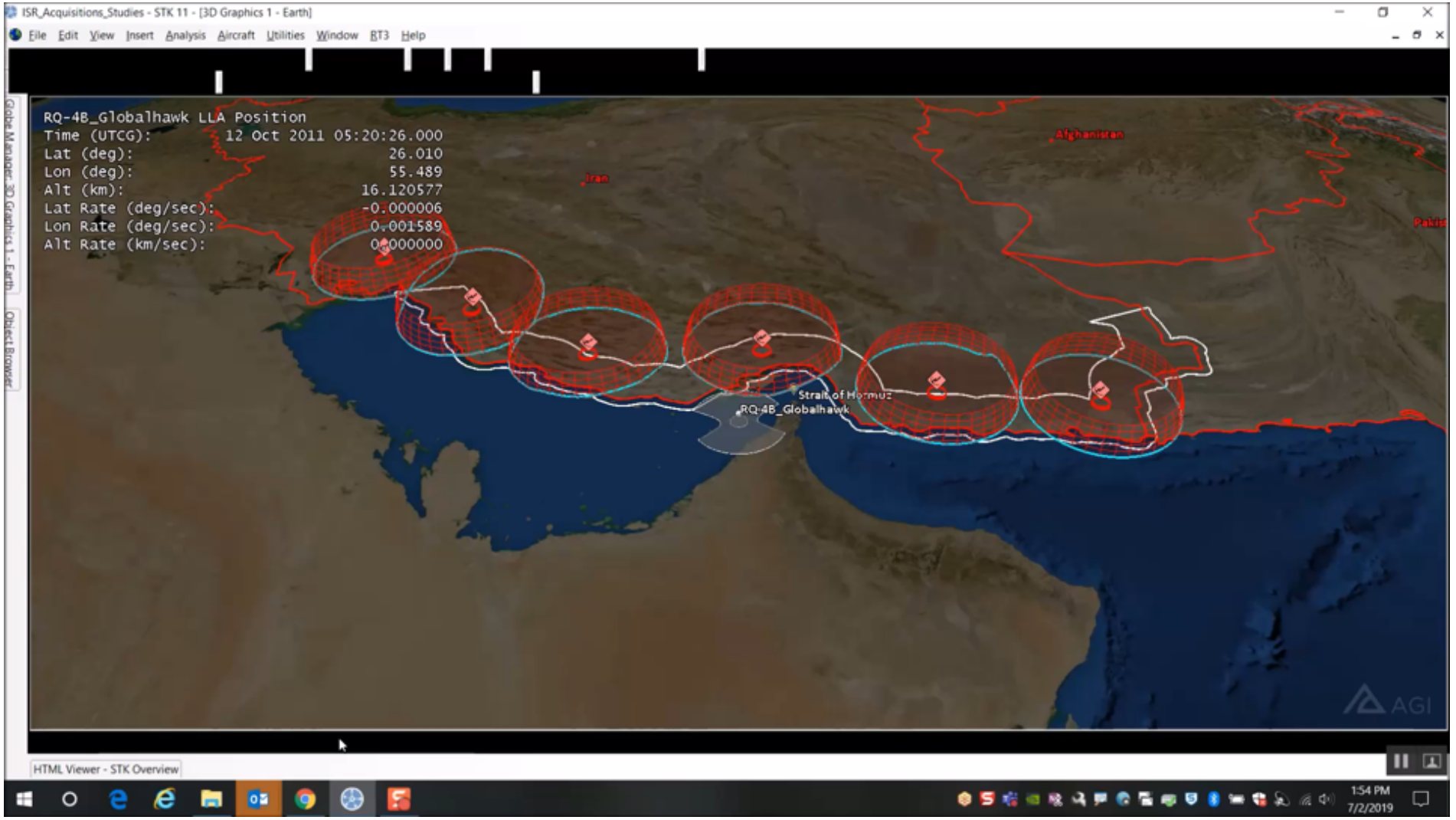
<4-hour forensic analysis

“From-scratch” model construction

See “Strait of Hormuz Simulation,” and "Strait of Hormuz Simulation Update," AGI, 2019

Operations Analysis: Strait of Hormuz

Global Product Data Interoperability Summit | **2019**



Digital Mission Engineering

Critical decisions earlier

2.5x – 6x acceleration

Digital Engineering

Ecosystem integration

Operations and Analysis

2.5x to 6x