RSESC
Rotorcraft Systems Engineering and Simulation Center

Introduction to the RSESC
Complex Systems Integration Lab

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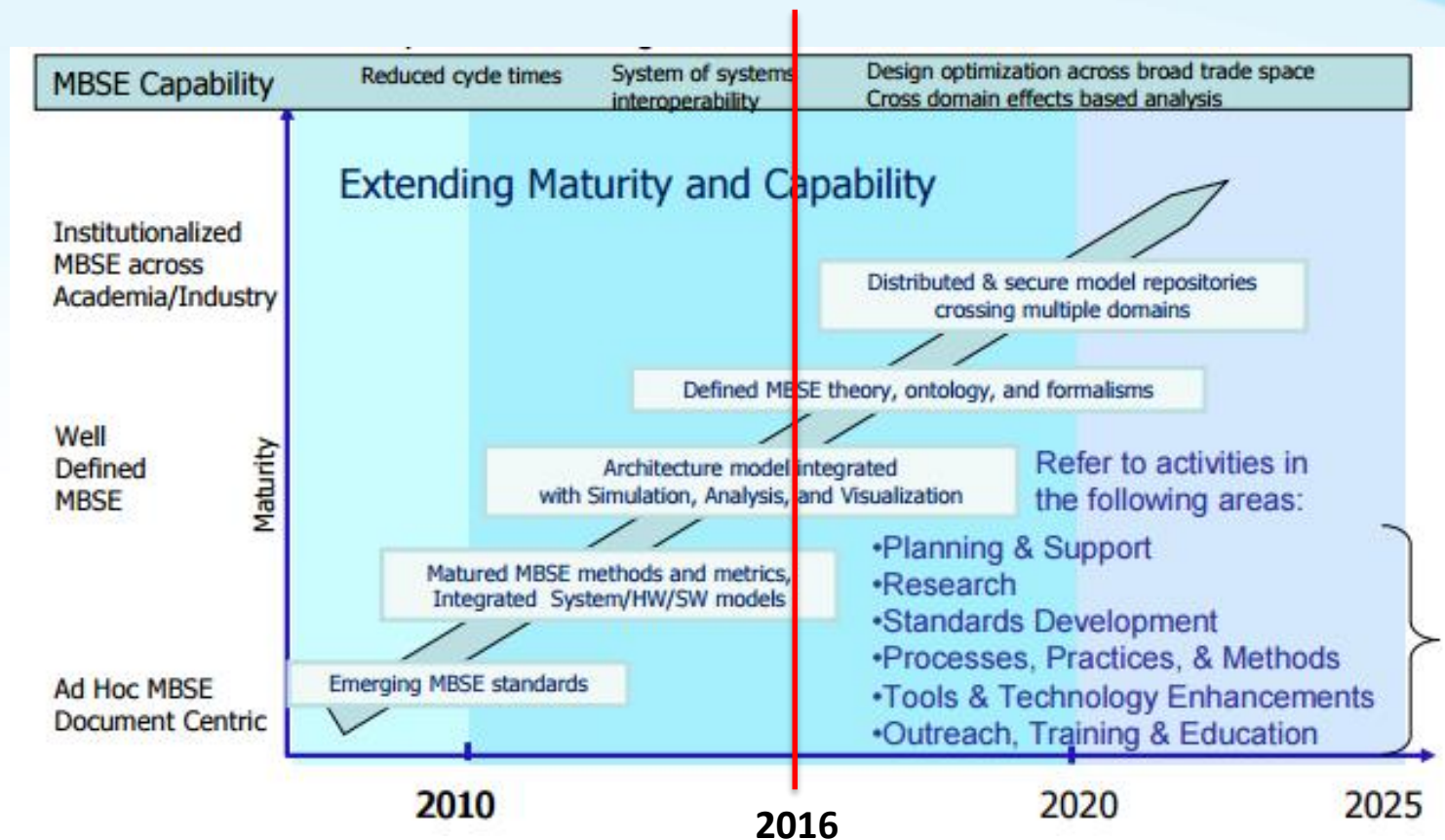ALABAMA IN HUNTSVILLE

Complex Systems Integration Environment

- Changes in technology are occurring much faster than changes in standards and methods of compliance

- As systems become more complex, traditional systems engineering, contracting methods and airworthiness processes and standards
  - May not be sufficient to ensure safety of the platform while supporting the acquisition process throughout the lifecycle
  - Can drive weight into the design as well as cost without significantly improving the safety and mission effectiveness of systems

- The acquisition process must clearly articulate the buyers intent in terms of mission effectiveness and capability in order to
  - Create affordable systems and understand the trade space
  - Better assess cost and schedule risk starting at source through airworthiness determination and fielding

> **Finding from the Study on the Airworthiness of Complex Systems**
>
> Model Based Systems Engineering (MBSE) tools and methods require more S&T funding to mature these tools. PEO Aviation and US Army Aviation Engineering Directorate (AED) must create processes and deliverables for MBSE models and data that meet the needs of AED

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INCOSE MBSE Roadmap

| MBSE Capability | Reduced cycle times | System of systems interoperability | Design optimization across broad trade space Cross domain effects based analysis |

Extending Maturity and Capability

Institutionalized MBSE across Academia/Industry

Distributed & secure model repositories crossing multiple domains

Defined MBSE theory, ontology, and formalisms

Well Defined MBSE

Maturity

Architecture model integrated with Simulation, Analysis, and Visualization

Refer to activities in the following areas:

Matured MBSE methods and metrics, Integrated System/HW/SW models

•Planning & Support
•Research
•Standards Development
•Processes, Practices, & Methods
•Tools & Technology Enhancements
•Outreach, Training & Education

Ad Hoc MBSE Document Centric

Emerging MBSE standards

2010   2016   2020   2025

Where is the "State of Practice" within Government and Industry on this Roadmap??

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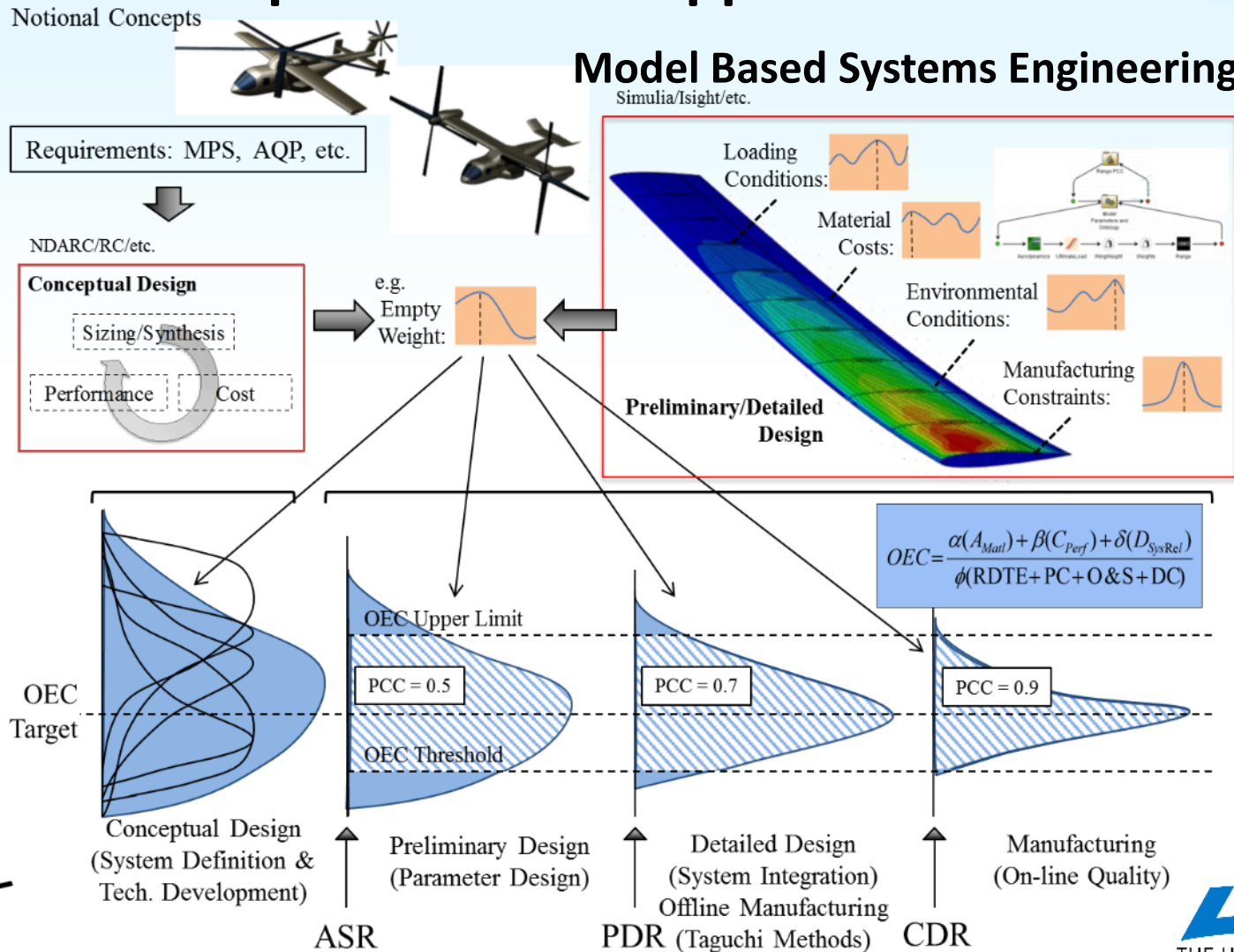
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RSESC Complex Systems Lab

Provides an collaborative environment to:

- Move from a non-integrated document-based Systems Engineering method to an integrated model-based method
- Develop holistic system models supporting full product lifecycle from requirements development through manufacturing and long-term sustainment – end-to-end modeling and virtual prototyping
- Enable advanced configuration management and specification compliance by tracking and propagating component and specification requirement changes throughout the full system model
- RSESC hosts Magic Draw, IBM Rationale Rhapsody, and Architecture Analysis and Design Language (AADL)
- Maintain segregated servers enabling use of multiple software versions depending on customer needs
- Conduct internal design work and as a testbed for government and industry to develop/test MBSE protocols prior to making internal investments in software and laboratories

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A Notional Model Based Systems Engineering (MBE) Example of DAVBA Approach for FVL

RSESC Complex Systems Lab Software – Magic Draw

- Magic Draw:
  - Common Language – Systems Modeling Language (SysMIL 1.4)
  - Standards Compliant application of modeling to support:
    - Systems Requirements
    - Analysis and Simulation
    - Design
    - Verification and Validation
    - Interoperable with standard modeling tools
      - MATLAB/Simulink
      - CAD
  - Currently being used for:
    - NASA SUBSA – Solidification Using a Baffle And Sealed Ampules redesign
    - Hydraulic Manifold Redesign on Aviation Ground Power Unit
    - Working on validating interoperability with Pro-E
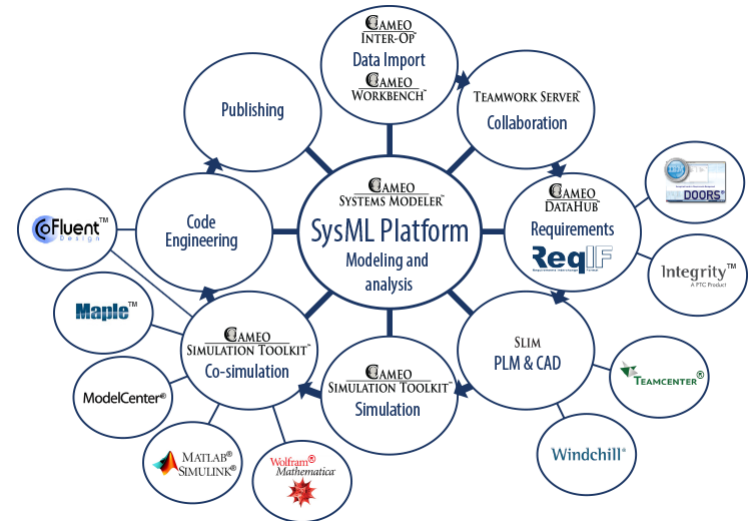
RSESC Complex Systems Lab Software - AADL

- An SAE International standard established in 2004, the Architecture Analysis and Design Language (AADL) provides a new framework that allows analysis of system (and system of systems) designs prior to development and supports an **architecture-centric, model-based development approach throughout the system life cycle.**

- AADL can be used to model:
  - embedded systems as component-based system architecture
  - component interactions as flows, service calls, and shared access
  - task execution and communication with precise timing semantics
  - execution platform and specify application binding; and operational modes and fault tolerant configurations

- Currently being used for:
  - AGPU Redesign
  - Cybersecurity work with Honeywell
  - Software Engineering Directorate tool kit support

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RSESC Complex Systems Lab Software – IBM Rational Rhapsody

- IBM® Rational® Rhapsody® family provides a collaborative design, development and test environment for systems engineers and software engineers.

- Rapid prototyping and execution to address errors earlier when they are least costly to fix.

- Automatic consistency checking to enhance agility and improve reuse with collaboration to reduce both recurring and non-recurring costs.

- Share, collaborate, and review your engineering lifecycle artifacts created with Rational Rhapsody or other design tools, such as Mathworks Simulink, with the extended engineering team.

- IBM has pushed this as an ideal vehicle for working on DO-178C software compliance

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Questions