

Exploring Model-Based System Engineering(MBSE) /Model-Based Development (MBD) in the Life-Cycle Development for Civil Aircrafts

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DISCLAIMER

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2 Benchmarking

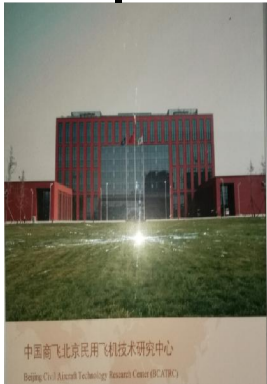
3 COMAC Approaches to MBSE/MBD

4 Needs/Challenges

COMAC In A Glance



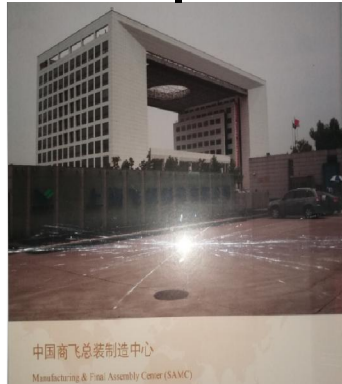
中国商飞董事会



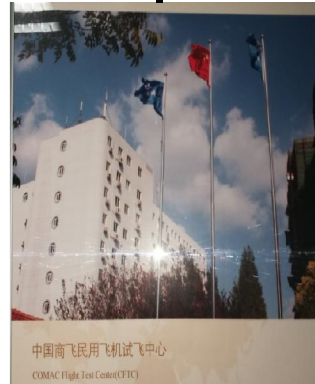
预先研究



型号研发



生产制造



飞行试飞



客户支持

商飞基础能力中心

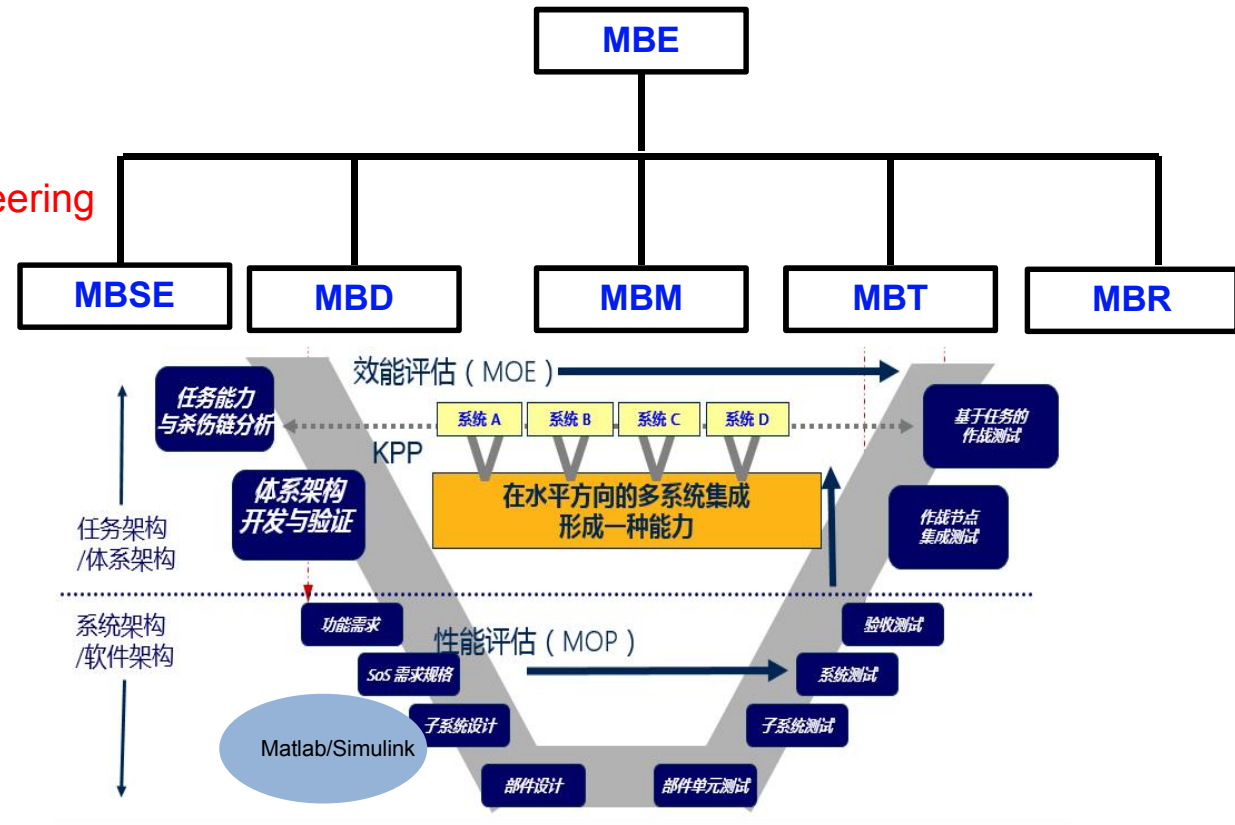
Challenges for Commercial Aircraft Development

产品设计的挑战



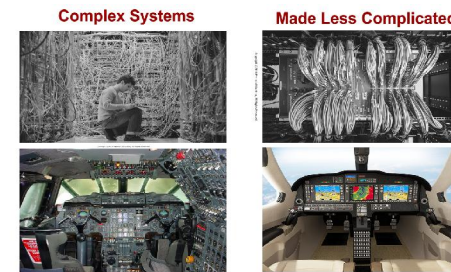
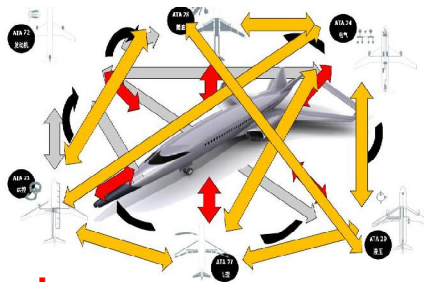
MBSE v.s. MBD

- MBE – Model Based Engineering
- MCE – Model Centric Engineering
- **MBSE – Model Based System Engineering**
- **MBD – Model Based Development**
- MBT – Model Based Test
- MBR – Model Based Reliability
- MBM – Model Based Manufacturing



Background

- **MBSE Definition:** The formalized application of modeling to support system requirements, design, analysis, verification and validation activities beginning in the conceptual design phase and continuing throughout development and later life cycle phases”
- **3 Key Characteristics of Commercial Aircraft**
 - High Complexity
 - High Risk
 - High Cost



Virtual System Integration Is Very Critical in Early Stage

Motivation

- **MBSE/MBD is a cultural change, and a new disruptive development process**

- **Key SE Characteristics Requirements**
 - Open Minds
 - Independent Critical Thinking
 - Life-long learning

- **Overcome Psychological Inertia**
 - Understand how sub-conscious mind works
 - Be aware of mind-mistakes
 - Engage with active listening like an infant

Motivation – Paradigm Shift

In order to implement MBSE successfully, a mindset change is needed and required

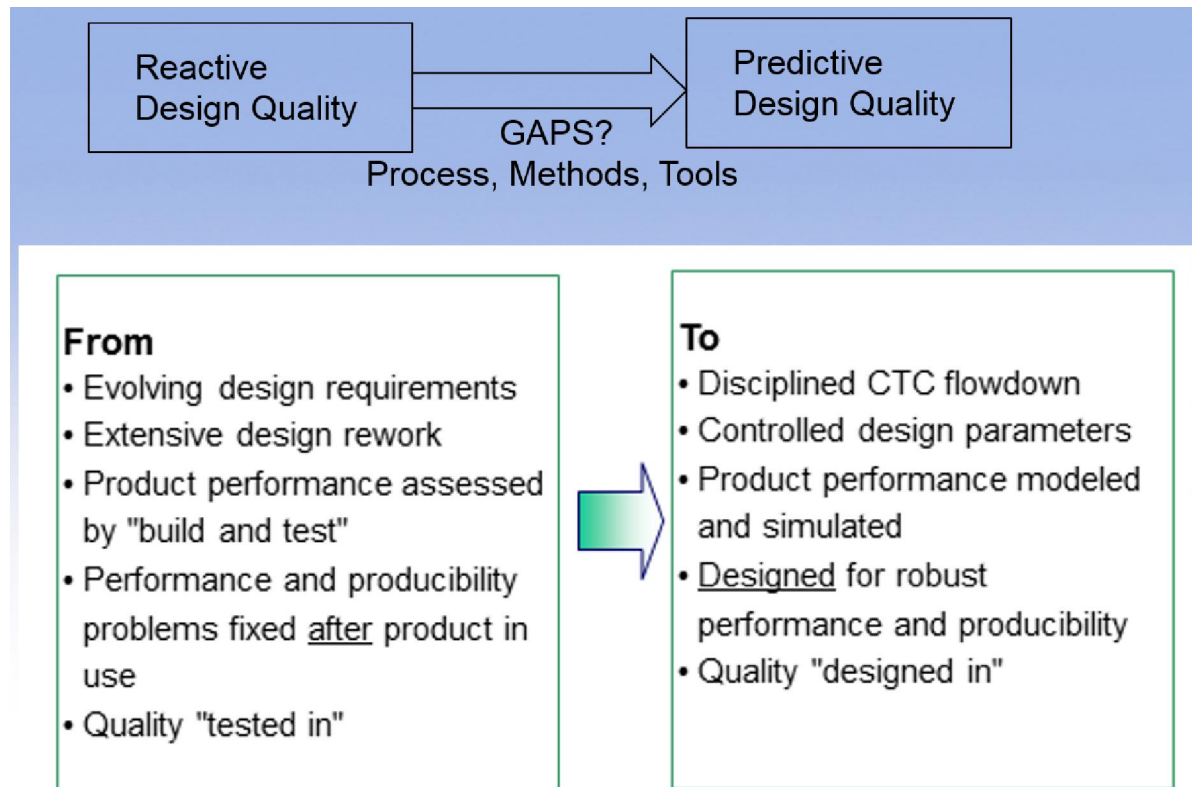


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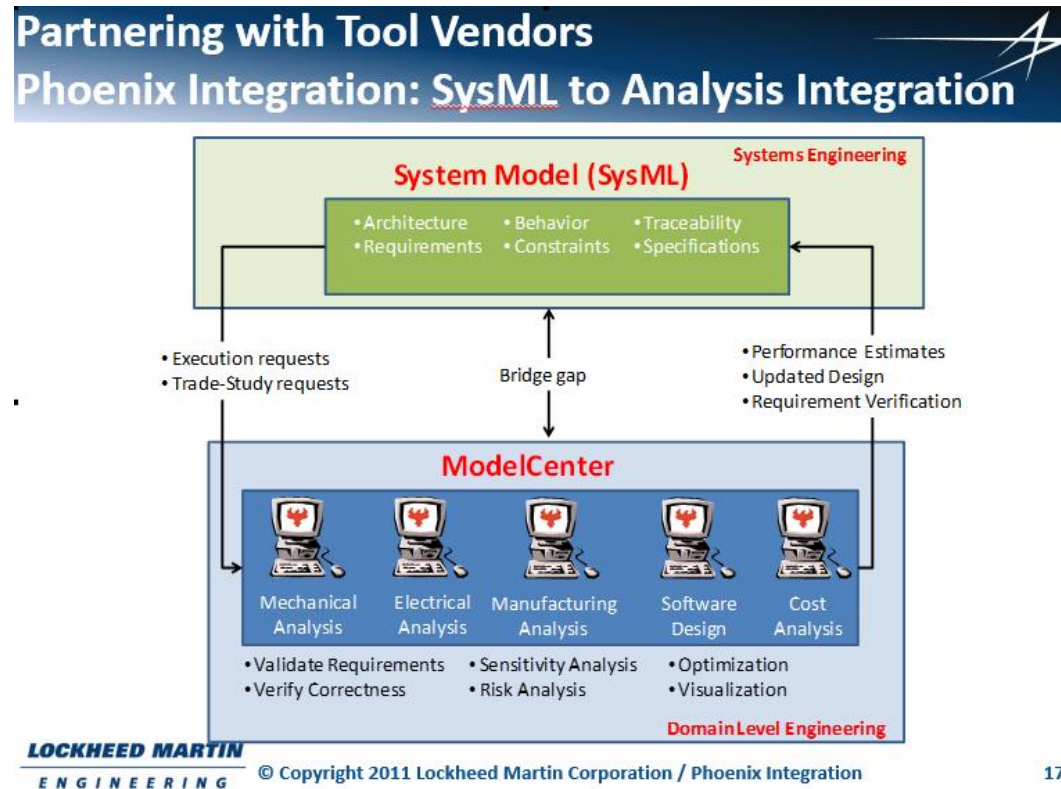
2 Benchmarking

3 COMAC Approaches to MBSE/MBD

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Benchmarking – Lockheed Martin 1

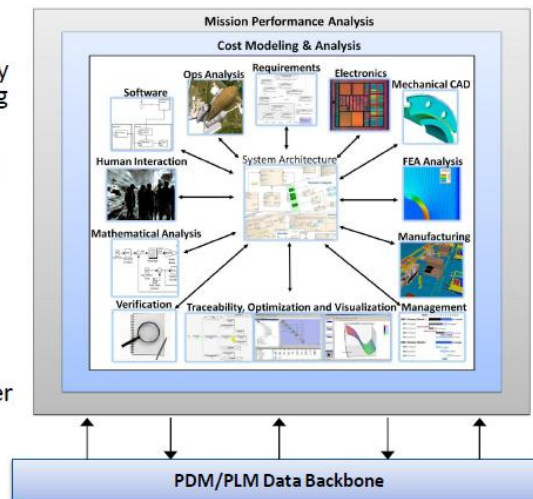
Complex Model Ecosystem – Combined a fully integrated digital system model enables programs to pull a digital thread to analyze performance and change impacts faster and with more accuracy.



Benchmarking – Lockheed Martin 2

Model-Centric Engineering – Model is an essential part of product data baseline.

- A well defined System Architecture Model (SAM) is a key enabler for integrating and linking our engineering enterprise
- The SAM helps link requirements to logical and behavioral design
- Requirements can be fed into increasingly detailed levels of domain specific modeling
- Integration between Systems Engineering and the PDM/PLM backbone opens up a new frontier for integrated model-centric engineering

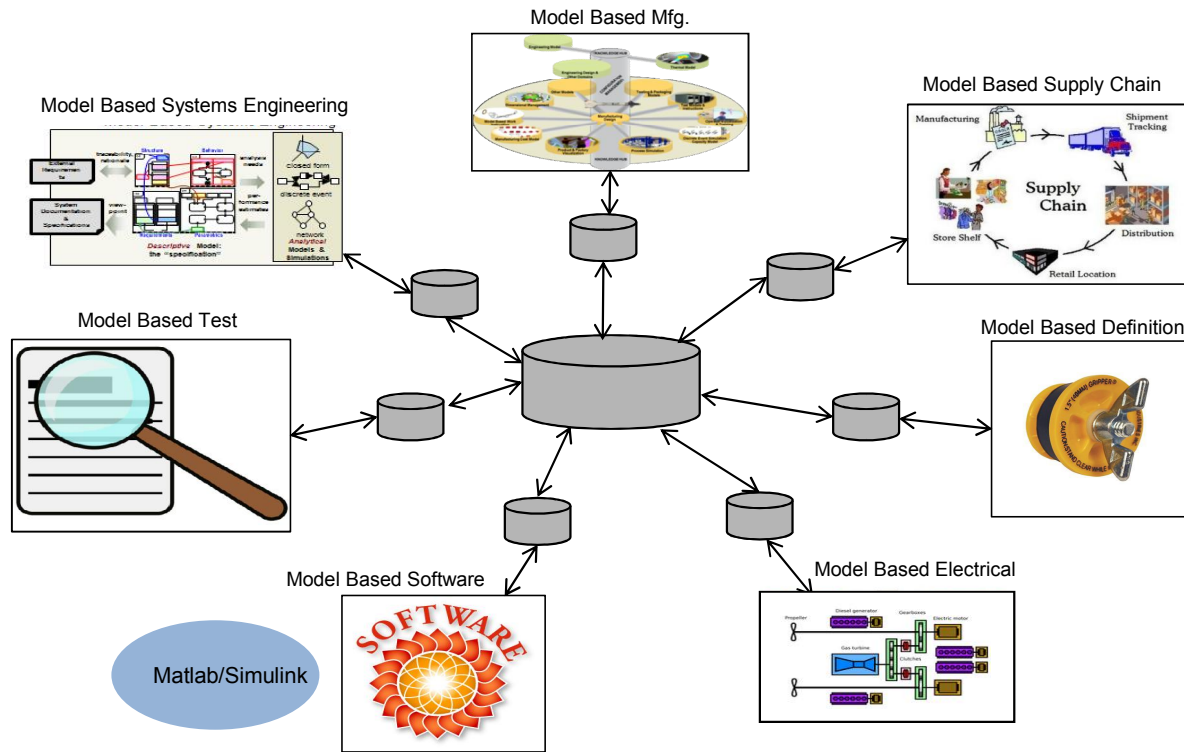


Key Points:

- ① System Architecture Model;
- ② SAM Links Reqs & Design;
- ③ Mission Analysis & Cost Model;
- ④ PDM/PLM Backbone;
- ⑤ Model-centric.

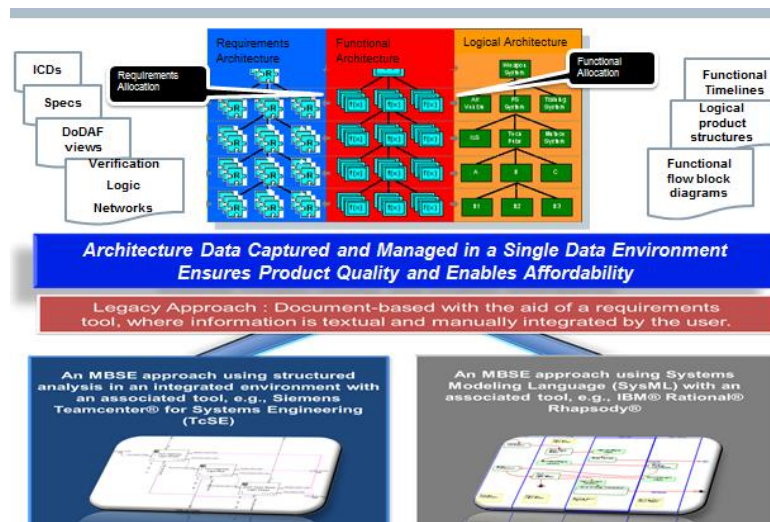
Benchmarking – Raytheon

Complex Model Ecosystem – Combined A fully integrated digital system model enables programs to pull a digital thread to analyze performance and change impacts faster and with more accuracy.



Benchmarking – Boeing Company

Integrated Product Architectures at The Boeing Company



- IPA is an enterprise effort to develop and deploy a common capability to enable Boeing engineers to integrate requirements, architectures, and analyses
- IPA uses a model based systems engineering (MBSE) approach in an integrated data environment
- The Integrated environment architectures enables consistent, seamless generation of SE artifacts and enables more effective system trades



Paradigm Shift/Change:

- ① Model is requirement;
- ② Model is technical baseline;
- ③ Model is component of product data;
- ④ Model is useful even it is not fully validated!

Key Points:

- ① Requirement Architecture;
- ② Single Data Environment;
- ③ Effective System Trades;
- ④ Quality & Affordability.

Benchmarking – Airbus Group

4 Layers: Workflow → Methods → Platform → Tools

Our Vision

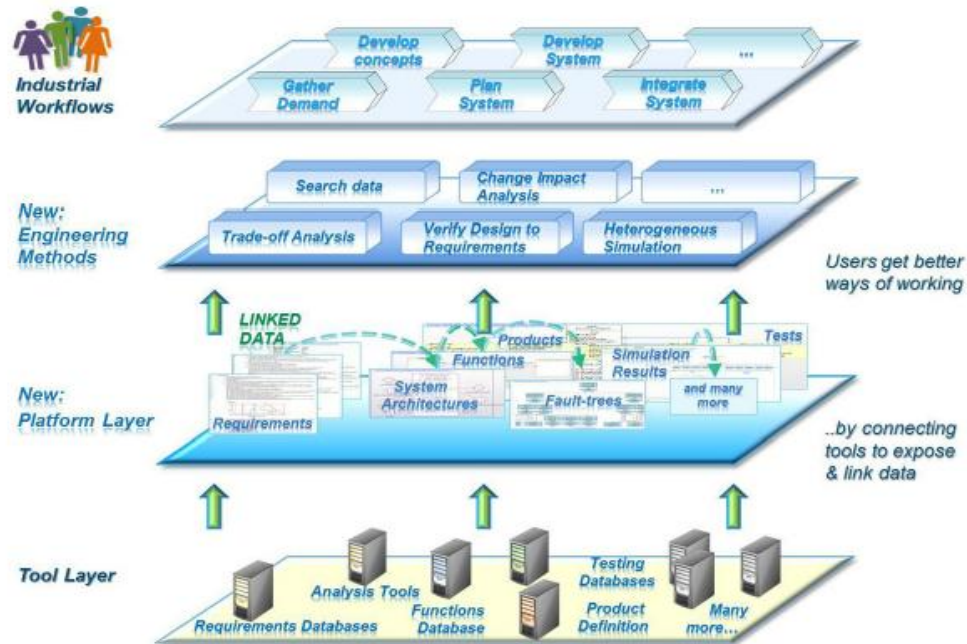


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COMAC MBSE DreamWorks

Vision

- To be the industry leader in the area of MBSE

Mission

- To promote & Implement MBSE

Values

- Integrity, Innovation, Customer-Oriented, Continuous Improvement

Slogan

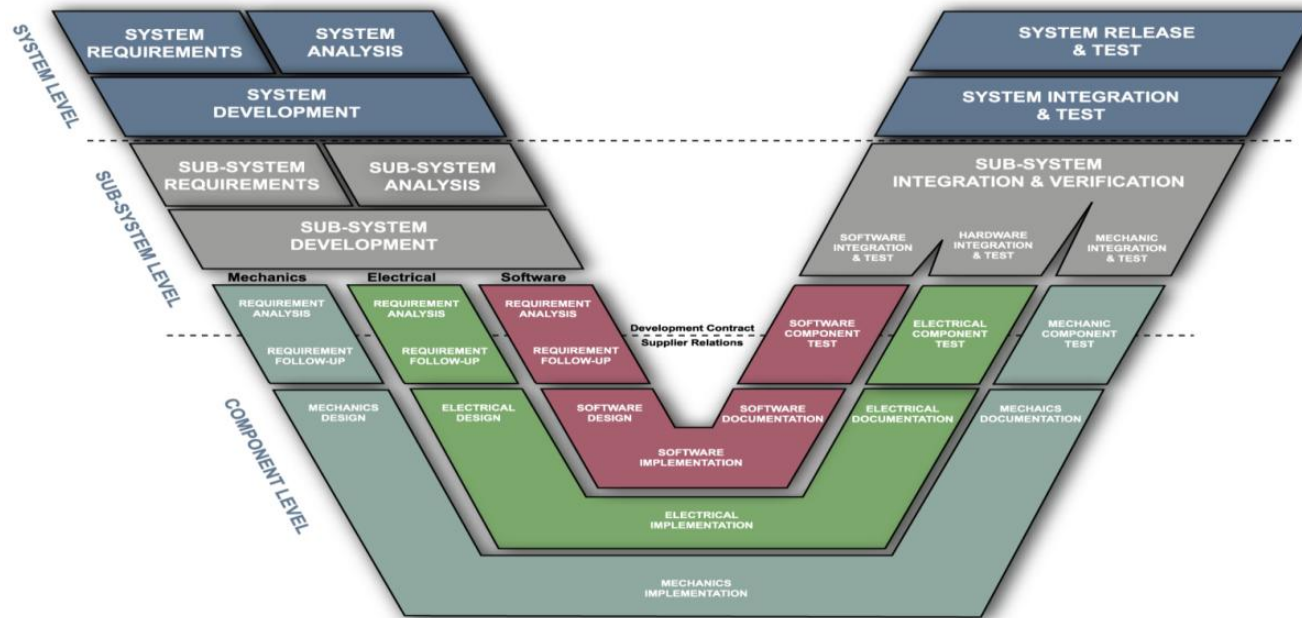
- We are OneTeam!

COMAC Approach to MBSE Implementation

- Education on the topic of MBSE
 - Grass-rooting 2 session of enterprise-wide formal SE training
 - Rotation within different organizations within COMAC for students
 - Re-establishment of basic SE beyond requirements management only
 - Importance of requirement & functional models
- Development of MBSE key capability for programs to use through pilot projects
- Development of guidance for how to use the MBSE developed capability
- A core group (COMAC MBSE DreamWorks) that provides support to all programs
- Means to capture and share successes and lessons learned within the enterprise

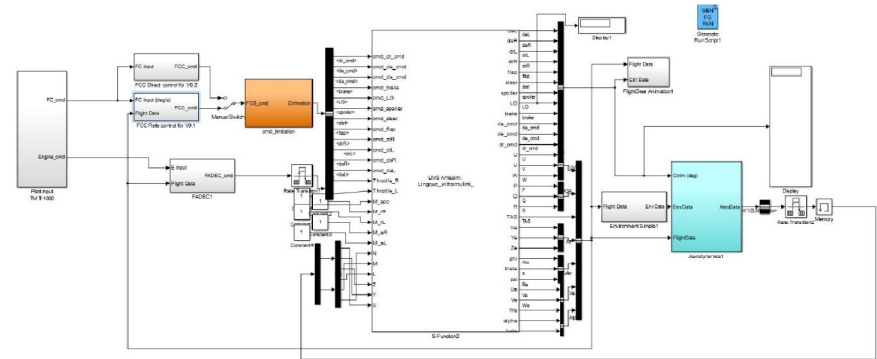
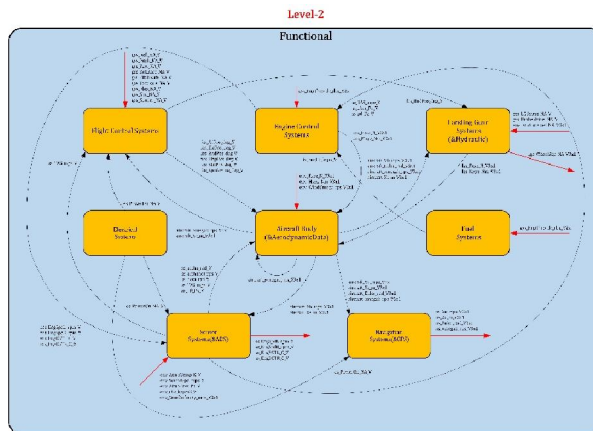
COMAC Approach to MBSE Tools & Methodologies

- Different tools & methodologies at different stages
 - Tools: Rhapsody, EA, Canpella, Matlab/Simulink, AMESim/SysDM/Synthesis
 - Methodologies: OOSEM(IncoSE Object-Oriented SE Method), RUP-SE



COMAC MBSE Implementation – Pilot Project

Use a small aircraft as a pilot project to demonstrate the MBSE implementation process



COMAC MBSE Implementation – Pilot Project

Use a small aircraft as a pilot project to demonstrate the MBSE implementation process – Using Simulink as a common simulation platform



COMAC MBSE Implementation – Next Steps

Using MathWorks Certification Toolkit for Automatic Certification Compliance

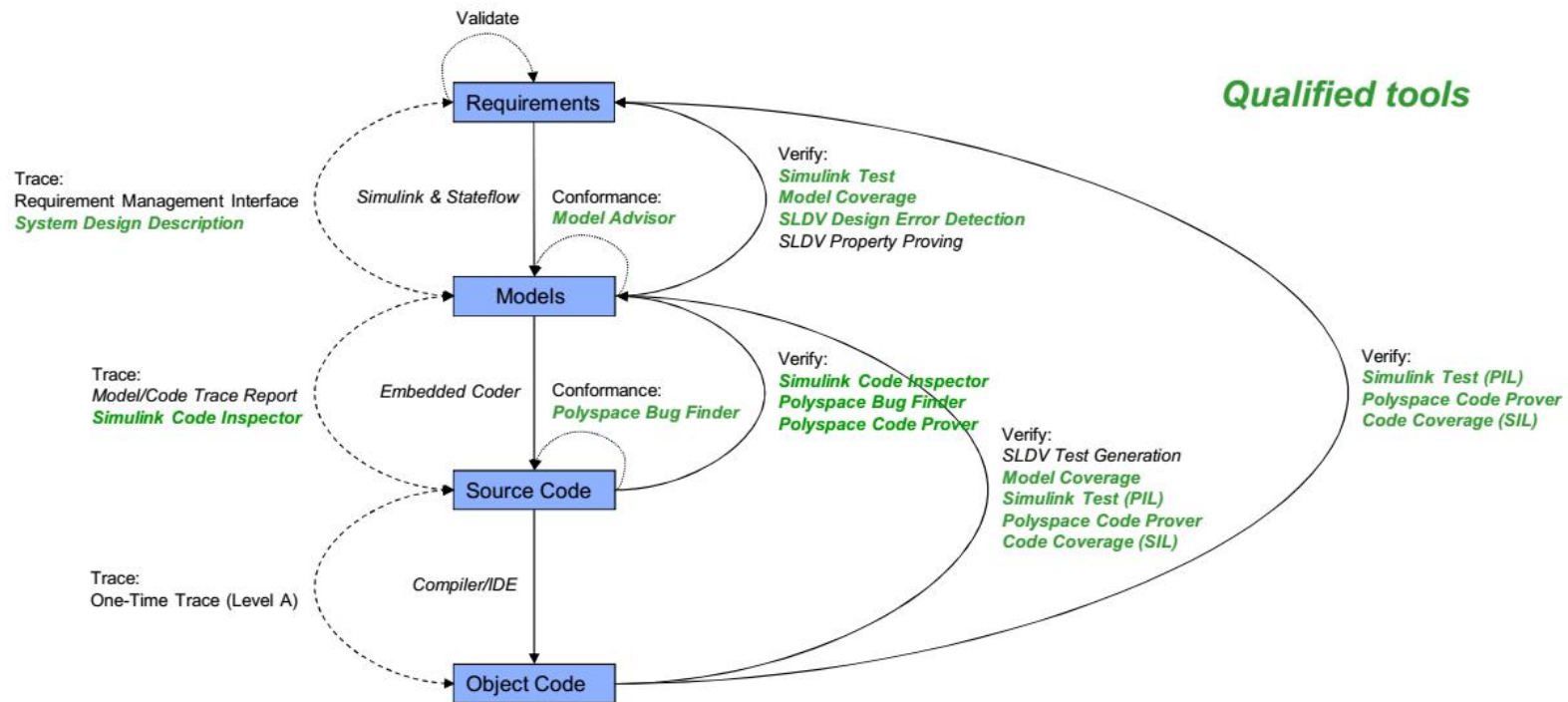


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COMAC MBSE Needs

- **COMAC Cultural Change Needs**

- **COMAC Process Needs**
 - Process methods to measure the impact of MBSE/MBD (Tangible values)
 - Training good modelers using levels I, II, and III
 - Process method to make sure the persistence of MBSE/MBD
 - Modeling guidelines and standards

- **COMAC MBSE Tools Needs – With Tool Vendors Together**
 - Tool support for distributed users across all enterprise
 - Tool support for reference model and model/data reuse
 - Configuration and version control tool for all objects
 - Exchange and synchronization of federated engineering data
 - Tool support for managing large quantity of model users

COMAC MBSE Challenges

- **COMAC Cultural and Traditional Resistance (Need top leader)**
 - Communication and understanding of motivation of MBSE

- **COMAC MBSE Implementation Challenges**
 - Legacy and new product development methods conflicts
 - New MBSE process definition and adoption
 - MBSE V-shape whole life-cycle tool support
 - Product complexity and quantity of large engineering data
 - Diagramming (SysML) limitation

- **Training and Skill Challenges**
 - Knowing what to model at what level of detail based on the questions to be answered
 - Knowing what modeled data to analyze & how to analyze it
 - Need to have combination of 4 skills:
 - 1) SE knowledge and experience
 - 2) Product domain knowledge
 - 3) Tool use skills and modeling skills

Summary

- **COMAC requires a balanced effort to implement MBSE/MBD due to the complex nature of commercial aircraft and cultural challenges**
- **Success has been seen on a variety of pilot programs**
- **COMAC will be committed to moving forward with MBSE/MBD**
- **COMAC needs help with integrating model/data among different tools for strengthening virtual system integration capability**



Thank You for Your Attention



COMAC MBSE Approaches

OneVision, OneVoice, OneTeam, OneBrand