Uso de Modelos durante el Ciclo de Desarrollo en V para Plataformas de Aviónica

Airbus Defence and Space - Military Aircrafts
Key Takeaways

1. Models are used for Design, Implementation and Testing of …
   – Safety-Critical Avionics Products
   – V&V Test Means and Simulation Products

2. Time-consuming requirements validation and implementation verification tasks are reduced.

3. Models ensure product maturity and have increased the quality level of engineering development processes

   Requirements, design and implementation errors are reduced
Overview of Airbus Defence and Space

Airbus Defence and Space is a division of Airbus Group formed by combining the business activities of Cassidian, Astrium and Airbus Military.

- Space Systems
- Communications, Intelligence and Security

➤ Military Aircrafts

The new division is Europe’s number one defence and space enterprise, the second largest space business worldwide and among the top ten global defence enterprises. With some 40,000 employees, Airbus Defence and Space generates revenues of approximately €14 billion per year.
Airbus Defence & Space is a global leader for **tactical** and **strategic airlifters**, **tanker platforms**, advanced **combat aircrafts**, **manned** and **unmanned** mission aircrafts and a broad range of Services to support our customers to their full satisfaction.

We design, develop, manufacture and support manned and unmanned military aircraft, combining decades of industrial experience with the ability to stay at the cutting edge of technology.

**Overview of Military Aircrafts**

More than 2,200 fixed-wing aircraft sold  
More than 1,400 aircrafts in service in around 60 countries worldwide  
17 aircrafts A400M have been delivered in 2016  
28 aircrafts A330-MRTT in service from 51 aircrafts ordered by 8 countries
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Innovation Challenges
for Military Aircrafts Systems Engineering
Aeronautics Industry Challenges

1. **Safety Driven** - Avionics shall meet Airworthiness Certification standards to be integrated in Aircraft System depending on the Design Assurance Level.

And …

2. Aircraft Systems interconnections and data exchanged is growing.

3. Increased Automatic aircraft functions lead to increased Complexity.

4. Decrease the product development cycles in a more competitive market.
Breakdown of Intermediate Products
Managing Complexity

The V-Cycle can be decomposed in Intermediate Products
... and the Test Means Products needed to verify them
Innovation Challenges in Safety-Critical Equipments

- Software and Hardware Components (μProcessors, FPGAs, ASICs ...) may be as complex as the whole Equipment itself.

- Design of a Safety-Critical Equipment requires, company processes, structured development methods and a lot of human resources.

- The use of Model-Based Design allows comply with the certification processes.
Traditional V-Cycle for Avionics or Test Products

Gaps in company processes

- Only rely on Textual Requirements
- Interfaces and Parameters only shared as Text
- Use of non-executable top-level architectures
- Manual processes for HW/SW implementation
- Build the Product before starting the Test phase
- All test cases executed Manually

Each step ends with a review (multi-role principle) of activities through output document(s)
Model-Based Design
for Avionics or Test Products

- Functional Requirements
- Specification Model
- Architecture Model
- Detailed Design
- Design Model
- Generated Code
- Component Tests
- Unit Tests
- Product Tests
- Model-Based Digital Transformation
  - Textual Requirements → Model Specifications
  - Use Data Dictionaries for I/Fs and Parameters
  - Model internal Architecture with submodels
  - Generate Code from Models
  - Execute Tests from Model to HiL levels
  - Automatic Testing and Replay real data

Verification

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Achievements using Model-Based Design
Achievements using MBD for Safety-Critical Equipments

The following Toolboxes have been used during the design phase of Safety-Critical Equipments for these Aircrafts:

- A330-MRTT
- A400M
- C-295 (EIS in 2018)

MathWorks Tools

- MATLAB / Simulink
- Stateflow
- Embedded Coder
- Simulink Code Inspector
- Polyspace
- Fixed-Point Designer
- HDL Coder
- HDL Verifier
- MATLAB Coder
- Simulink Verification and Validation
- Simulink Design Verifier
- DO Qualification Kit
Achievements using MBD for Integration:
A400M A/C0 Integration Simulator

A/C Installation Elements
- Real Cockpit
- Real Avionics Bay
- Real A/C Wiring

Based on Airbus SW and HW
- ASPIC Real Time Kernel
- Airbus custom Hardware

A/C Systems
- More than 15 real A/C systems integrated: F/CTL, FMS, CDS, HUD, FWS, IOM, ADCN ...

Configuration and Modifications
- Wiring changes, Loaded Models, SW and HW P/N s, Databases

A/C Instrumentation
- ~200000 instrumented parameters

Simulated Models comply AP2633
- ~80 Simulated Models
  (Systems and Environment)
An A/C0 Simulator is the **Overall Integration Rig** for A/C systems to validate the systems, functions or equipment in a real operating environment.

**First Development “Aircraft”**

S401 at a glance
FLIGHT &
MBD Opportunities and concluding remarks
Identified best practices and learnings

• Reuse models as much as possible!
• Feed models with real data as much as possible!
• Generate Code in the early phases with Mockup Models
• Models architecture must be scalable from local to globally distributed teams
• Use of Configuration Control, Simulink Projects, Libraries, Model References and Data Dictionaries
Forward-looking plans

- Reuse Code from Model References
- Link with PLM Tools
- Explore support of Virtual and Non-Virtual Buses in HDL Coder
- Explore Simulink Test
- HDL Code Inspection
Gracias por vuestra atención

Preguntas!