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

Airbus Defence and Space - Military Aircrafts

DEFENCE AND SPACE

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AIRBUS

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

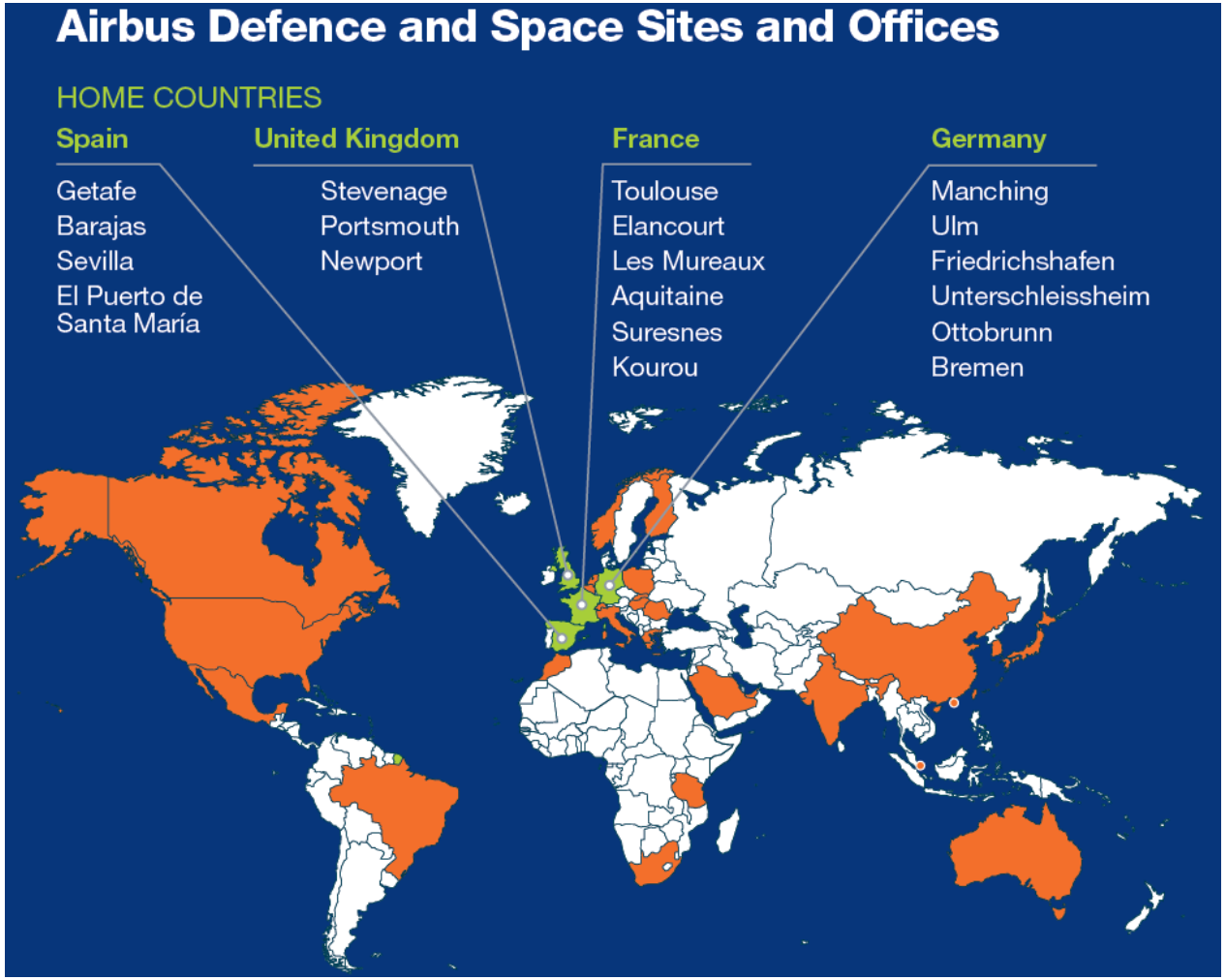
   Requirements, design and implementation errors are reduced

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.



Overview of Military Aircrafts

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.

A400M completed an important set of trials demonstrating the new-generation airlifter's performance on soft unpaved airstrip in Woodbridge, United Kingdom

A330 MRTT - The most capable tanker transport

The Eurofighter is the world's most advanced new generation multi-role/swing-role combat aircraft available on the market

Airbus Defence and Space has successfully demonstrated the Airbus C295W medium transport as an airborne tanker.

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

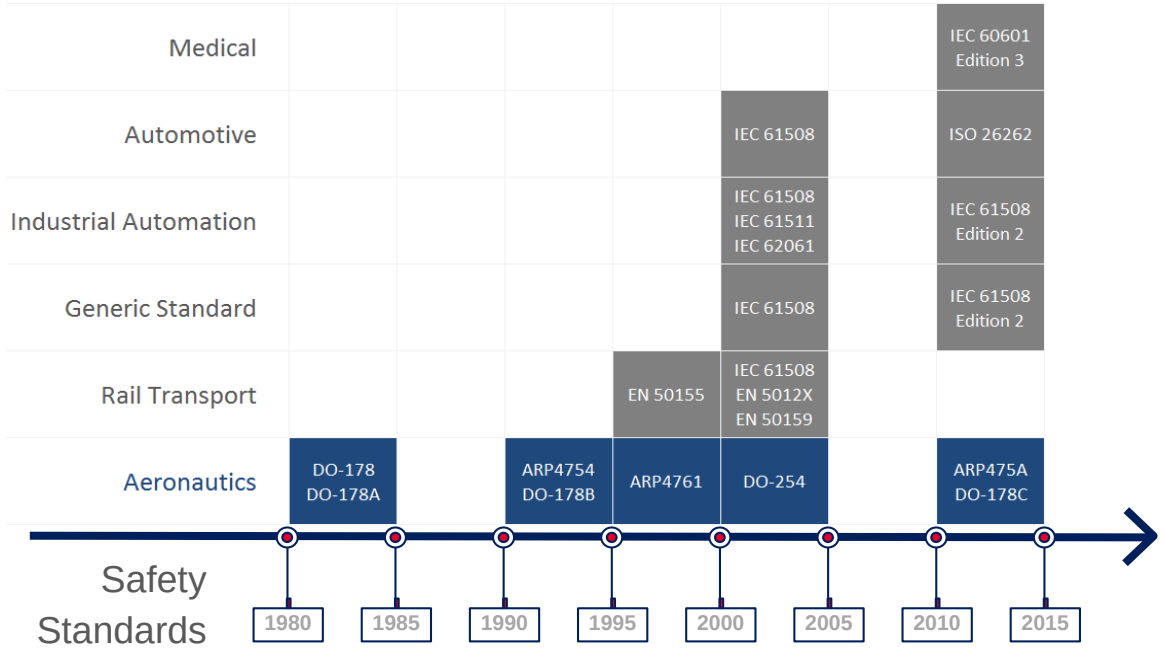
28 aircrafts A330-MRTT in service
from 51 aircrafts ordered by 8 countries

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

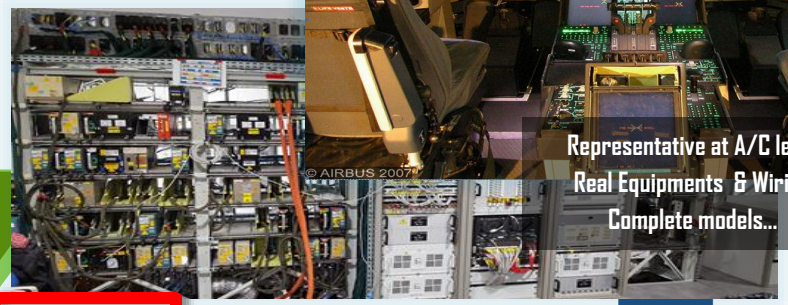


And …

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



Aircraft Level
- What Type of Aircraft?
  - Cockpit Layout
  - Human Factors
- Overall systems integration
- Handling Qualities
- Human Factors
- First Development Aircraft

Functions Level
- What Functionality?
- Specification validation
- Handling Qualities

System Level
- What Equipments?
- System Integration

LRU Development
- LRU Supplier

Aircraft Platform BreakDown
- A/C Program
- A/C ATA(1) Chapter
- A/C System
- Avionics
- IMA(2) / SRU
- HL
- ASIC | PLD | PL
- IC | µP | SW

Test Mean Platform BreakDown
- A/C0 (S401) → Flight Tests A/Cs (MSNxx)
- ATA Test Bench (CH0, EDIB, LG0 ..)
- System Integration Bench (FSIB, GSIB)
- Equipment Integration Bench (FIB)
- SubAss. Test Bench (SATB)
- HL
- PL | PLD | ASIC
- SW | µP | IC

Product Level
Functional Level
System - Subsystem Level
Equipment Level
SubAssembly / Modules Level
Circuit Board Level
Custom Device Level
COTS Device Level

The V-Cycle can be decomposed in Intermediate Products … and the Test Means Products needed to verify them

Innovation Challenges in Safety-Critical Equipments

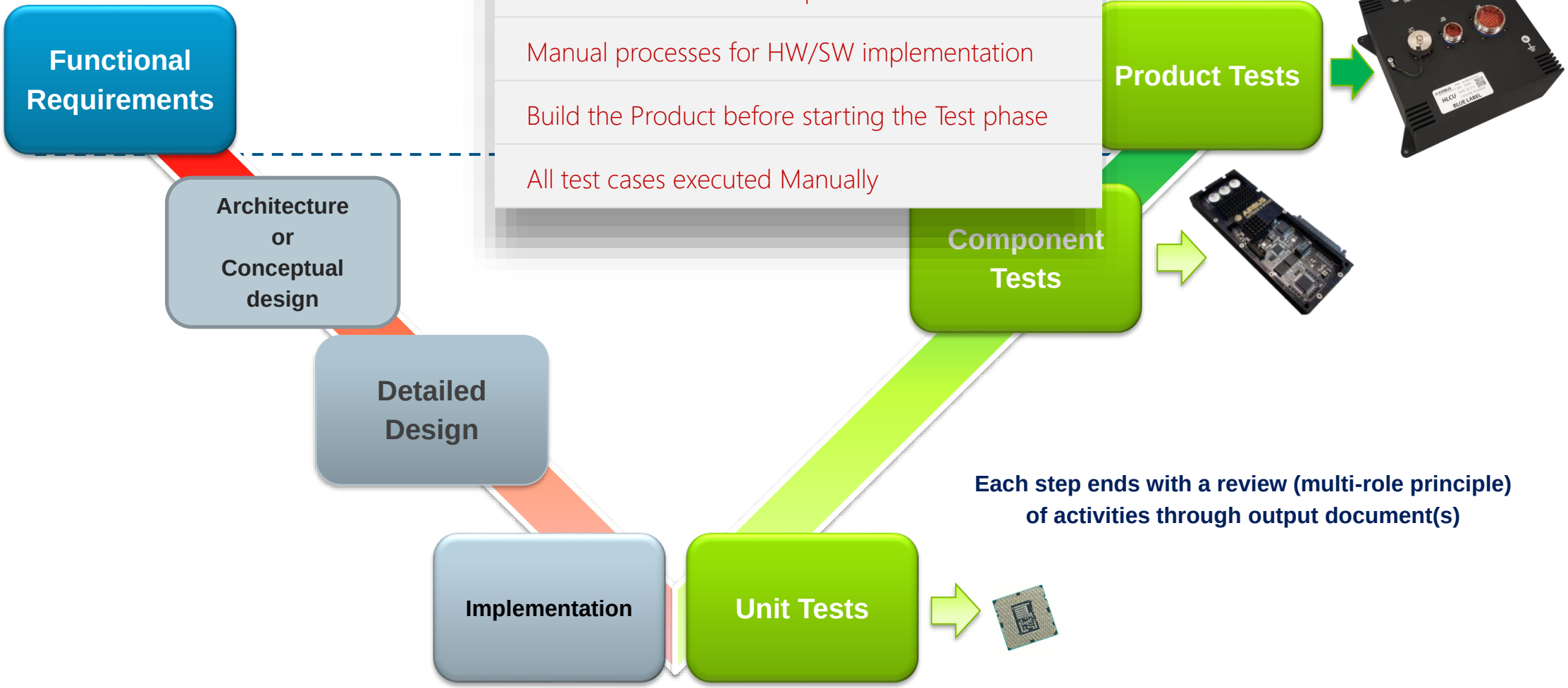
- Software and Hardware Components (µProcessors, FPGAs, ASICs ...) may be as complex as the whole Equipment itself.
- Design of a Safety-Critical Equipment requires, company processes, structured development methods and a lot of human resources.
- The use of Model-Based Design allows comply with the certification processes.

Traditional V-Cycle

for Avionics or Test Products

Gaps in company processes

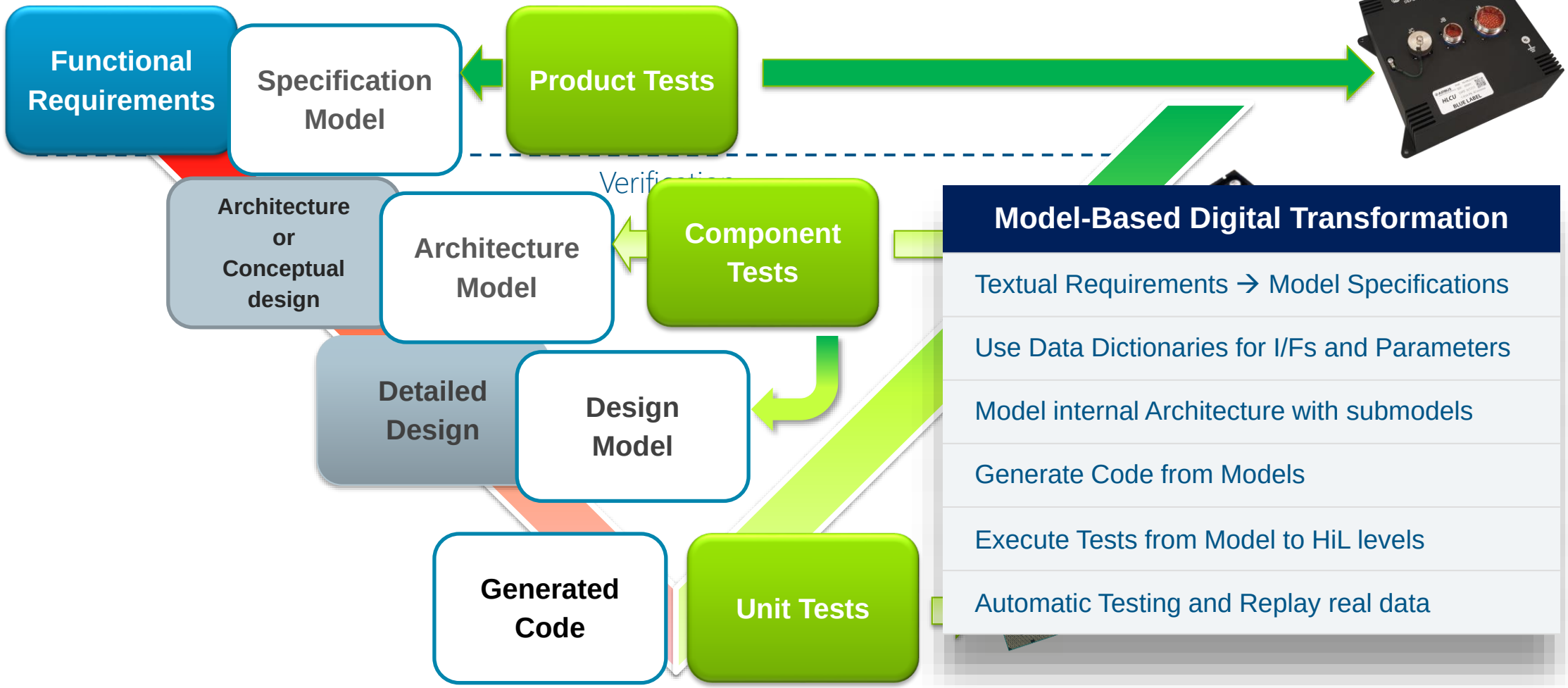
- Only rely on Textual Requirements
- Interfaces and Parameters only shared as Text
- Use of non-executable top-level architectures
- Manual processes for HW/SW implementation
- Build the Product before starting the Test phase
- All test cases executed Manually



Each step ends with a review (multi-role principle) of activities through output document(s)

Model-Based Design

for Avionics or Test Products



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 Representativity

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

Real 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

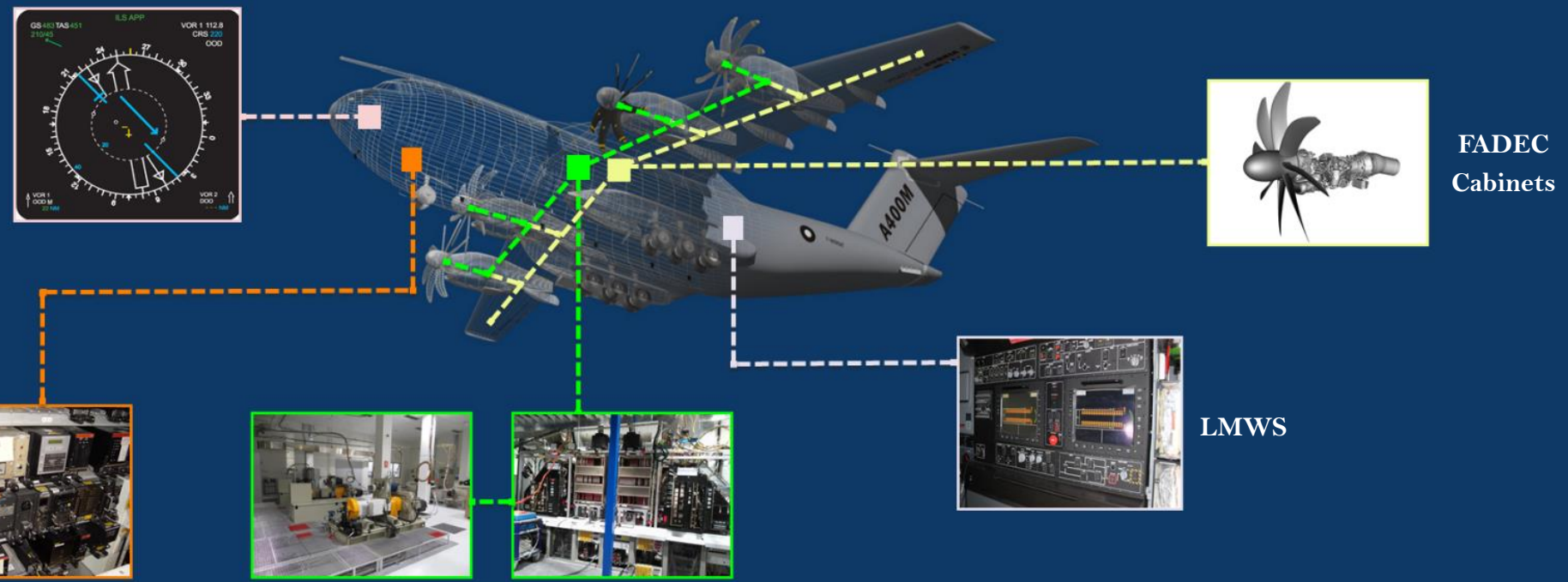
Simulated Models comply AP2633

~80 Simulated Models (Systems and Environment)

A/C0 Integration Simulator: Coupling Capabilities

S401 at a glance

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"**



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!

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