Lip6 meeting

Sharing perspectives

20th February 2019

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Avionics Products & Simulation - Missions

Airbus **Avionics Equipment** supplier

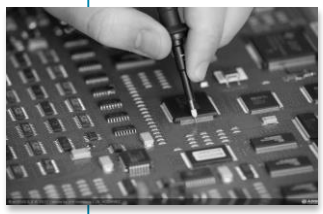
Develop excellence on the full scope of hardware and embedded software activities

Deliver Airbus core equipment to all aircraft programs

Simulations Models & Platforms provider

Develop innovative solutions to optimize the efficiency of aircraft design, testing and training

Deliver mature simulation products for all aircraft types, from research to commercial operations.



Chamber of Reference

Build a reference & set the standards for equipment suppliers.

Leverage high level skills in embedded software, on-board electronics and real-time simulation

Technical support and knowledge sharing with design teams, procurement, customer services

Business centre

Sell and support avionics and simulation products to customers.

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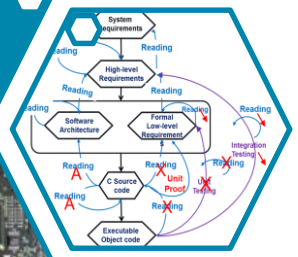
Avionics Products & Simulation - Dimensions

8000 equipments per year

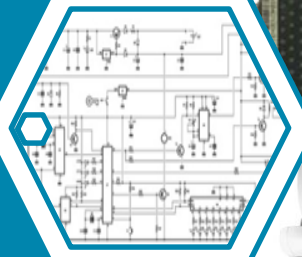
12000 electronic boards per year

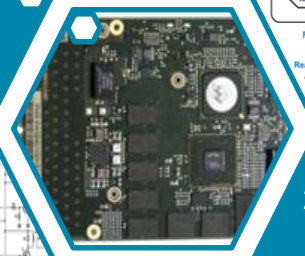
120 software standards per year



590 Employees (530 France – 60 India)

75% engineers





250Full Flight Simulators 170 Flight Training Devices

380 airlines & training centres

4500 repairs and up to 4000 retrofits per year

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Product Line approach

Software Product Line Engineering

- Component Based development
- Modular architecture / Re-usable Building Blocks
- Virtual Integration Platform

“Generic Safety Critical Platforms” Product Line

- Multicore architecture
- Versatility/Configurability vs hw context
- In-house kernel

“Applicative“ Product Line

- Design Patterns
- System/Software Architecture

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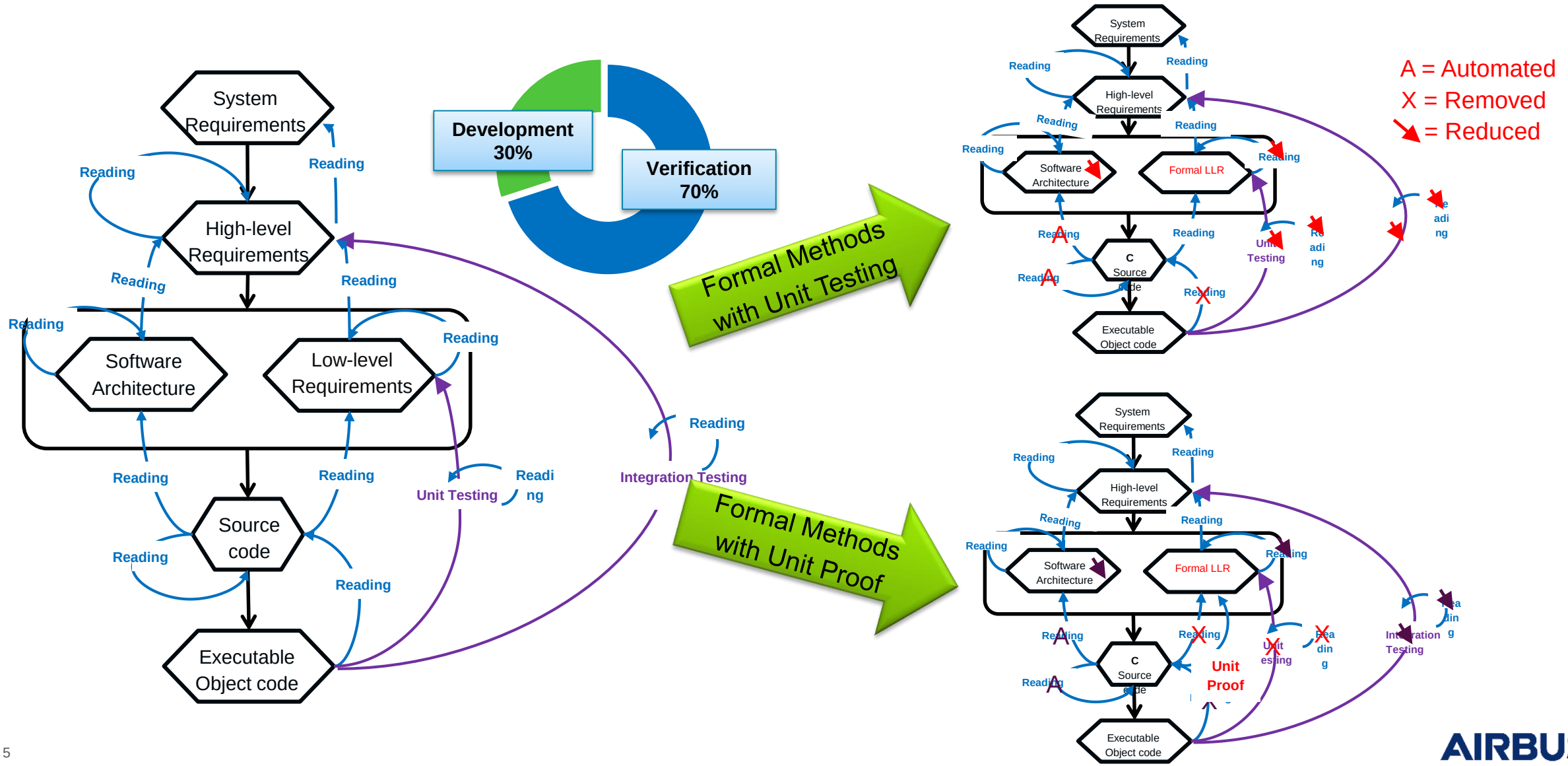
Formal methods applied to critical software design (DAL A) to reduce verification effort



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Formal methods - some examples

Binary static analyzer for Stack use & WCET computing

- ⇨ Abstract Interpretation based static analysis of the Executable Object Code
- ⇨ Static analyzer: **A3** (AbsInt GmbH);

Static analyses for Unit Verification of components services Unit Proof

- ⇨ Weakest Precondition (WP) based program proof at C function level
- ⇨ Proof tool: **PHENIX_P** (Frama-C/WP based from CEA)

"Local" static analyses (i.e. on subsets of the call graph)

- Data & Control flow analyses
  - ⇨ Abstract Interpretation based static analysis of C code
  - ⇨ Static analyzer: **Fan-C** (Airbus)
- Numerical accuracy assessment of floating-point computation
  - ⇨ Abstract Interpretation based static analysis of C source code
  - ⇨ Static analyzer: **FLUCTUAT** (CEA)

Run-Time Error analysis of C programs

- The ASTRÉE static analyzer
  - ⇨ Developed by CNRS/ENS and AbsInt GmbH
  - ⇨ Commercialized by AbsInt

Proved compilation of C source code

- CompCert (INRIA + AbsInt GmbH)
  - ⇨ Formally verified source / object code semantic equivalence

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Automatic Code Generation (relying on Formal Modelling techniques)

Reactive Systems

Real-time Control/Command systems (e.g.: Flight Controls)

⇒ Synchronous Language: Subset of Scade (Lustre) – Mainly pure data flow

Desired 'non functional' properties:

- *Determinism / Predictibility*
- *Direct traceability Scade '⇔ Binary file'*
- *Fast / Safe / Automated generation process*

Suited for:

- *Formal verification (e.g.: fully automated computation of safe upper bound of WCET)*
- *Parallelisation of treatments*

⇒ *80%_90% of LoC are automatically generated*

Communication systems (e.g. ATC)

⇒ Asynchronous language: LDS for communication protocols

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Some technological/engineering trends

Short term

- Product Line engineering
- Reduce System/Software gap
- Pursue Process improvement (certification and engineering activities
- Be competitive, reduce cost and lead time
- Data Security
- Multi-Core for Applications
- Formal methods: Pursue investment

Medium/Long term

- Artificial intelligence
- Parallel software engineering
- Data management
- Distributed avionics
- Many-cores architectures & New processing cores

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