Avionics Verification and Validation

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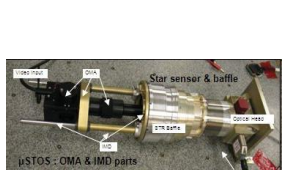
Avionics according to Technical Domain

The Avionics Embedded System (AES) includes the hardware and software required for the command & control of the spacecraft, its failure detection, isolation and recovery (FDIR) and all the mission and vehicle management functions including all functional chains.



Perimeter

TT&C E2E systems
space communication architecture, payload data modulator, transponder

Avionics systems
architecture, o/b communication, o/b autonomy, fdir, operability, o/b security, o/b gnss receiver, **development process, verification, validation**

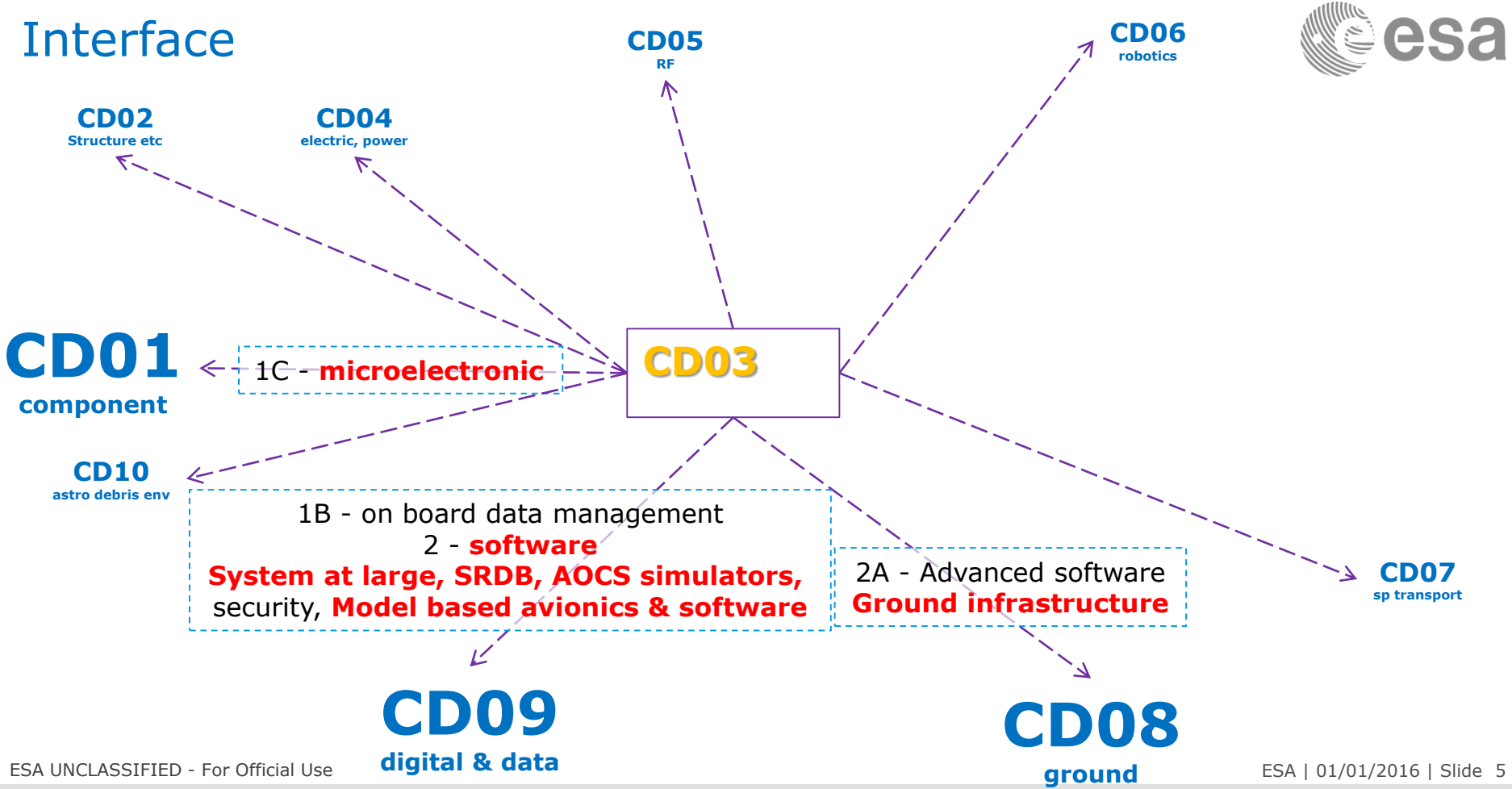
Data systems
data processing, data management, payload/platform computers, data storage, on-board network, microelectronics (**hw-sw codesign**)

CD03
Avionics

Control systems
aocs & pointing, **gnc,** enabling technologies, control techniques, sensors, RF and optical metrology

Software systems
flight software,
software quality, dependability

Interface


CD05
RF
CD06
robotics
CD02
Structure etc
CD04
electric, power
CD01
component
1C - microelectronic
CD03
CD10
astro debris env
1B - on board data management
2 - software
System at large, SRDB, AOCS simulators,
security, Model based avionics & software
2A - Advanced software
Ground infrastructure
CD07
sp transport
CD09
digital & data
CD08
ground

Verification according to ECSS

Qualification shall be carried-out on hardware and software which is representative of the end item configuration in terms of design, materials, tooling and methods.

- What does this mean for SW intensive systems?

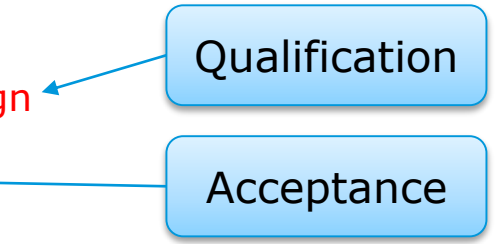
In the Acceptance stage the verification shall demonstrate that the product is free of workmanship errors and is ready for subsequent operational use.

Acceptance shall be carried-out on the final hardware and software

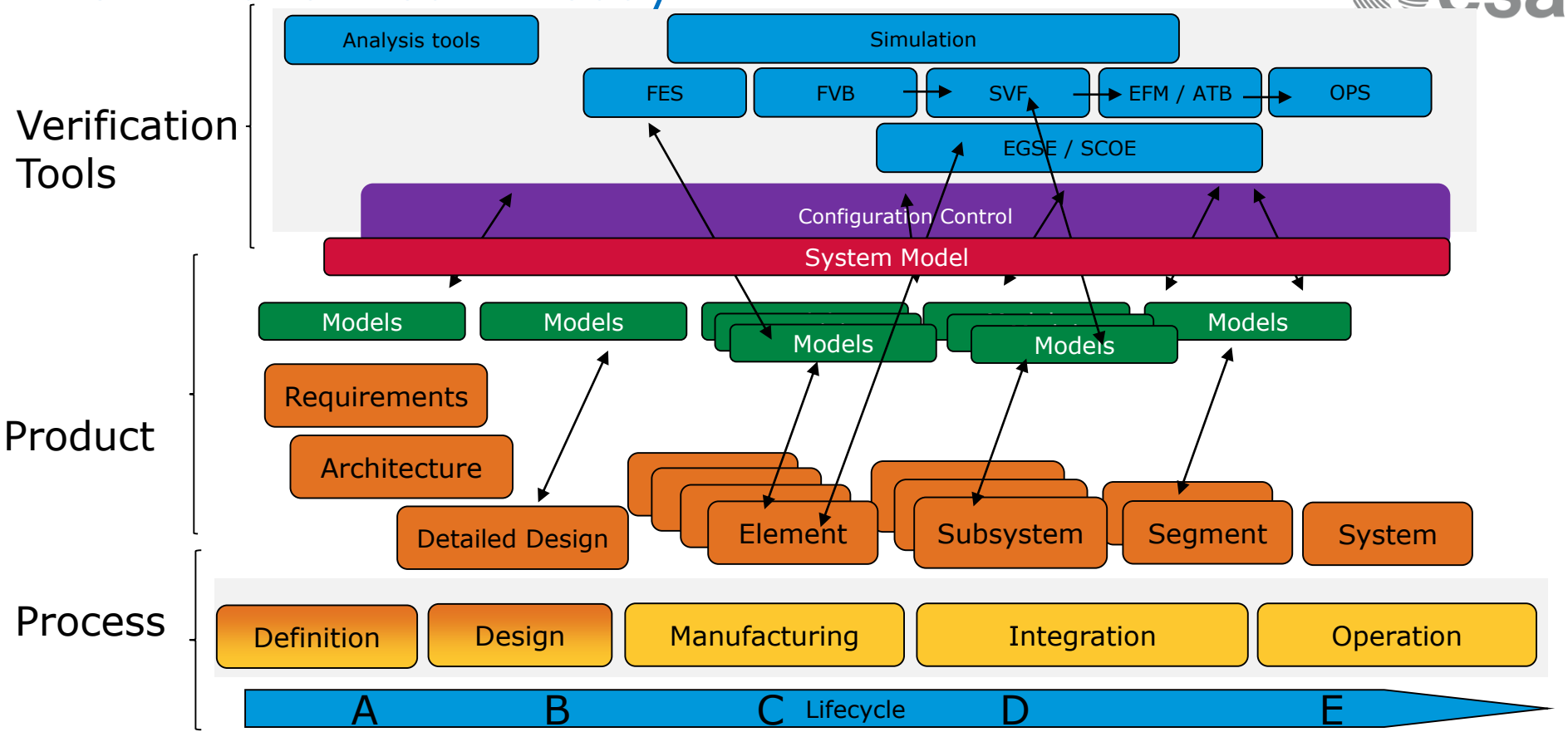
- Issue here on coverage and completeness?

Elements under verification

- What are we verifying at which state
  - Problem specification – Requirements
  - Solution definition – Architecture and Detailed Design
  - Product realization – MAIV&V
  - Operation
- What are the Objectives of the verification steps
  - Requirement closure – Verification
  - Overall Design validation
  - Detailed design consolidation
    - Breadboarding for risk mitigation
  - Design or I/F freeze
    - Proof of concept
    - Proof of Architecture
  - AIT or OPS preparation



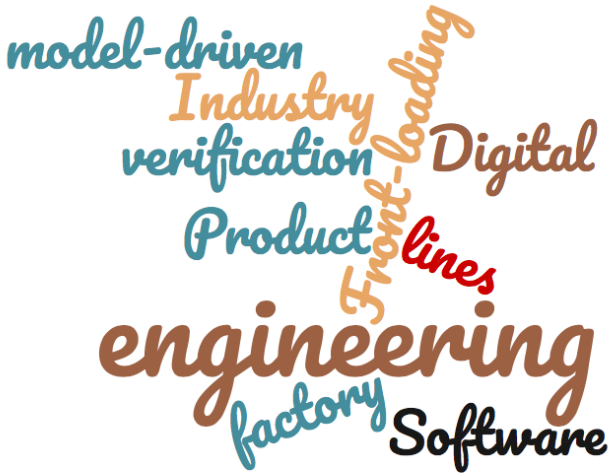
Process and models today



Impact of new trends

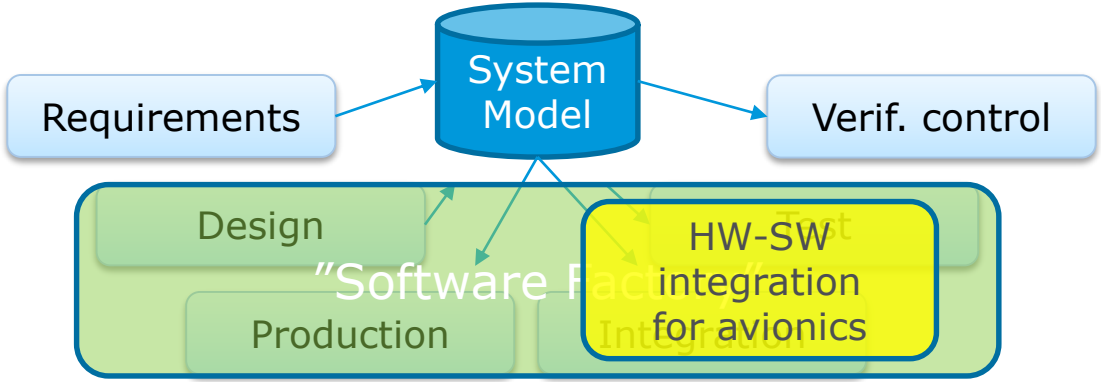
We are confronted with (current buzzwords and hypes):

- Model-based / model-driven engineering
- Software factory
- Digital engineering
- Industry 4.0
- Front-loading of verification
- Product lines
- …



What do they mean ?

Process changes



- Information is exchanged in a structured and controlled way
- For SW production collapses with design (from ”V” to ”Y”)
  - The design becomes the realisation
- In avionics HW/SW integration
  - Still acceptance challenge
- Final product still needs verification (as opposed to toolchain qualification)

Presentations

Verification driven from system to avionics

- SVTLC – 2 prime views

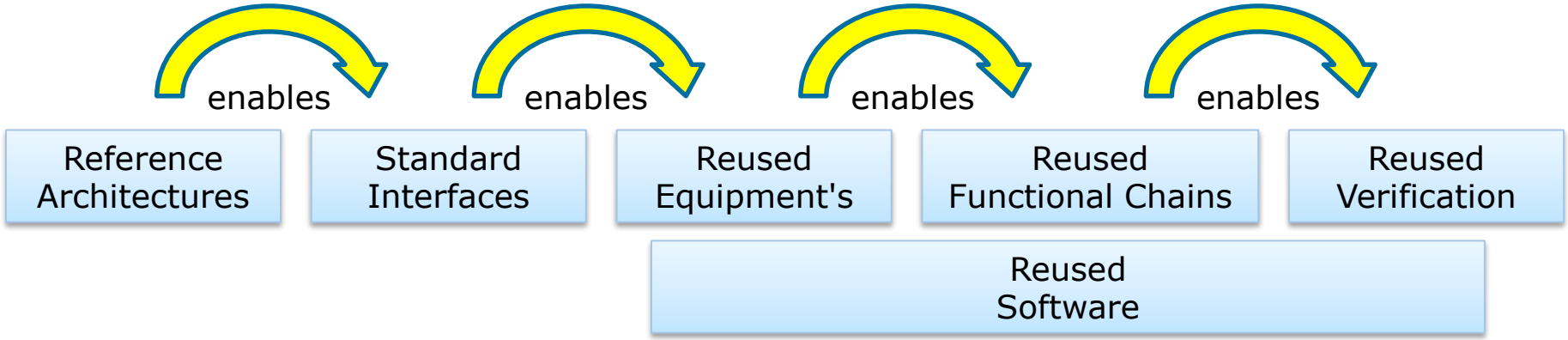
Specific examples / implementations

- Multi-national integration approach used for the Orion Avionics, Power, & Software verification and validation
- Avionics Test Bench for the Next Generation space Transportation systems, different life-cycle configurations using state-of-the-art technology

GNC specific and Methodology

- NEOShield-2 specific implementation for several GNC algorithms, validating performances on PIL and HIL test benches
- Assessment of a methodology for the certification of safety GNC critical space systems to improve the certification processes

Product Lines



In addition to reuse, product lines require:

- Specification commonalities
- Configuration control
- Common model repositories

→ To a large extent addressed by SAVOIR

Additional concluding thoughts

More iterative Customer-Supplier collaboration

- While respecting contractual and project management needs / constraints

Most pressing problems

- Digital (Model-Based) Approach helps to handle complexity and huge amount of information
- Inclusion of Concurrent Engineering principles
  - Most tools are still designed as a single-user-at-a-time tool
- Challenges and Opportunities of “Industry 4.0”
- Joint effort to develop and mature standards for interoperability of data and process

Product lines will have an effect for customer and for supplier